Republic of Serbia
Ministry of European Integration

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#ЕУ ЗА ТЕБЕ

SCOPING REPORT RAILWAY LINE BELGRADE–NIŠ, SECTION II VELIKA PLANA–PARAĆIN

EU PPF
PROJECT PREPARATION FACILITY

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LIST OF ABBREVIATIONS AND ACRONYMS

AZE	Alliance for Zero Extinction
BAP	Biodiversity Action Plan
BATs	Best Available Techniques
BMP	Biodiversity Management Plan
CBA	Cost - Benefit Analysis
CDW	Construction and Demolition Waste (CDW)
CH	Critical Habitats
CITES	Convention on International Trade in Endangered Species
EAAA	Ecologically Appropriate Areas of Analysis
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EIB	European Investment Bank
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESPOO	The Convention on Environmental Impact Assessment in a Transboundary Context
EU	European Union
EUD	European Union Delegation
EUNIS	European Nature Information System
FS	Feasibility Study
GDP	Gross Domestic Product
GHG	Greenhouse gas
GSM-R	Global System for Mobile Communication - Railway
HD	Habitat Directive
HGV	Heavy Goods Vehicle
IBA	Important Bird Areas
IBAT	Integrated Biodiversity Assessment Tool

ILO	International Labour Organization
IPA	Important Plant Areas
IPF	Infrastructure Project Facility
IUCN	International Union for Conservation of Nature
MCA	Multi Criterial Analysis
MEI	Ministry of European Integration
MCTI	Ministry of Construction, Transport, and Infrastructure
PBA	Prime Butterfly Areas
PBF	Priority Biodiversity Features
PD	Preliminary Design
PFS	Pre-feasibility study
PPF9	Project Preparation Facility 9
RAP	Resettlement Action Plan
ROS	Republic of Serbia
SEETO	South-East Europe Transport Observatory
SEP	Stakeholder Engagement Plan
SRI	Serbian Railways Infrastructure
SRT	Safety in Railway Tunnels
TEN-T	Trans-European Transport Network
TSI	Technical Specifications for Interoperability
UNESCO	The United Nations Educational, Scientific and Cultural Organization

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FIGURES

1. INTRODUCTION

The railway route Belgrade – Niš represents one of the most important transport corridors in the Republic of Serbia and plays an important role in the concept of transport system development. It is a part of SEETO Corridor X and connects Central and Western Europe with Greece, Turkey, and the Middle East, and also part of the indicative extension of the Core TEN-T rail network in the Western Balkans.

This document is based on the information of section II (Velika Plana–Paraćin) from the Preliminary feasibility study (PFS) on "Reconstruction and modernization of the railway line Belgrade – Niš" done by PPF9 team in 2022.

The data within this report present the available environmental and social baseline information obtained through desktop research and site visits at the time of writing and the current available technical (engineering) design (Preliminary Design) which is under the development. Additional field research, such as air quality, noise and vibration, surface water, etc., as well as additional biodiversity corridor assessment will be done and presented in the ESIA.

Scoped section Velika Plana–Paracin, part of the Beograd Centar – Niš railway line is 78,7km long.

The PPF9 team for this particular sub-project, namely SAFEGE consortium (composed of Egis, EPEM, and KPMG), is contracted as the executing agent for the mentioned sub-project. Main task of the consultant is to provide Feasibility study, Preliminary Design and ESIA and EIA for the purpose of National legislation.

Preparation of the Preliminary Design and ESIA is divided into 3 sections.

- Belgrade (Resnik) – Velika Plana
- Velika Plana – Paraćin
- Paraćin – Trupale (Niš)

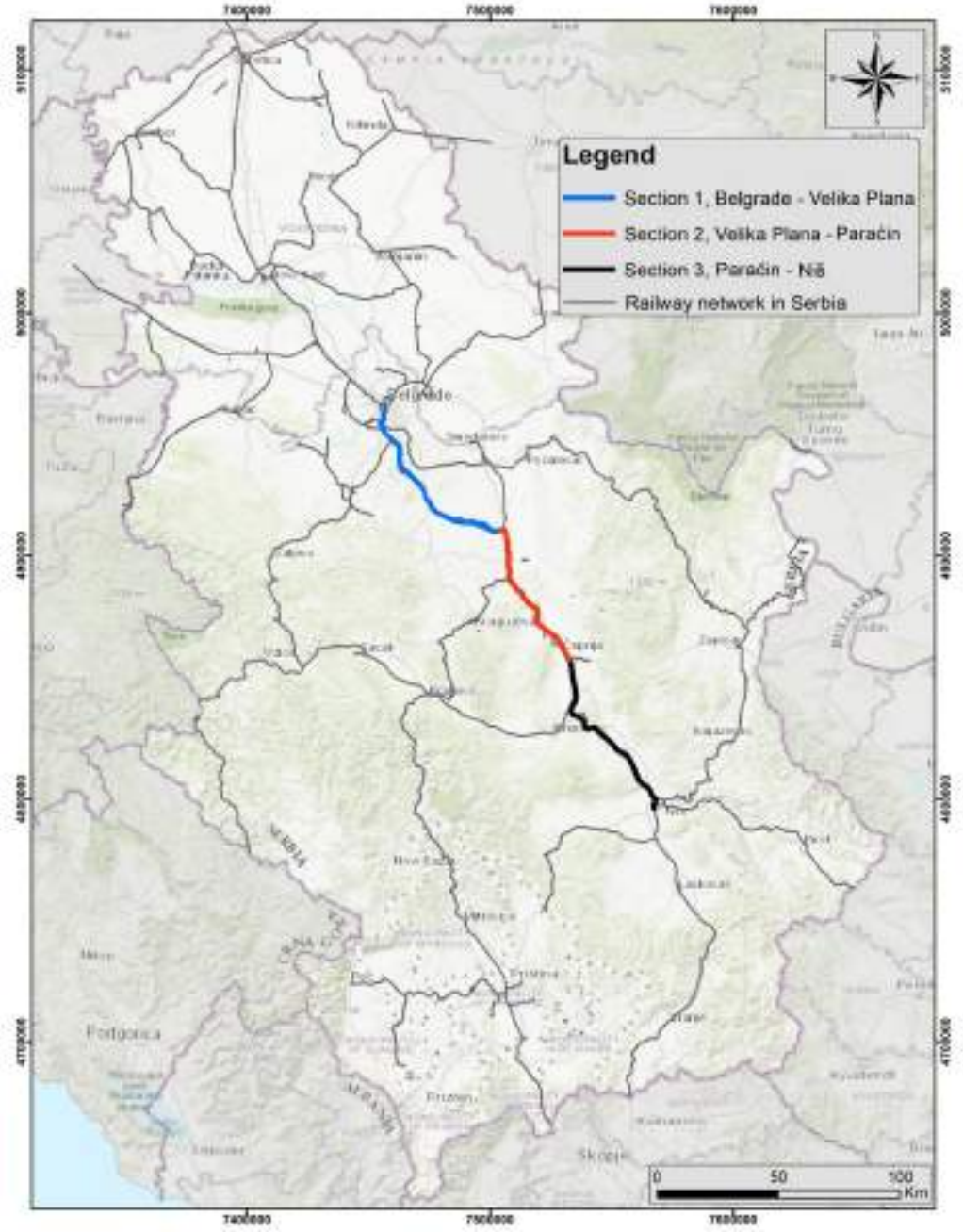


Figure 1. Main arterial routes of the Railway Network in Serbia (Prepared by the Authors of the Study)

Contrary to ESIA which will be done per sections, a single EIA in accordance with the National legislation will cover entire alignment from Belgrade (Resnik) – Niš (Trupale). This was agreed after discussions with stakeholders and in accordance with official opinion of Ministry of Environmental Protection.

The Beneficiary of the Project is the Ministry of Construction, Transport, and Infrastructure of Serbia (MCTI), with the Serbian Railways Infrastructure JSC (SRI) as the end recipient. The main activity of SRI includes:

- the management of public railway infrastructure including maintenance of public railway infrastructure, organization and control of railway traffic,
- the provision of access and use of public railway infrastructure to all interested railway undertakings, as well as to legal entities and individuals performing transport for their own purposes, and
- the protection of public railway infrastructure

Throughout this scoping exercise the following generic assumptions have been made:

- This ESIA Scoping Report has been prepared based on the selected railway corridor(s) from the PFS prepared by PPF9 consortium, the environmental and social baseline information and stakeholder feedback available at the time of writing and the current available technical (engineering) design (Preliminary Design) which is under the development. Further information will become available as the iterative technical (engineering) design and E&S assessment proceed through preliminary design, and subsequently, the scope of ESIA will need to be reviewed and updated as process evolves, if necessary
- Number and precise locations of the stations, bridges for railway are not confirmed at present stage of the Project development, and what is presented in this document is based on the PFS. More detailed information will be identified during upcoming design stages of the Project.
- Details in regard to the construction methodologies are unknown at present stage of the Project development.
- Locations and details of auxiliary works (e.g. access roads for construction purposes, workers camps and materials storage) are unknown at present stage of the Project development. The assumption is that this would be located on publicly owned and unused land outside of designated areas for natural heritage as well as areas of known cultural heritage.

A comprehensive understanding of existing environmental and societal baseline conditions in the Project region is essential prerequisite for sound identification and assessment of potential impacts from the proposed developments. Understanding the baseline allows the measurement of changes that would be caused by the Project. The process for collecting the baseline environmental and social data is based on:

- Desk studies (i.e. legally defined quality standards for environmental media and emission limit values; existing literature, strategic / planning documents, statistics, databases and reports from various relevant organizations; as well as available internet sources and other similar projects).
- Site visits and walkover observations to identify the area of influence (study area) and to collect required supplementary data at substation location and along the railway corridor(s) (i.e. biodiversity survey, video recognition of railway line, observation of river crossings, landscape assessment; etc.), as well as benefiting from various field surveys carried out for the purposes of the engineering design (i.e. traffic and passengers counting, crossing locations survey, survey of bridges, etc.).
- Feedback received from stakeholder engagement meetings carried out in the Project prefeasibility stage, during the development of a preliminary E&S Corridor Assessment Study.

2. PURPOSE AND DISCLOSURE OF THE ESIA SCOPING STUDY

The purpose of preparing this ESIA Scoping Report is to:

- Consider the preliminary design of the project from an environmental and social aspect;
- Review the existing baseline information and identify gaps;
- Define the project Area of Influence and identify the likely positive and negative environmental and social impacts of the project;
- Confirm the international standards and national legislative requirements that will apply in developing the ESIA;
- Describe the investigations that will be undertaken to assess the expected impacts and how they may be mitigated;
- Confirm the overall scope of the full ESIA and the activities needed to complete it.

Various project studies completed during previous development phases, are available on the website of Serbian Railways Infrastructure: https://infrazs.rs, under the banner: High Speed Rail Belgrade to Niš. Once approved by all parties, this Scoping report will be added to the document package and available to the public for review.

Disclosing the Scoping report is recognised as a measure of international good practice. The Scoping report is intended to serve as a tool for communication with stakeholders, to ensure that all relevant environmental and social impacts of the Project are identified and assessed, so that appropriate measures for addressing them can be defined.

Questions and comments regarding the Project documentation, including this Scoping report, can be submitted to SRI using the following contact details:

- Name and Title: Nenad Stanisavljevic, Grievance Manager
- Company- Serbian Railways Infrastructure
- Email: nenad.stanisavljevic@srbrail.rs
- Phone number: + 381 11/3618443
- Address: Nemanjina 6, 11000 Belgrade

3. LEGAL FRAMEWORK

The environmental and social regulations applicable to this project are numerous and diverse. Therefore, only the key requirements associated with the project have been chosen to be presented in this section. However, a full and detailed list of legislation associated with the project will be developed as part of the project management systems for construction and operation.

The Environmental Impact Assessment (EIA) procedure in the Republic of Serbia as governed by the Law on Environmental Impact Assessment, which is harmonized with European EIA Directive (85/337/EEC, 97/11/EC, 2003/35/EC and COM 2009/378 as codified by the Directive 2011/92/EU and as amended by the Directive 2014/52/EU).

3.1. National Environmental and Social Regulatory Framework

The legal, legislative and institutional framework for environment and society i.e. social considerations in Serbia is founded on the Constitution of Serbia, which stipulates the right to a healthy environment and the duty of all, in line with the law, to protect and enhance the environment. Health and environment are also supported by many governmental strategies, international agreements, and the Millennium Development Goals. Environmental legislation in Serbia has over 100 laws and regulations. Currently, the majority of these are harmonized with EU directives and other legislation.

The Constitution of Republic of Serbia was proclaimed on November 8th, 2006. According to Article 74 of the Constitution:

- Everyone shall have the right to live in healthy environment and the right to timely and full information about the state of environment.
- Everyone, especially the Republic of Serbia and autonomous provinces, shall be accountable for the protection of environment.
- Everyone shall be obliged to preserve and improve the environment.

Article 58 of the Constitution guarantees of peaceful tenure of a person's own property and other property rights acquired by law. The Article indicates that right of property may be revoked or restricted only in public interest established by law and with compensation which cannot be less than market value.

Article 16 of the Constitution states that the foreign policy of the Republic of Serbia shall be based on generally accepted principles and rules of international law. Generally accepted rules of international law and ratified international treaties shall be applied directly if they are dully signed and ratified by the Government of Serbia.

The following table presents the key national laws and regulations applicable to the reduce the potential environmental and social impacts that may arise from the construction and operational activities of the Project.

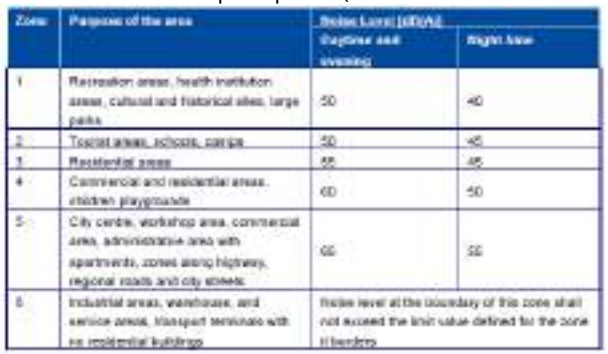
A more detailed presentation of legislation related to information disclosure and consultation, land acquisition and labour and working conditions is provided in separate sections further in the text.

Table 1. Main national legislation regarding environmental and social parameters

Laws and regulations	Official gazette Republic of Serbia	Relevance
Law on Environment	135/04, 36/09, 72/09, 43/11, 14/16, 76/18 and 95/18	The Law on Environmental Protection is the framework national environmental law. The law is currently the main legislation relating to environment protection in Serbia and is harmonized with the Council Directive 2003/105/EC, which amends Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (Seveso II Directive). The main objectives of Law on Environmental Protection are Conservation and improvement of the environment; and Control and mitigation of pollution of the environment. The main focuses of Law on Environmental Protection are: Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out/ initiated in the ecologically critical areas; Environmental Approval; Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes; Promulgation of a standard limit for discharging and emitting waste; and Formulation and declaration of environmental guidelines.
Law on Environmental Impact Assessment	135/04 and 36/09	This Law regulates EIA process, EIA content, Interested Authorities and organizations participation and public participation, international notification for projects that can have important impacts on other environment and inception and other important issues for EIA.
Law on Strategic Environmental Assessment	135/04 and 88/10	The Law on Strategic Environmental Impact Assessment regulates the conditions, manner and procedure for assessing the environmental impact assessment of certain plans and programs, on the environment.
Law on Air Protection	36/09, 10/13 and 26/21	The Law on Air Protection regulates the management of air quality and determines the measures, manner of organization and control of the implementation of protection and improvement of air quality as a natural value of general interest that enjoys special protection.
Law on Nature Conservation	36/09, 88/10, 91/10, 14/16, 95/18 and 71/21	This law creates the following objectives: 1) protection, preservation and improvement of biological (genetic, spices and ecosystem), geological and landscape diversity, 2) harmonization of human activities, economic and social development plans, programs, bases and projects with sustainable use of renewable and non-renewable natural resources and long-term preservation of natural ecosystems and natural balance, 3) sustainable use and / or management of natural resources and goods, ensuring their function while preserving natural values and balance of natural ecosystems,

		4) timely prevention of human activities and activities that may lead to permanent impoverishment of biological, geological and landscape diversity, as well as disturbances with negative consequences in nature, 5) determining and monitoring the state of nature, 6) improvement of the condition of disturbed parts of nature and landscapes. The Law on Nature Conservation adopted EU Habitats Directive and the Birds Directive. The Decree on Ecological Network ("Official Gazette of RS", No. 102/10) identifies ecological network areas in Serbia and sets the management, financing, monitoring and protection requirements. Serbian Legal Framework on Habitats and Species: Regulation on the criteria for separation of habitat types, habitat types, sensitive, vulnerable, rare, and for the protection of priority habitat types and protection measures for their preservation (Official Gazette of No. 35 /10), Regulation on cross-border trade and trade in protected species (Official Gazette No. 6/14), Regulation on special technical and technological solutions that enable undisturbed and safe communication of wild animals (Official Gazette of No. 72/10), Regulation on control of use and trade of wild flora and fauna (Official Gazette of No. 69/11) Regulation on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi (Official Gazette of No. 98/16)
Law on Waste Management	36/09, 88/10, 14/16 and 95/18 and 35/23-68	The Law on Waste Management is harmonized with all relevant EU directives. The Law regulate: types and classification of waste; waste management planning; waste management entities; responsibilities and obligations in waste management; organization of waste management; managing special waste streams; conditions and procedure for permit issuance; transboundary movement of waste; reporting on waste and database; financing of waste management; supervision, and other issues relevant for waste management. The Law on Waste Management has transposed the European Waste Framework Directive (2008/98/EC as last amended by 851/2018/EC), the European Directive on Landfills (1999/31/EC, as amended) through transposition in the Serbian Law on Waste Management and/or Regulation on waste landfilling in combination with the Regulation on Categories, Testing and Classification of Waste, the European Directive on Packaging and Packaging Waste (1994/62/EC, as amended transposition in the Serbian Law on Packaging and Packaging Waste. The European Directive on Waste Electric and Electronical Equipment (WEEE) (2012/19/EU, as amended) has experienced transposition though the Serbian Law on Packaging and Packaging Waste in combination with the Rulebook on the List of Electric and Electronic Products, Measures of Prohibition and Restriction of Use of Electric and Electronic Equipment Containing Hazardous Substances, Methods and Procedures of Managing Waste from Electric and Electronic Products. In April 2016, IZS the Board of Directors of IZS adopted a Hazardous waste Manual governing management, disposal, and deposit and selling of materials characterized as hazardous. The Manual is aligned with the National Strategy on Waste Management, the

		Law on waste Management and the applicable secondary laws. The Manual in particular treats management of PCB containing waste, absorbents, filter material and oil, wooden sleepers, asbestos containing waste. Serbia has ratified the: Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and pesticides in International Trade (Official Gazette of RS, International Agreements, No. 38/09) the Stockholm Convention on Persistent Organic Pollutants (Official Gazette of RS–International Agreements, No. 42/09) the Basel Convention on Trans boundary Movement of Hazardous Wastes and their Disposal Official Journal of FRY, International Treaties, No. 2/99, the Aarhus Convention ("Official Gazette of RS-International Treaties", No. 38/09), the Protocol on Pollutant Release and Transfer Register to the Aarhus Convention" ("Official Gazette of RS - International Treaties", No. 8/1)
Law on Chemicals	36/09, 88/10, 92/11, 93/12 and 25/15	The Law on Chemicals regulates the integrated management of chemicals, their classification, packaging and labelling, register of chemicals and trade of chemicals. It transposed EU legislation in the field of chemicals related to POPs Regulation 1907/2006/EC on registration, evaluation and authorization on chemicals (REACH) – partially harmonized, Regulation 757/2010 amending Regulation 850/2004, Directive 2004/42/EC on limitation of emissions of volatile organic compounds (VOC) from the use of organic solvents in certain paints, varnishes and vehicle refinishing products, Regulation 689/2008/EC export and import of dangerous chemicals on banned and severely restricted chemicals as well as Directive 67/548/EEC on classification, labelling and packaging of substances, Directive 1999/45/EC on classification, labelling and packaging of preparations Regulation 1272/2008/EC on classification, labelling and packaging of substances and mixtures in accordance with GHS and Regulation 440/2008/EC on test methods pursuant to REACH.
Law on Water	30/10, 93/12, 101/16, 95/18 and 95/18 – other law	The Law on Water which incorporates the EU Water Framework Directive, covers water regimes, water management areas, responsibilities for water management (including sub-law water management legislation), water management activities, limitation of owners' and beneficiaries' rights, water cooperatives, financing of water management activities, and administrative inspection to enforce the Law. The legislation provides for various water management sub-laws on water resource conditions, water resource compliance and water resource permits.
Law on Environmental Noise Protection	36/09, 88/10, and 96/21	The Law on Protection against Environmental Noise, transposes EU Directive 2002/49/EC relating to the assessment and management of environmental noise. The Law has the following main goals: establishment, maintenance and improvement of the system of noise protection on Serbian territory; and determination and realization of measures and standards in the field of noise protection aimed to avoid, prevent or reduce the harmful effects of noise on human health and the environment. The permitted noise levels are defined by the Decree on environmental noise indicators, limITSvalues, assessment methods of the noise indicators, the nuisance and the harmful effects (Off. Gazette of RS No. 75/10). This Decree stipulates the noise levels, which must not be exceeded. Annex 2 of the Decree states that the defined noise limits are applied to the all-encompassing noise generated by all

<table>
<tr><td></td><td></td><td>noise sources at the site. Noise levels in open spaces (noise limits as defined in Serbian legislation) 
<table>
<tr><th>Zone</th><th>Purpose of the area</th><th>Noise Level [dB(A)]</th><th></th></tr>
<tr><td></td><td></td><td>Daytime and evening</td><td>Night time</td></tr>
<tr><td>1</td><td>Recreation areas, health institution areas, cultural and historical sites, large parks</td><td>50</td><td>40</td></tr>
<tr><td>2</td><td>Tourist areas, schools, camps</td><td>50</td><td>40</td></tr>
<tr><td>3</td><td>Residential areas</td><td>55</td><td>45</td></tr>
<tr><td>4</td><td>Commercial and residential areas, children playgrounds</td><td>60</td><td>50</td></tr>
<tr><td>5</td><td>City centre, workshop area, commercial area, administrative area with apartments, zones along highway, regional roads and city streets</td><td>65</td><td>55</td></tr>
<tr><td>6</td><td>Industrial areas, warehouse, and service areas, transport terminals with no residential buildings</td><td>Noise level at the boundary of this zone shall not exceed the limit value defined for the zone it borders</td><td></td></tr>
</table></td></tr>
<tr><td>Law on safe transport of hazardous goods</td><td>104/16, 83/18, 95/18 and 10/19</td><td>Law on transport of hazardous materials regulates conditions for performing domestic and international transport of dangerous goods in road, rail and inland waterway transport on the territory of the Republic of Serbia. Furthermore, it sets requirements in relation to packaging, mobile pressure equipment (e.g. tanks), means of transport intended for transport of dangerous goods, conditions for body designation which examine and control packaging, mobile pressure equipment, and vehicles for transport of dangerous goods. This Law also defines competencies of state bodies and organizations in transport of dangerous goods, conditions and obligations to fulfil the participants in the transport of dangerous goods, supervision, as well as other issues related to the transport of dangerous goods.</td></tr>
<tr><td>Law on mining and geological explorations</td><td>101/15, 95/18 and 40/21</td><td>The Law on mining and geological explorations regulate measures and activities of the mineral policy and the manner of implementation thereof, conditions and manner of execution of geological explorations of mineral and other geological resources, researching of geological environment, as well as geological explorations for the purpose of spatial and urban planning, designing, construction of buildings and remediation of site, manner of classification of resources and reserves of mineral raw materials and ground waters, exploitations of reserves of mineral raw materials and geothermal resources, construction, use and maintenance of mining facilities, plants, machines and equipment, execution of mining works, mining waste management, remediation and recultivation of abandoned mining facilities, as well as inspection over the implementation of the present Law. The Geological Institute of Serbia is established by the same Law as an individual organization with the capacity of a legal entity that carries out the basic geological explorations and other geological explorations as well as the works of applied geological explorations of importance for the Republic of Serbia, in accordance with this Law.</td></tr>
<tr><td>Law on Railway</td><td>41/18 and 62/23</td><td>This law regulates the management of railway infrastructure, the performance of railway transport activities, and the licensing of railway undertakings. Access to railway infrastructure, service facilities and services, principles and procedures for determining and calculating prices of access to public railway infrastructure and prices of services related to railway transport, public railway</td></tr>
</table>

		infrastructure capacity allocation, industrial railways and industrial tracks, competencies of the Railway Directorate, passenger rights and public passenger transport services by rail of general economic interest.
Planning and construction law	72/09, 81/09 (Corrigendum), 64/10 (CC), 24/11, 121/12, 42/13 (CC), 50/13 (CC), 98/13 (CC), 132/14 145/14, 83/18, 31/19, 37/19 (CC), 9/20, 52/21 and 62/23	The planning and construction law it governs the following issues: the conditions and modalities of spatial planning and development, the development of general and detailed regulation plans, the development and use of construction land and the construction of facilities, predominant use of land when the land has multiple uses, public use of land and other issues of significance in the development of space, landscaping and use of construction land and the construction of facilities. It prescribe procedure for: issuance of site conditions; issuance of building permit; notice of works; issuance of occupancy permit; attainment of conditions for design, i.e. connection of a facility to the infrastructure network; obtaining legal instruments and other documents issued by the holders of public authorities required for the construction of facilities, i.e. for the issuance of site location conditions, building permit and occupancy permit within their competence, as well as for the provision of conditions for connection to the infrastructure network and for the registration of title to the built facility and for designating a house number (unified procedure).
Law on Occupational Safety and Health organized	101/05, 91/15 and 113/17 - other law	The Law on Occupational Safety and Health organized governs the occupational safety and health system in Serbia. By harmonizing this law with the ratified International Labor Organization conventions and EU Framework Directive 89/391/EEC, as well as special directives derived from the Framework Directive, all guidelines originating from them have been accepted in a form adjusted to national conditions. Apart from this Law, the regulatory framework of the occupational safety and health system is integrated by several sub-acts. The Rulebook on preventive measures for occupational health and safety and prevention and containment of contagious diseases epidemic ("Official Gazette RS" No 94/20) governs preventive measures employers need to introduce at workplaces and applies to all persons at workplaces in cases an epidemic has been declared. The provisions of this are further elaborated in numerous by-laws, for regulating the specific implementation procedures. A total of 8 legal acts and 55 rulebooks related to the area of occupational health and safety are ensuring implementation of the Law, and providing targeted OH&S procedures for e.g. working on temporary and movable construction sites, deep drilling and exploitation of raw minerals, exposure to asbestos, working in an environment at risk from explosive atmosphere, mitigation measures from hazardous risk of electricity, working in quarries, clay, sand and pebble extraction sites, rail traffic, noise, vibration emissions exposure etc. preventive measures during manual cargo movement.
Law on Cultural property	71/94, 52/11 – other law, 92/11 – other law, 6/20 and 35/21- other law	The Law on Cultural property regulates the system of the protection and use of cultural property and define conditions for the implementation of activities relating to the protection of cultural property.

		Depending on its physical, artistic, cultural and historical features, cultural property in Serbia include: cultural monuments, spatial cultural-historical units, archaeological sites and landmarks – immovable cultural property; works of art and history, archival material, film material and old and rare books – movable cultural property. Depending on its importance, cultural property in Serbia is also classified into: cultural property, cultural property of great importance and cultural property of exceptional importance. This Law define chance find procedure. According to Article 28 of subject law, a person who digs out of earth or takes from water property under prior protection outside of organized research shall immediately, within 24 hours at the latest, inform thereof a competent cultural property protection institution and the ministry responsible for interior affairs.

3.1.1. Information Disclosure

The right to information, i.e. that everyone shall have the right to be informed accurately, fully and timely about issues of public importance is guaranteed to all citizens under Serbian legislation. These provisions are included in the Constitution of the Republic of Serbia[1], as well as in the Law on Free Access to Information of Public Importance[2].

The Law on Planning and Construction of the Republic of Serbia regulates the development and adoption of spatial and urban plans in Serbia, which are all subject to a public disclosure and consultation process. This is described in more detail in the Regulation on the Content, the Method and the Procedure for Developing Planning Documents[3].

Serbian laws and bylaws in the area of environmental protection, including the main Environmental Protection Law, require the public to be informed about and involved in all matters concerning the environment. Public disclosure and consultation procedures are organised in connection to the development of project environmental impact assessments (EIAs) as per the Rules for Disclosure of Information, Presentations and Public Consultations Regarding EIAs[4].

The main required steps in the disclosure and consultation process for the above-mentioned plans and projects are:

- Informing the public through the media about details of disclosure of the draft plan/document (i.e. where the electronic version and hard copy are available for review, the dates and time when the hard copy can be reviewed, the dates when the developer of the draft is available to answer questions) and inviting citizens/organisations to submit comments and/or attend a public meeting/session during the disclosure period. Citizens can request that their comments are responded to in writing;
- Organizing a public meeting/session to ask further questions and present/elaborate the submitted comments (usually in the municipal building or other appropriate local venue) during the disclosure period;
- Processing comments received from all stakeholders and revising the draft plan/document to reflect them, as well as preparing a report to justify why certain comments were not adopted; in case of significant changes of the plan / document, the revised draft may once again be publicly disclosed for another round of comments;
- Submission of the revised draft plan/document and report to relevant authorities which judge whether the comments have been meaningfully considered and addressed.
- Adopting the final plan / document by the relevant authorities and disclosing it.

3.1.2. Land acquisition

[1] *Official Gazette of the RS No. 98/2006*

[2] *Official Gazette of the RS No. 120/2004, 54/2007, 104/2009, 36/2010*

[3] *Official Gazette of the RS No. 32/2019*

[4] *Official Gazette of the RS No. 69/2005*

The main law regulation acquisition of land and assets in the public interest in Serbia is the Expropriation Law of the Republic of Serbia[5]. The Expropriation Law focuses on properties and assets which may be expropriated and restrictions which may be placed on property rights, in the public interest, which is established in accordance with the law.

Public interest is established either through a separate law or by a decision of the Government of Serbia. Following establishment of public interest, an expropriation proposal is submitted by the Beneficiary of Expropriation (in the case of this Project, SRI) to the property administration in the relevant municipality (property administration) together with a set of accompanying documents, including proof that funds needed for compensation are available.

Owners of affected properties are individually invited to a hearing by the property administration and notified about the submission of the expropriation proposal. If the documentation is in order, a decision on expropriation (first degree) is passed by the municipal property administration. The affected owners can submit an administrative appeal to the Ministry of Finance, which decides in the second degree, after which the decision becomes final. If there is no further (judicial) appeal, the expropriation decision also becomes legally binding. However, the affected owner can choose to submit a judicial appeal to the relevant administrative court, after whose ruling the decision on expropriation becomes legally binding.

When the decision on expropriation becomes legally binding, another hearing must be held by the municipal property administration to discuss and determine the amount of compensation for each affected owner. In case an agreement on the level of compensation is not reached within two months of the decision on expropriation becoming legally binding, the case is referred to the courts to decide. The Beneficiary of Expropriation proceeds with the payment of compensation or provision of replacement properties, after the signing of a compensation agreement or the decision on compensation becoming legally binding.

Some of the relevant key characteristics of the Expropriation Law are that it:

- Focuses on providing compensation for any affected properties and assets, rather than on addressing further impacts of land acquisition / restrictions on land use, i.e. physical and economic displacement. The law indirectly covers physical and economic displacement, but only for affected people who have formal legal rights or rights / claims that are recognisable under national law.
- Encourages amicable agreements on expropriation and compensation, however always after proclamation of public interest, rendering land acquisition 'involuntary'.

[5] *Official Gazette of the RS 53/95, 16/01 – Federal Constitutional Court decision, 20/09, 55/13 – Constitutional Court decision and 106/16)*

- Requires the provision of compensation which is determined in accordance with the prevailing market price of the affected property/asset.
- Foresees the possibility of providing increased cash compensation for persons whose sources of livelihoods are adversely affected. Vulnerability, in that regard, is determined by taking into account the number of household members, the number of household members capable of earning a living or who are employed, the health status of household members, the monthly income of the household.
- The Law defines a cut off date for determining the value of affected properties, and it is the date of notification of the owner that an expropriation proposal has been submitted, meaning that all investments into properties made after this date will not be considered for compensation in the valuation process (unless needed for regular maintenance and use). In practice, certified appraisers create an inventory of affected assets during their site visit and provide a valuation of all of these affected assets, effectively causing the cut off date to be the date of the site visit of certified appraisers.
- Enables owners whose assets and land are partially acquired, to request expropriation of all the remaining land and assets (orphan land), if the partial expropriation would negatively affect their economic situation or make the remaining part of the property useless or difficult to use. This request can be made even after the completion of expropriation and up to two years following completion of construction works.
- Enables compensation for land and residential and business structures to be provided in kind (replacement properties), at the request of the affected person.
- Allows for the Beneficiary of Expropriation to acquire the right of accessing the land/property, under certain circumstances (if the responsible authority determines it is necessary due to the urgency of constructing a certain structure or executing construction works, if the decision on expropriation is final and if an offer specifying the form and amount of compensation was previously sent to the affected owner), even if compensation has not been executed (e.g. affected person seeks higher compensation from the court).
- Provides administrative and judicial remedies for disputing expropriation and the amount of compensation provided for affected assets.

Solutions for addressing physical and economic displacement can be sought through cooperation with various government and non-government service providers, such as municipal Centres for Social Welfare which can provide assistance to vulnerable people, under relevant social welfare laws or the National Employment Service (NES) of the RS, which can provide affected people with assistance for employment and training, with the aim of livelihood restoration.

In 2020 a special law was passed to regulate the implementation of linear projects of national importance in the Republic of Serbia and a part of this law focuses on land acquisition. The name of this law is the Law on Special Procedures for the Implementation of Construction and Reconstruction Projects of Linear Infrastructure of Particular Importance for the Republic of Serbia[6] (Law on Linear Infrastructure). Although the aforementioned law ceased to be

[6] *Official Gazette of the RS 09/2020*

valid with the adoption of the Law on the Termination of the Law on Special Procedures for the Implementation of Construction and Reconstruction Projects of Linear Infrastructure of Particular Importance for the Republic of Serbia[7], which entered into force in August 2023, all projects whose implementation started in accordance with the provisions of the aforementioned law, are to be concluded in accordance with it. This also applies to the Project of Reconstruction and Modernization of the Belgrade - Niš Railway.

In the field of land acquisition, the law aims to accelerate the expropriation process and to enable more efficient implementation, as it shortens the deadlines from the Expropriation Law, both for affected people and involved institutions.

The most relevant features of this law, for this Project, are:

- Public interest for expropriation lasts until the use permit for the newly built infrastructure is issued (it does not have to be renewed); if during construction additional land is affected (land not originally included in the expropriation zone), a process of concluding a settlement (amicable agreement) with the owner of land is initiated, without having to initiate expropriation;
- The law stipulates that when construction land, on which an unregistered structure has been built (and for which the legalisation process has not been completed), is being expropriated, the affected owner of the structure (the person who owns the land), has a right to be compensated for the construction value of that structure.
- If the residence of a registered owner of a property cannot be identified (and he/she has no legal representation) or if the registered owner is deceased and the inheritance proceedings have not been completed, the expropriation authority has a right to set a temporary representative. An appeal against the expropriation decision may be submitted, however this does not prevent issuing of a construction permit and application for starting construction works. It should be noted that the temporary representative does not have a right to conclude a compensation agreement on behalf of the owner (or his/her heirs); their right to claim compensation can never expire and they can do so even years after expropriation has taken place.
- The market value of affected land is determined by the Tax Administration based on the most recent registered sale purchase transactions for similar land in the vicinity of the affected land. The law allows the Tax Administration to align compensation rates with other rates provided for similar land affected by linear projects in nearby municipalities. Structures and other assets located on land are compensated as determined by the Expropriation Law.

3.1.3. Labour and working conditions

Serbia was a member state of the International Labour Organisation (ILO) between 1919 and 1992 and restarted its membership in 2000. The country has ratified 77 ILO International Labour Standards (Conventions) of which 62 are in force, including the eight fundamental Conventions.

[7] *Official Gazette of the RS 62/2023*

Labour and human resource management in Serbia is primarily addressed through the Labour Law of the Republic of Serbia[8]. Compliance with labour laws is monitored by the Labour Inspectorate of the Ministry of Labour, Employment, Veteran and Social Affairs of the Republic of Serbia.

Some of the key provisions of the Labour Law are:

- Labour and working conditions are regulated in line with international conventions, by the Labour Law, which states that the rights, obligations, and responsibilities of workers are governed by collective agreements and labour regulations (employment contracts). Labour regulations and employment contracts must be aligned with the law and they can only provide more rights and improved working conditions compared to those stipulated by the law. Employers are obliged to present workers with their rights, obligations and responsibilities in writing and contracts must be signed by both parties.
- Workers have the right to adequate wages (including paid overtime, expenses), health and safety at work, health protection, protection of personal integrity, dignity and other benefits in case of illness, reduction of the ability to work or old age, financial aid during temporary unemployment and other forms of protection. The law sets out in detail employee rights in relation to hours of work, wages, overtime, compensation and benefits.
- Employees have the right to form and join Labour Unions and freely express their views in relation to labour and working condition issues.
- Discrimination is explicitly prohibited by law, both in relation to employees and those looking for employment and the person who feels discriminated against can turn to the court. Special protection of vulnerable groups, to give them equal opportunities, is allowed. Harassment in any form is also strictly prohibited by law. Women employees have the right to special protection during pregnancy and childbirth. Employees have the right to special protection for childcare. Employees below the age of 18 and those who have disabilities have the right to special protection. Employers are not allowed to request data from employees on their marital status or family planning. Employees are entitled to equal pay for the same work or work of equal value with an employer. These provisions are further defined and strengthened in the Law on Gender Equality.
- The law allows for establishing a mechanism for amicable resolution of disputes between employees and the employer. Employees (or their authorised representatives) can turn to the courts for any breach of their labour and working conditions.
- Employment of minors (over 15) is allowed by law, under certain conditions – approval of parents, guardians and if the work does not jeopardise the minor's health and safety, moral or education. The law sets out in detail workers' rights in relation to working hours, leave, daily work break, termination of employment, etc.
- The law applies to foreign citizens working on the territory of the Republic of Serbia.

Other applicable laws include:

- Law on Amicable Resolution of Labour Disputes[9];
- Law on Strikes[10];

[8] *Official Gazette of the RS No. 24/2005, 61/2005, 54/2009, 32/2013, 75/2014, 13/2017, 113/2017 and 95/2018*

[9] *Official Gazette of the RS No. 125/2004, 104/2009, 50/2018*

[10] *Official Gazette of the FRY No. 29/1996, RS No. 101/2005, 103/2012*

- Law on Mobbing[11];
- Anti-Discrimination Law;
- Pension and Disability Insurance Law[12];
- Law on Gender Equality[13].

3.2. National EIA procedure

Law on Environmental Impact Assessment (EIA) ("Official Gazette of the RS ", No. 135/04 and 36/09) regulates EIA process, EIA content, Interested Authorities and organizations participation and public participation, international notification for projects that can have important impacts on other environment and inception and other important issues for EIA.

The impact assessment includes projects in the field of industry, mining, energy, transport, tourism, forestry, agriculture, water management, waste management, utilities and projects planned in a protected natural asset or special purpose area defined by the Decree on making the list of projects which require environmental impact assessment and list of projects which may require environmental impact assessment ("Official Gazette of the RS", No. 114/08).

The process of environmental impact assessment of the modernization project of the existing railway is initiated by the owner of the project, which is "Serbian Railway Infrastructure" AD, with the competent authority for environmental protection. If the request is submitted by another person on behalf of the project - it must have the appropriate authorization issued to the project holder with the number of the request, the date of issue and the signature of the authorized person of the project owner. Facilities whose construction permit is issued by the republic authority; the impact assessment procedure is carried out by the Ministry of Environmental Protection.

Facilities whose construction permit is issued by the Autonomous Region, the impact assessment procedure is carried out by the Provincial Secretariat for Spatial Planning, Construction and Environmental Protection. For projects for which a building permit is issued by the local self-government, the impact assessment procedure is carried out by the local self-government in charge of environmental issues. The Ministry of Environmental Protection is responsible for all projects that may have a trans boundary impact.

The process of environmental impact assessment for railway infrastructure projects consists of the following phases:

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[11] *Official Gazette of the RS No. 22/2009, 52/2021*

[12] *Official Gazette of the RS No. 34/2003, 64/2004, 84/2004, 85/2005, 101/2005, 63/2006, 05/2009, 107/2009, 101/2010, 93/2012, 62/2013, 108/2013, 75/2014, 142/2014, 73/2018, 46/2019, 86/2019*

[13] *Official Gazette of the RS No. 52/2021*

- Phase I - Deciding on the need for impact assessment,
- Phase II - Determining the scope and content of the impact assessment.

The process of impact assessment commences with the submission of Request as follows:

1. Request for deciding on the need to assess the impact of the project on the environment for reconstruction projects and/or construction of railway lines including associated buildings and equipment i.e. projects that are on the list of projects that may be required to have Environmental impact assessment - List II Regulation (Infrastructure Projects)

2. Request for determining the scope and content of the environmental impact assessment for the following projects: main railway lines, including associated facilities (bridges, tunnels, stations), i.e. for projects that are on the list of projects for which the impact assessment is mandatory - List I Regulations as well as projects that are on the List II for which the competent authority has decided to require assessment of the impact on the environment.

The scope and content of the Request for deciding on the need to assess the impact of the project on the environment and the Request for determining the scope and content of the project impact assessment on the environment are defined by the Law on Impact Assessment and the Ordinance on the content of and the content of the study on environmental impact assessment ("Official Gazette of RS", No. 69/05).

The request for determining necessity of assessment shall be accompanied by the following documents:

- A copy of the current planning document (location information), that is - verified planning design or act on planning requirements for construction of project concerned (location requirements);
- conceptual design or preliminary design, or the excerpt from the preliminary design,
- graphical representation of micro- and macro-design;
- requirements and approvals of other competent authorities and organizations obtained in accordance with the law;
- Proof of payment for the administrative fee;
- other evidence at the request of the competent authority.

In addition to the requirements for determining the scope and content of the EIA assessment shall be accompanied by the following documents:

- A copy of the current planning document (location information), and verified planning design or act on planning conditions for construction of the concerned project (location conditions);
- conceptual design or preliminary design, or the excerpt from the preliminary design,
- graphical representation of micro- and macro-location;
- requirements and approvals of other competent authorities and organizations obtained in accordance with the law;

- Proof of payment for the administrative fee;
- other evidence at the request of the competent authority.

The Rulebook on the content of the Environmental Impact Assessment Study defines the content of the study, including a qualitative and quantitative presentation of possible changes in the environment during the project, regular work, in case of an accident and assessment of whether the changes are temporary or permanent. The decision on defining the scope and content of the study made by the competent authority in charge of environmental issues specifies in detail the content of the study on environmental impact assessment.

The Law explicitly stipulates that the implementation of the project cannot be undertaken without the implementation of the environmental impact assessment procedure and obtained consent to the Environmental Impact Assessment Study, or decision that there is no need for the EIA Study.

- Phase III - Procedure for granting approval for the Environmental Impact Assessment Study

Since the Environmental Impact Assessment Study is an integral part of the technical documentation required to obtain a building permit, it is usually made at a very early design stage at the level of the preliminary or main design, i.e. project for a building permit. More specifically:

- At the request of the project holder, the competent authority shall issue a decision on granting approval to the EIA Study or on rejecting the request for granting approval to the EIA Study, based on the conducted procedure and the report of the Technical Commission.
- The competent authority establishes a technical evaluation committee for the Environmental Impact Assessment Study. The Technical Commission evaluates the EIA study in accordance with the Law on Environmental Impact Assessment and the Rules of Procedure of the Technical Commission for the Evaluation of the Environmental Impact Assessment Study.
- Public participation is ensured at all stages of the environmental impact assessment process: the decision-making process on the need for impact assessment, the procedure for determining the scope and content of the EIA Study and the procedure for giving approval to the Environmental Impact Assessment Study. The competent authority is obliged to inform the interested authorities and organizations and the public about the submitted request, provide insight in submitting the request and documentation that is attached to the request and provide public insight, organize the presentation, and conduct a public discussion on the Environmental Impact Assessment Study.

The following Figure presents the EIA Procedure in Serbia through flowchart and the stakeholder engagement required by the law in each phase of the EIA managed by the Ministry of Environmental Protection.

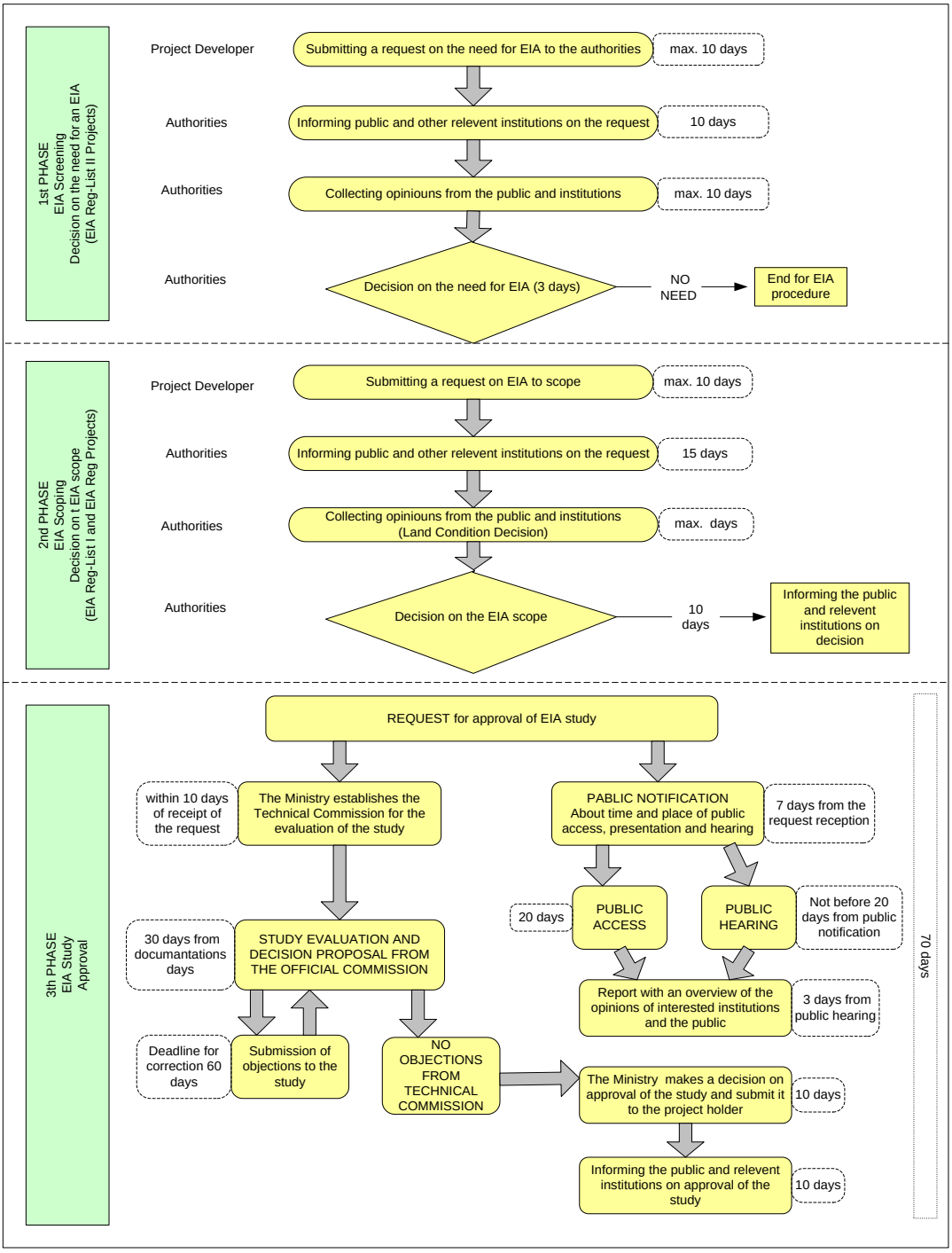


Figure 2. The EIA procedure in Serbia

The Ministry of Environmental Protection is responsible for the environmental impact assessment procedure and approves the EIA, in accordance with the Law on Environmental Impact Assessment.

The Decree on Determining the List of Projects for which an Impact Assessment is mandatory and the list of projects for which an Environmental Impact Assessment may be Required ("Official Gazette of the RS", No. 114/08) determines the List I Projects (for which an Environmental Impact Assessment is mandatory) and List II Projects (for which an environmental impact assessment may be required). According to its characteristics, the project in question is classified in List I, under item 7. Construction of: 1) Main railway lines including ancillary facilities (bridges, tunnels and stations).

The Law on Environmental Impact Assessment ("Official Gazette of RS", No. 135/04 and 36/09) regulates the environmental impact assessment procedure, the content of the environmental impact assessment study, the participation of interested bodies and organizations and the public, cross-border notification for projects that may have significant environmental impacts, supervision and other environmental impact assessments.

An overview of the relevant laws governing the permitting process is provided in the table below.

Table 2. Relevant law to permitting process

Law	OfG.	Relevance for this ESIA
Law on Planning and Construction	72/09, 81/09, 64/10, 24/11, 121/12, 42/13, 50/13, 98/13, 132/14, 145/14, 83/18, 31/19, 37/19, 9/20, 52/21 and 62/23	Art. 27-33, 53a-57 and 99- Defines Location Condition Issuance Art. 133-140 - Defines the Issuance of Building Permit Art. 148 - Defines Construction Works Application Submission Art. 154-159- Defines The Issuance Of Use Permit
Law on Environmental Impact Assessment	135/04 and 36/09	Article 5 - The obligation to obtain an approval for the impact assessment Art. 16-28 - Deciding on approval of the Impact Assessment

The following permits will be required for the ESIA phase: Location conditions for the preliminary design and the decision to approve the impact assessment. ESIA approval is required to issue a building permit.

3.3. Overview of the Main Relevant International Regulatory Framework

3.3.1. The EU EIA Directive

The Environmental Impact Assessment (EIA) was introduced for the first time in Europe in 1985 by the EIA Directive (85/337/EEC) and represents a key instrument for European Union environmental policy. The EIA Directive of 1985 has been amended three times:

- Directive 97/11/EC brought the EIA Directive in line with the UN ECE Espoo Convention on EIAs in a Trans boundary Context. The 1997 Directive widened the scope of the EIA Directive by increasing the types of projects covered and the number of projects requiring mandatory environmental impact assessment (Annex I). It also provided for new screening arrangements, including new screening criteria (included in Annex III) for Annex II projects, and established minimum information requirements;
- Directive 2003/35/EC sought to align EIA Directive provisions with the Aarhus Convention on public participation in decision-making and access to justice in environmental matters; and
- Directive 2009/31/EC amended Annexes I and II of the EIA Directive, by adding projects related to the transport, capture and storage of carbon dioxide (CO2).

On January 28th 2012, Directive 2011/92/EU on the effects of public and private projects on the environment was published in the Official Journal. Directive 2011/92/EU codifies Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (EIA Directive) and its associated amendments. Directive 2011/92/EU fully preserves the content of the acts being codified and does no more than bring them together with only such formal amendments as are required by the codification exercise itself.

The scope of this Directive is to ensure that plans, programmes, and projects likely to have significant effects on the environment undergo an Environmental Assessment prior to their approval or authorization. While Annex I contain a list of projects for which the EIA is mandatory, Annex II defines those categories of projects whose ESIA is optional and at the discretion of the community member states.

According to the Directive 2011/92 EC, the proposed Project falls into Annex I, Category 7 (a) “Construction of lines for long-distance railway traffic and of airports with a basic runway length of 2100 m or more".

The EU Directive on Environmental Impact Assessment (Directive 2011/92 EC as amended by EIA Directive[14] 2014/52/EU) defines the requirements for assessment of potential adverse effects on the environment of some public and private projects that are expected to have significant impact on the environment. The EIA is conducted prior to the issue of the construction permit and approval for project implementation.

[14] *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment*

The environmental impact may be the impact on human beings or on biological diversity, on the quality of soil, water, air or other natural resources, on the climate and contribution on the climate change, or on the historical and cultural heritage, as well as on the interaction between these elements. Cumulative impacts will be taken into account, while alternatives description will involve the baseline scenario and the "zero" alternative description. The public and other parties are to be consulted on the EIA as the consultation with the public is a key feature of environmental assessment procedures.

3.3.2. Other Most Relevant EU Directives

Other relevant EU Directives that will be considered are the following:

- Water Framework Directive establishing a framework for Community action in the field of water policy (2000/60/EC)
- Directive on the assessment and management of flood risks (2007/60/EC) - Floods Directive
- Directive 2008/105/EC on environmental quality standards in the field of water policy(amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC) establishes, among others: (1) limits on concentrations in surface waters of 33 priority substances and 8 other pollutants (Annex I); (2) the possibility of applying Environmental Quality Standards (EQS) for sediment and biota, instead of those for water; (3) the possibility of designating mixing zones adjacent to discharge points where concentrations of the substances in Annex I might be expected to exceed their EQS; and (4) a requirement for Member States to establish an inventory of emissions, discharges and losses of the substances in Annex I.
- Directive 2006/11/EC on Dangerous Substances lays down rules for protection against, and prevention of, pollution resulting from the discharge of certain substances into the aquatic environment of the Community.
- Groundwater Directive 2006/118/EC established a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater.
- Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances (amending and subsequently repealing Council Directive 96/82/EC), obliges Member States to ensure that operators have a policy in place to prevent major accidents.
- Environmental Noise Directive 2002/49/EC defines a common approach intended to avoid, prevent or reduce on a prioritized basis the harmful effects, including annoyance, due to exposure to environmental noise, including, among other, assessment methods for the noise indicators.
- Directive 2000/14/EC on the approximation of laws of the Member States relating to noise applies to equipment for use outdoors listed in Articles 12 and 13 and defined in Annex I of this Directive.
- Directive 2008/50/EC 16 on ambient air quality and cleaner air for Europe;
- Directive 2008/98/EC 18 on waste (Waste Framework Directive)
- Habitats Directive 92/43/EEC aims to contribute towards ensuring biodiversity through the conservation of natural habitats and of wild fauna and flora in the territory of the Member States.
- Birds Directive 2009/147/EC relates to the conservation of all species of naturally occurring birds in the wild state in the territory of the Member States.
- Directive 89/391/EEC – Occupational Health and Safety

- 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').

3.3.3. Relevant International Multilateral Agreements

Most of the International Conventions regarding the Environment, Public Participation and Labour issues have been transposed in the Serbian national legislation such as:

- Bern Convention for the Protection of flora, wild fauna and nature environment of Europe, signed in 1995 and ratified by the GoA in 1999, ratified by the law 8294/1998.
- CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora, ratified by the GoA in 2003.
- Convention of Biological Diversity (CBD) Rio de Janeiro, signed in 1996 and ratified by the GoA in 2004.
- Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus, 1998), ratified by the law no.8672/2000.
- United Nations Convention to Combat Desertification (UNCCD) was ratified in 1999.
- Convention on the Conservation of Migratory Species of Wild Animals (CMS or the Bonn Convention) ratified by the GoA in 2002.
- ESPOO Convention (Finland) "On Environmental Impact Assessment in a Trans boundary Context.", ratified by the law no 9478/2006.
- United Nations Framework Convention on Climate Change (UNFCCC) ratified by the law no. 2/97.
- Kyoto protocol to the United Nations Framework Convention on climate change 1998 ratified by Serbian government 2007.
- Paris Agreement, United Nations 2015, ratified by the law no. 4/17.
- Protocol on Strategic Environmental Assessment ratified by Serbian government at the end of 2004,
- The European Landscape Convention, Florence, 2000, ratified 2011.
- International Convention on the Elimination of all forms of Racial Discrimination, New York, 7.03.1966
- Convention on Elimination of all forms of Discriminations Against Women, New York, 03.09.1981, ratified by Republic of Serbia in 2001.
- Council of Europe Convention on Preventing and Combating Violence Against Women and Domestic Violence, Istanbul, 11.05.2011, in force in Republic of Serbia from 01.08.2014.
- National Convention on Economic, Social and Cultural Rights New York, 16.12. 1966, ratified by Republic of Serbia in 1990.
- International Labour Organization Convention No. 155: Occupational Safety and Health, 1981, ratified 1992.
- UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage, 2003, ratified in May 2010.
- EUROPEAN Convention "For the Protection of Archaeological Heritage", ratified in 2009.

The IFIs recognise the responsibility of clients and their business activities to respect human rights. This responsibility involves respecting human rights, avoiding infringement on the human rights of others, and addressing adverse human rights impacts that their business activities may cause, or to which they may contribute. The term "social"

refers to those issues which pertain to project-affected people (PAPs) and their communities and workers and related to socioeconomic status, vulnerability, gender equality, human rights, sexual orientation, cultural heritage, labour and working conditions, health and safety and participation in decision making.

The social standard IFIs Policy is guided by provisions of several fundamental treaties and conventions: The International Bill of Human Rights, International Labour Organization (ILO) Conventions, the European Convention on Human Rights, UNESCO World Heritage Convention etc.

In addition to the above, Serbia has adopted or embedded in its regulations the principles of many international treaties(*Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW); World Health Organisation (WHO) standards and guidelines ; International Labor Organization Convention on Construction Safety and Health No. 167; EC Directive 98/59/EC of 20 July 1998 on the approximation of the laws of the Member States relating to collective redundancies and collective dismissals; EEC Directive 89/391/EEC the Safety and Health at Work Directive is a European Union directive that sets out general principles for protection of workers' Occupational safety and health; ECDirective 2008/96/EC On Road Infrastructure Safety Management; EU Directive 2012/18/EUon the control of major-accident hazards and standards that provide base for EIB Policy SIA regulation.) and standards that provide base for EIB Policy SIA regulation.

3.4. EBRD Environmental and Social Policy

The EBRD is committed to promote “environmentally sound and sustainable development” in the full range of its investment and technical cooperation activities. This Policy outlines how the Bank will address the environmental and social impacts of its projects by defining the respective roles and responsibilities of both EBRD and its clients in designing, implementing and operating projects in line with this Policy.

To translate this objective into successful practical outcomes, the EBRD has adopted a comprehensive set of specific Performance Requirements (PRs) that clients are expected to meet, covering key areas of environmental and social impacts and issues. EBRD’s document “Environment and Social Policy” (the Policy) and related Performance Requirements (PRs) detail the commitments of the Bank to promote environmentally sound and sustainable development across the full range of its activities.

EBRD categorizes proposed projects as A / B / C based on environmental and social criteria to: (i) reflect the level of potential environmental and social impacts and issues associated with the proposed project; and (ii) determine the nature and level of environmental and social investigations, information disclosure and stakeholder engagement required for each project, taking into account the nature, location, sensitivity and scale of the project, and the nature and magnitude of its possible environmental and social impacts and issues.

Projects categorized by EBRD as “A” require special, formalized, and participatory assessment processes.

In general, a project funded by the EBRD must meet the 2019 Environmental and Social Policy and related Performance Requirements that are presented more analytically in the following table:

Table 3. EBRD’s PRs

No	Name
PR 1	Assessment and Management of Environmental and Social Risks and Issues
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
PR 8	Cultural Heritage
PR 9	Financial Intermediaries
PR 10	Information Disclosure and Stakeholder Engagement

This Project

This Project proposal falls under category “A” of the EBRD screening categorization as it is listed in Appendix 2 - point 6. Construction of lines for long-distance railway traffic; airports with a basic runway length of 2,100 metres or more; motorways, express roads, and new roads of four or more lanes, or realignment and/or widening of existing roads to provide four or more lanes, where such new roads, or realigned and/or widened sections of road would be 10 km or more in a continuous length.

As such, the Project requires a special, formalized, and participatory assessment process in compliance to the EBRD’s comprehensive set of specific Performance Requirements (PRs) that it is expected to meet, covering key areas of environmental and social impacts and issues.

The process should include:

- A comprehensive ESIA in compliance with PR 1 Environmental and Social Appraisal and Management and PR 10 Information Disclosure and Stakeholder Engagement;
- An examination of the technically and financially feasible alternatives and the rationale for the alternative selection;
- The ESIA (while addressing PR 2 and PR4) should identify the issues related to potential risks related to community health, safety and security, as well as labour and working conditions;
- The ESIA should identify the main issues regarding Pollution Prevention and Control (PR 3);

- An assessment of involuntary resettlement issues according to PR 5 Land Acquisition, Involuntary Resettlement and Economic Displacement;
- The sustainable use of the natural resources and the protection of biodiversity will have to be considered as instructed by PR 6;
- An assessment of impacts on cultural heritage according to PR 8 Cultural Heritage.
- PR 7 on indigenous people has been scoped out of the Project because no social and/or cultural group that is distinct from dominant groups within Serbian society is expected to be affected by the Project.
- PR 9 on financial intermediaries has been scoped out of the Project because no delegated responsibility for environmental and social assessment, risk management and monitoring or overall portfolio management is expected to be required for the Project.

3.5. EIB Environmental and Social Policy

The new EIB Group Environmental and Social Policy lays out the Group's vision to 2030, namely, to actively contribute to sustainable development and inclusive growth. The new EIB Group Environmental and Social Policy, which lays out the Group's vision to 2030, namely, to actively contribute to sustainable development and inclusive growth; and this is reflected in its environmental and social safeguards, through the EIB Statement on Environmental and Social Principles and Standards. Such procedures, principles and standards are translated into the routine practices of the EIB in the environmental and social policy published on February 2, 2022.

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 Peoples and Gender

Standard 8 – Labour Rights

Standard 9 – Health, Safety and Security

Standard 10 – Cultural Heritage

Standard 11 – Intermediated Finance

3.6. GAP Analysis

The international and national processes are aligned regarding the requirements for assessment of environmental impact. However, the international ESIA is a more integrated process and needs to encompass the requirements associated with regulatory mechanisms such as those which are part of the local "planning process" and are outside the formal environmental impact assessment process. The international ESIA also needs to consider and address social issues in a more detailed manner, including particularly the preparation of specific management plans for land acquisition related impacts, grievance management and engagement with stakeholders. The table below summarises the similarities and differences between the ESIA and Serbian EIA process.

Table 4. Similarities and differences between ESIA and Serbian EIA process

Activity	ESIA	EIA	Comments
Screening Study	Yes	Yes	Due to nature and scale of the proposed project and the clear requirement under international standards and national legislation the project is a Category A /List I project and a formal screening study was not produced for this project. The procedure started from the scoping study.
Categorisation	Yes	Yes	Formal categorisation in accordance with banking standards and national legislation indicates that the proposed project is a Category A / List I project and requires a full impact assessment.
Stakeholder Engagement Plan	Yes	Partial	A formal stakeholder engagement plan (SEP) is not required under national legislation. However, stakeholder consultation is a part of the planning procedures and the EIA process. A SEP in line with international standards is being developed and implemented for the project
Scoping Study	Yes	Yes	Due to the requirements of the ToR, an International Scoping Study was created for this project. The local scope study has not yet been submitted to the local regulatory authorities because there is no legislative basis for it yet (Location conditions).
Consideration of alternatives	Yes	Yes	Both the impact assessment process for investment and national regulatory requirements, require the consideration of other feasible approaches, including alternatives' locations, technologies, scales and 'no project' options.
Environmental Impact Assessment	Yes	Yes	The environmental impact assessment requirements are generally aligned. The standards adopted in the environmental assessment undertaken for the ESIA should be in line with European and other international best practice. The requirements under the national EIA regulatory process need to ensure compliance with national legislation and not the regulatory requirements outside of the country.

Activity	ESIA	EIA	Comments
Environmental impacts assessment in cases of accidents	Yes	Yes	The Serbian EIA legislation requires quite detailed analysis of environmental impacts in case of accidents which includes specification of hazardous substances used, emergency preparedness and response, remediation measures, etc.
Socio-Economic Impact Assessment	Yes	Limited	The impact assessment under international standards requires an integrated approach including full deliberation of the socio-economic effects. A formal socio-economic impact assessment is not required under national legislation. However, the local national legislation does require assessment of effects where impacts are associated with impacts to human health. The ESIA contains a full assessment of socio economic impacts as required under international standards.
Resettlement Action Plan	Yes	No	The preparation and implementation of Resettlement Policy Frameworks (RPFs) and/or Resettlement Action Plans (RAPs), as defined by international standards, is not required under national legislation. An RPF was prepared within the framework of the Project prefeasibility study. In the ESIA phase, the RPF will be updated for disclosure as part of the ESIA(s) disclosure package. Based on the updated RPF, when the necessary data on land acquisition becomes available, Project RAPs will be prepared and implemented.
Climate change vulnerability assessment	Yes	Limited	A formal climate change impact assessment is not required under national legislation. However, local national legislation requires an impact assessment where impacts are linked to impacts on meteorological parameters and climate characteristics.
Environmental and Social Management Plan (ESMP)	Yes	No	ESMP is not typically included as a requirement according to local legislation. It is required for Category A projects according to EBRD and EIB E&S standards. ESMP describes the roles, the responsibilities, the key commitments and general measures, which should be implemented. The Approved Study is the base document for the preparation of ESMP.
Non-Technical Summary (NTS)	Yes	Yes	NTS is required for investment requirements for use as a disclosure document. It is recognised as good practice to produce an NTS to provide readily accessible summary of the project key features, an assessment of its effects, the proposed mitigation measures and a summary of the residual impacts.
Public Consultation & Disclosure	Yes	Yes	The public consultation process for both investment and national regulatory purposes is required. Given the length of the railway and that this project involves the construction of new railway part, the project is categorised in Category A, requiring the full ESIA disclosure package to be publicly disclosed for a minimum of 120 days.
Management of Grievances and Objections	Yes	No	A project specific Grievance Mechanism is not a formal requirement under national legislation. However, grievances are reported under the consultation process and are encompassed under other regulatory mechanisms (e.g. the local 'planning' process). A project Grievance Mechanism will be established and implemented for the project, as required under international standards.

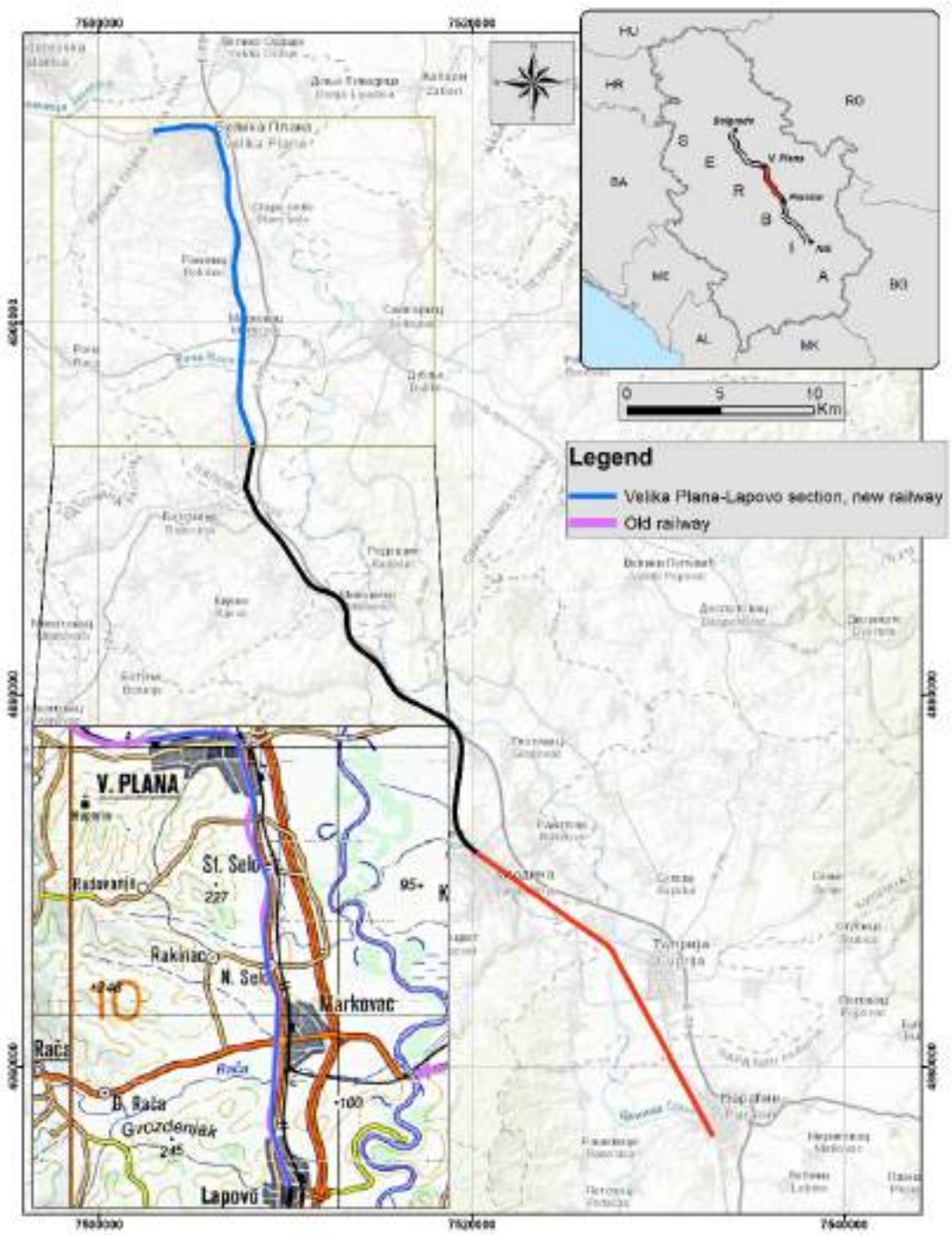
4. BASIC PROJECT DESCRIPTION

4.1. Existing State Analysis of Railway Arterial Route Belgrade–Niš, Section Velika Plana–Paraćin

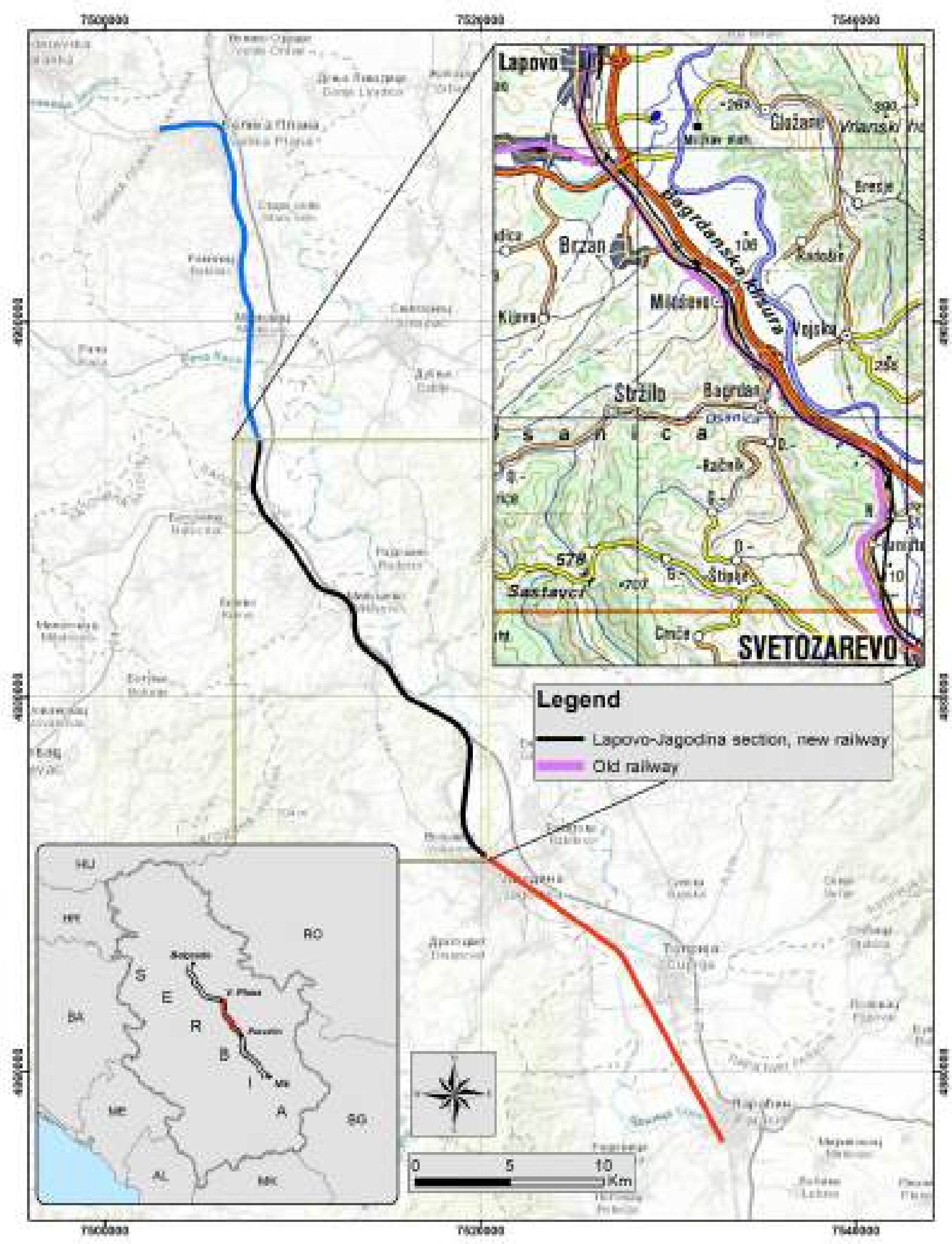
The length of the section Beograd Centar – Rasputnica „G" – Rakovica – Mladenovac – Lapovo – Niš – Preševo – State Border – (Tabanovce), Section Beograd Centar – Niš is 238.761 km, while the length of two-track sections is 137.691 kilometres, which represents 58% of the total length of the railway line to Niš. It was built in 1884 as a single-track railway, and from 1934 to 1993, a second track was added in stages in order to increase capacity. The provided data is based on the information of section II (Velika Plana – Paraćin) from the Preliminary feasibility study (PFS) on Reconstruction and modernization of the railway line Belgrade – Niš done by PPF9 team in 2022.

Double track section Velika Plana – Paraćin, part of the Beograd Centar – Niš railway line is 78,7 km long.

a)


Legend
Velika Plana-Lapovo section, new railway
Old railway
V. PLANA
St. Selo
Radovanje
Rakinac
N. Selo
Markovac
Rača
B. Rača
Gvozdenjak
Lapovo
0 5 10 Km

b)


Lapovo
Brzan
Stržilo
Bagrdan
SVETOZAREVO
Legend
Lapovo-Jagodina section, new railway
Old railway
0
5
10
Km

c)

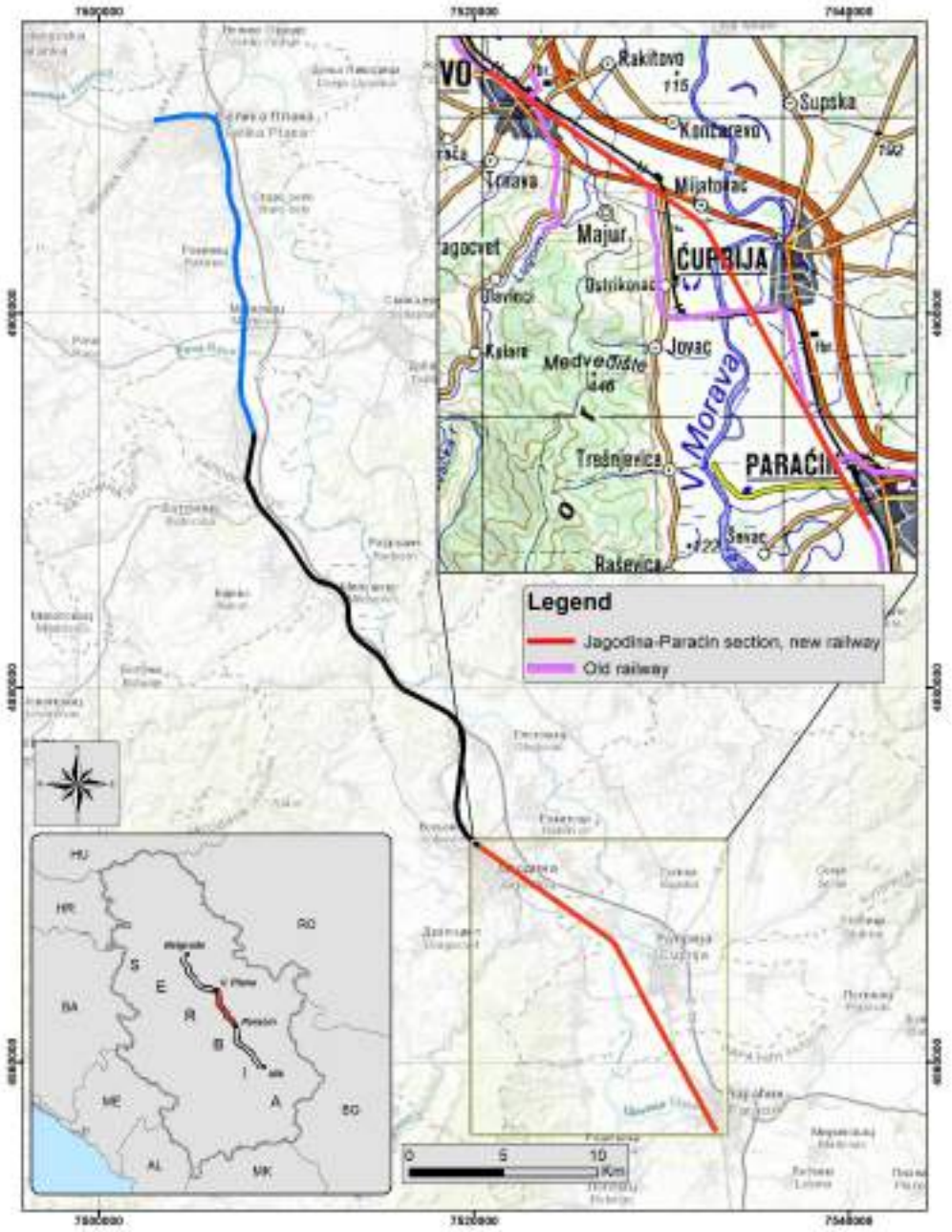


Figure 3. Section 2 Velika Plana–Paraćin railway line

On the section of the double-track railway line from Velika Plana to Paraćin, the minimum curve radius is 350 m, whereas the maximum gradient is 6.4 ‰.

4.1.1. Alignment

The alignment of the scoped double-track railway line starts in Velika Plana passenger station and ends in Paraćin station. It is planned that highest category international passenger trains will run at speed of 200 km/h, and other passenger trains will operate at speeds below 200 km/h, depending on the train category.

The design speed both, for passenger and freight trains is 100 km/h in the junctions.

Finished level of the railway line and stations is within the prescribed limits. In stations to be subject to reconstruction, due care was taken of the existing buildings which shall be kept, and, on the open railway line, finished level is adjusted to the requirements for intersections with canals and roads, as well as to the requirements for quality drainage of the track bed in accordance with the characteristics of the terrain in the corridor.

4.1.2. Formation

Width of formation of the open double-track railway line, which ensures the safety space, working paths and accommodation of electrical engineering and other equipment, is 12.5 m. Formation's cross fall is two-way with inclination of 5%.

Given the category of the railway line and the design speed up to 200 km/h, design envisages fencing of the railway line. Protective wire fence is envisaged on the entire section.

On parts of the railway line where protection against noise is needed, design envisages mounting of noise protection barriers, 3.5 meters high, on the formation edge.

Topsoil shall be stripped in 30–50 cm layer, and exact thickness of the topsoil shall be determined on site. After topsoil stripping, the foundation soil shall be compacted.

On terrains with lower bearing capacity, it is envisaged to place geocomposite on the formation in the width of 4m.

Slopes are envisaged to be topsoiled and grassed on the entire section.

4.1.3. Drainage

The railway line drainage addresses the drainage and protection of the designed railway line against rainwater from the track bed and from hillside waters from the sections of the railway line which are in cut. The design also includes the drainage of water from the designed structures along the railway line. These are road deviations, overpasses and underpasses and bridges.

The design addresses the drainage and protection of the designed railway line from stormwater, the protection against hillside waters on sections of the railway line which are in cut and parts of the railway line which on the embankment when the terrain falls towards the railway line. Channels are envisaged on one or both sides, depending on the railway line finished level and the configuration of the surrounding terrain. On the sections of the railway where the embankment is higher and where, in the transverse sense, the terrain "falls" from the railway line, no channels are envisaged.

Designed channels are earth or concrete. Concrete channels are 40 cm wide in the bottom in plan view and their minimum height is 25 cm, to prevent water from retaining at track foot, given the small available falls. The layout and levelling solution of the drainage channel is conditioned by the existing structures on the alignment, longitudinal and cross falls, relevant rains and catchment areas. The location of the channel is part of the railway line civil engineering design. The same applies to railway station drainage.

For drainage of track bed in railway stations, drainages are designed and fit into the railway line drainage system.

The collected water is discharged to the nearest recipient by the shortest route. Open infiltration ponds are envisaged, which represent green artificial depressions in the soil, with layers of broken rock and gravel at the bottom, which are occasionally filled up during heavy rains and completely emptied in dry weather. An alternative is absorbing wells and/or drainage fields.

The principle in locating the infiltration facility was to keep it at a minimum distance of 5 m from the edge of the slope of the railway embankment.

4.1.4. Permanent way

For the purposes of protection against harmful effects of train derailment, design envisages guard rails type 60E1 with elastic rail fastenings, which are to be placed on bridge structures and at 10.4m in front of and behind the bridge. Concrete sleepers with even top surface are envisaged, onto which running, and guard rails shall be mounted via double steel base plates.

This design includes the design of superstructure on bridge structures and on 10.4m length in front of and behind the bridge structures (from the beginning to the end of guard rail).

Given the category of the railway line and the design speed of up to 200 km/h, design envisages that the railway line is fenced with a type of fence used for highways. The fence shall have multiple purposes: protects and deters against unauthorized access to railway facilities and equipment, has an impact on safety because it prevents uncontrolled access for people and animals to the railway line. In general, fence is envisaged to be placed on both sides of the railway line, at 1.0m from the channel edge, i.e., from toe of embankment. On the outer side of the fence, a 5m space is reserved for service roads.

The Design of Expropriation will be done at the level of Preliminary Design, defines the engaged space required for construction of the project, in the way that, plots situated within the engaged space are defined within cadastral municipalities.

The Law on Railways ("Official Gazette of the RS", No 45/13 and 91/15), Article 58, stipulates that, in the infrastructure belt (25 m on both sides of the railway line from the centre lines of the end tracks except in the zone of inhabited place (6 m on both sides of the railway line from the axis lines of the last tracks), buildings which are not in the function of railway traffic can be constructed, based on the issued approval of the infrastructure manager, which is issued in the form of a decision, and if the construction of these buildings is foreseen by urban plan of local self-government plan which prescribes their protection and implements at its own expense the prescribed protection measures for those buildings.

According to this Law, it is forbidden to build any structures except for the railway functions in the zone of 8 m from the last track axis (6 m in the urban zone) on both sides. Regarding the wider zone of 25 m from the last track axis on both sides, it is for forbidden to build any structures except for railway function and, in some cases, for other purposes but no solid structures. It could be allowed by railways to build electrical and other installation in this zone. In the protective railway zone of 100 m on both sides from the last track axis, it is necessary to provide technical conditions from the railway authorities to build structures.

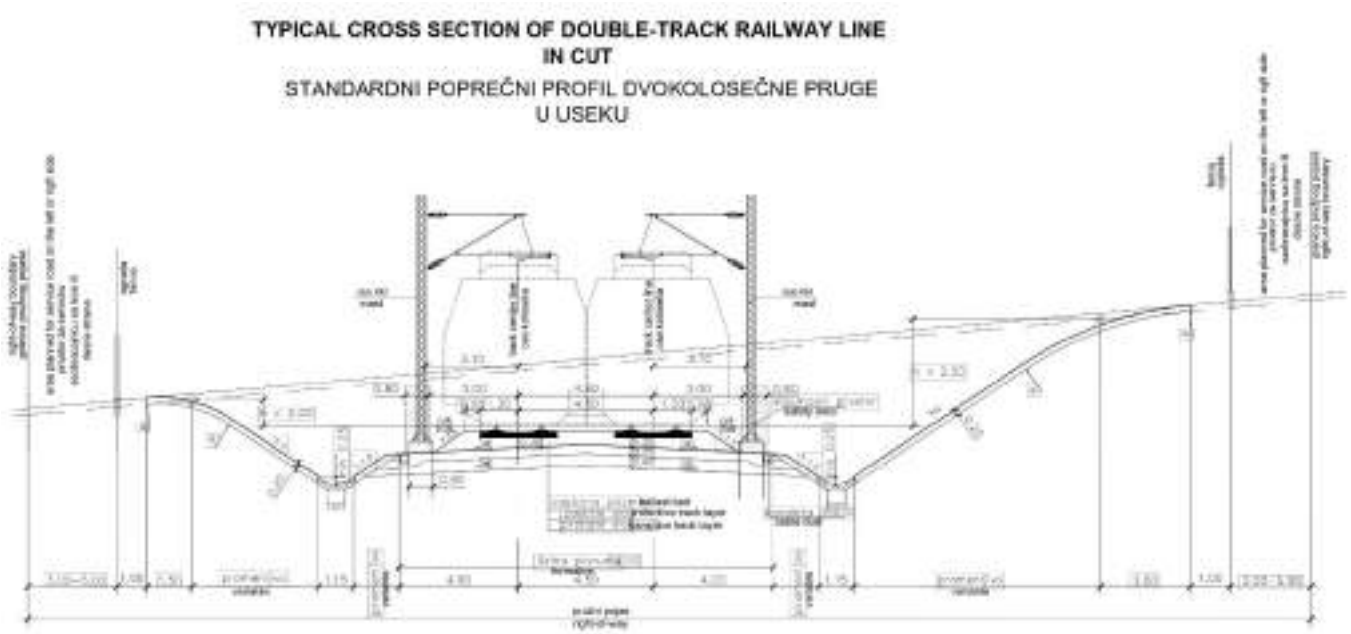


Figure 4. Typical cross section in cut

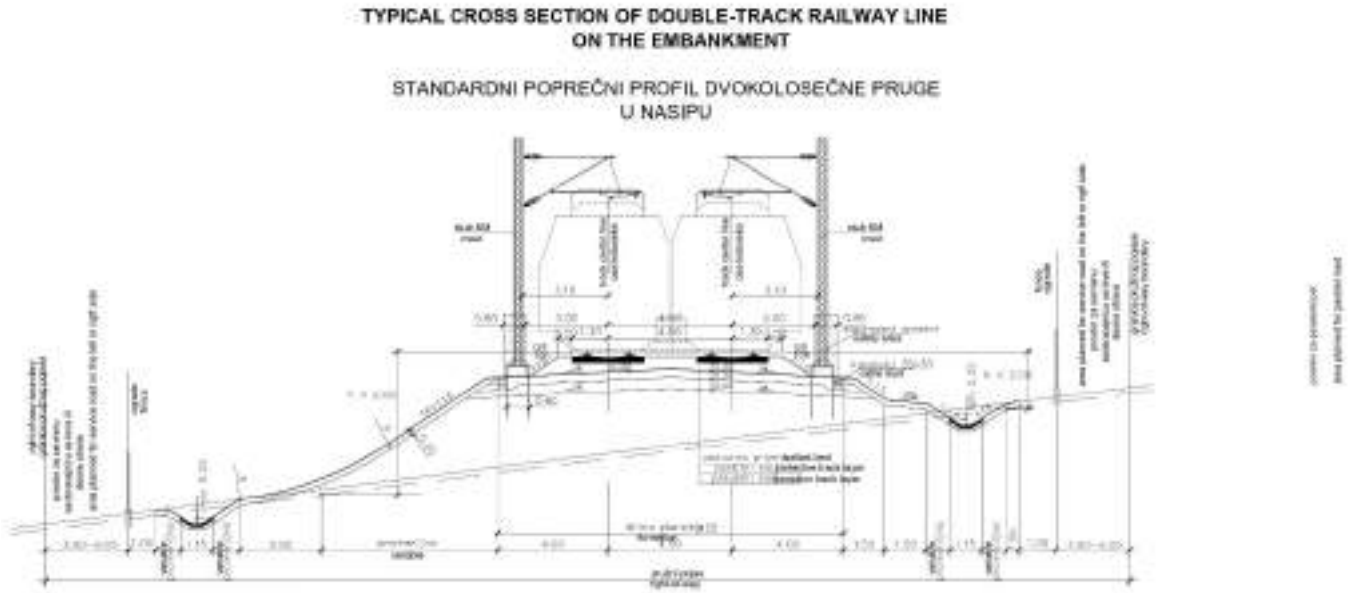


Figure 5. Typical cross section on the embankment

4.1.5. Structures

For preparation of Preliminary Feasibility Study (PFS) for reconstruction and modernization of the line, determination was performed for cross-section types of bridges, overpasses and underpasses. On the section from Velika Plana to Paraćin, there are 20 bridges, 12 overpasses and 6 underpasses.

Table 5. Bridges and bridge structures

Subsection	Tunnels and galleries	Bridges and bridge structures	Overpasses	Underpasses
Velika Plana–Paraćin	-	20	12	6

Precise locations of the bridges for railway are unknown at present stage of the Project development. More detailed information will be identified during the upcoming design stages of the Project.

Further development of the alignment is underway. The exact location and number of the underpasses, overpasses and culverts will determine the activities that take place and refer to the hydrological study, geological investigations and geotechnical elaborate. The exact number and location of crossings for large animals will also be determined by the above-mentioned activities as well as by stakeholder activities with the competent institutions. The data will be presented in more detail in the ESIA.

4.1.6. Stations and official places

Having in mind that the Belgrade - Niš railway line is the main line and the most important railway route of the Republic of Serbia, it is expected that passenger trains, as well as freight trains will run on this section. Of the passenger trains, it is expected that the highest-ranking trains (international passenger trains) will run on the line. Their speed will be the highest and will run at 200 km/h on all sections that have geometric characteristics will allow it. The next category of passenger trains consists of lower-ranking trains, internal long-distance (regional) trains. Their maximum speed will be the same as with international trains, except that their commercial speed will be slightly lower because they will have more stops and waiting at stations.

The third category of passenger trains includes local trains, which will run at a slightly lower speed. It is expected that these trains will stop at all official places that will be selected on the future line Belgrade - Niš.

The selection of stations on the future, modernized line Belgrade - Niš, was done in accordance with the legitimate norms in the Republic of Serbia. According to the National program of public railway infrastructure, on new lines the distance between official places where the length of the track must be provided according to TSI (> 740 m) should be between 20–25 km.

Specific technological tasks significantly influence the selection of stations. In stations where specific technological tasks are performed, they must stay in operation, regardless of the requirements related to the number of passengers or the quantity of transported goods. These stations include Lapovo passenger station and Lapovo Ranžirna (Marshalling) station.

For Lapovo railway node, conceptual solutions are proposed for stations Lapovo Varoš and Lapovo as intermediate stations on the main line Belgrade - Niš and junction stations at which a line for marshalling yard Lapovo Ranžirna branch off. The reconstruction of marshalling yard Lapovo Ranžirna was not assumed as a part of this project and it keeps its existing track layout and its current role in freight services with dominant local character of work.

Number and precise locations of the stations for railway are unknown at present stage of the Project development, and the presented data is based on the PFS from 2022. More detailed information will be identified during the upcoming design stages of the Project and will be presented within the ESIA.

Table 6. Official places on the Velika Plana–Paraćin railway line

No.	Chainage	Official place	Distance from previous station [km]
1	85+400	Velika Plana	12
2	95+200	Markovac	11
3	102+300	Lapovo Varoš	7
4	104+400	Lapovo	2
5	116+000	Bagrdan	12
6	129+700	Jagodina	14
7	135+200	Gilje	5
8	147+150	Paraćin	12

Description of the most important stations:

Velika Plana

Velika Plana station remains an intermediate station on the main line Beograd - Niš and a junction station at which another main line Rakovica - Mala Krsna - Velika Plana branch off. Main tasks of the station are related to the traffic management, shunting work organization and the performance of passenger and wagonload services.

Markovac

Markovac station remains an intermediate station on the main line Beograd - Niš and a junction station at which another main line Markovac - Resavica branch off. Main tasks of the station are related to the traffic management and the station remains open for local passenger services.

Lapovo Varos

The existing junction Lapovo Varos change the role on the network and become an intermediate station on the main line Beograd - Niš. It remains the north border station in the Lapovo railway node at which the freight tracks to the marshalling yard Lapovo Ranžirna branch off the main line. Main tasks of the station are related to the traffic management and the station remains open for local passenger services.

Lapovo

Lapovo station remains an intermediate station on the main line Beograd - Nis and a junction station at which another main line Lapovo - Kraljevo branch off. The station remains the south border station in the Lapovo railway node branch off freight tracks directed to the marshalling yard Lapovo Ranžirna. Main tasks of the station are related to the traffic management. The station remains opened for domestic and international passenger services. Three platforms are proposed to be designed in the station. In the area of the railway station Lapovo, an archaeological site with settlements from the prehistoric period and the ancient period has been recorded. This archaeological site is located in the settlement and was partially damaged by construction works for the needs of the construction of the railway station, railway and surrounding infrastructure.

Bagrdan

Bagrdan station remains an intermediate station on the main line Beograd - Niš. Main tasks of the station are related to the traffic management and local passenger services.

Jagodina

Jagodina station remains an intermediate station on the main line Beograd - Niš. Main tasks of the station are related to the traffic management, shunting work organization and the performance of passenger and wagonload services. The station remains opened for domestic and international passenger services. For freight services, it remains opened for wagonload services at station loading tracks and private sidings.

Gilje

Gilje remains a halt on a two-track line with two main through tracks and it remains open for receiving and dispatching passengers in local traffic.

Ćuprija Junction

The Ćuprija Junction is not the subject of this study and keeps the current track layout designed according to the Main Project for Reconstruction and Modernization of the section Gilje - Ćuprija - Paraćin of the Belgrade - Niš railway made in 2007.

Paraćin

Paraćin station remains an intermediate station on the main line Beograd - Niš and a junction station at which two lines branch off Rasputnica Ćuprija - Paraćin and Paraćin - Stari Popovac, respectively. Main tasks of the station are related to the traffic management, shunting work organization and the performance of passenger and wagonload services. The station remains opened for domestic and international passenger services. For freight services, it remains opened for wagonload services at station loading tracks and private sidings.

Station buildings:

Modernization project includes reconstruction of existing stations and train stops and their adjustment to EU railway standards.

Architectural buildings and structures are concentrated in all stations along the railway line and they include the following groups of buildings and structures:

- Station buildings with the landscaping of station complex
- Subways with canopies, stairs, and lifts
- Platforms and platform canopies
- Buildings for signalling and interlocking and telecommunication facilities – SI and TC
- Building for sectioning posts - SP
- Building for sectioning posts with neutral section – SPN
- Building for electric traction substation - ETS
- Building for Electrical Engineering Operations EEO – overhead contact system section
- Standardized buildings to accommodate TC equipment and landscaping

All buildings/structures are designed based on the existing condition, characteristics of the location, and the traffic and technological needs and requirements of a modern railway line, following the regulations, standards, and TSI for

the appropriate type of buildings/structures. Depending on the current condition of the buildings, a specific plan of action is proposed trough Preliminary Design for each of them.

Other design characteristics:

Electric Traction Substations and Sectioning Posts

Within the scope of reconstruction, modernization and construction of double-track railway line Belgrade Centre – Nis (Međurovo) it is necessary to perform the reconstruction and modernization of the existing power supply substations and sectioning posts located on this section.

Remote Control of the Fixed Electric Traction Installations

Preliminary design shall contain the design of the temporary remote-control centre located in the premises of the existing centre and local and remote control of motor-driven disconnectors. The design envisages equipment (and software) of temporary remote-control centre for fixed electric traction installations.

Transformer Substations 25/0.23 kV from the Overhead Contact System

For back-up supply of signalling and interlocking devices, devices for control of motor-driven disconnectors and switch point heating, on the section Belgrade Centre - Nis (Međurovo) transformer substations (TS) supplied from the overhead contact system are envisaged, whereof ratio is 25/0.23 kV, power: 5kVA, 50kVA and 100kVA.

Protection and Relocation of the Existing Technical and Utility Infrastructure

Within the scope of reconstruction, modernization and construction of double-track railway line Belgrade Centre - Nis (Medjurovo), it is necessary to perform verification of crossings and, as necessary, reconstruction of all overhead power lines whereof nominal voltage is 110kV-400kV, and which collide with the concerned railway line.

On the relevant section, there are collisions with power lines whereof nominal voltage is 35 kV, 20kV, 10 kV and 1 kV. Reconstruction of overhead 35 kV, 20 kV, 10 kV and 1kV lines at points of crossing with the railway line, implies, in principle, the replacement of existing towers in crossing spans with new terminal towers, at appropriate distance from the railway line, and cabling of overhead lines in crossing spans.

Signalling devices

All stations on the railway section Belgrade Centre-Niš of the railway line no.102 Belgrade Centre-Junction »G«-Rakovica-Mladenovac-Niš-Preševo-state border with North Macedonia are equipped with centralized relay

interlocking devices for traffic management. The signalling system has been in operation for more than 30 years, and its' maintenance is difficult due to the expiration of lifetime and lack of spare parts.

Telecommunication

Telecommuniacation systems in stations are old and capacity of these systems is not sufficient. Based on the considered requirements from the ToR, the analysis to be carried out under Preliminary Design will include installation of the following:

- Copper cables
- Fiber optic cables
- Dispatcher and trackside telephone devices
- Radio-dispatching system
- GSM-R system
- Transport system
- Station telecommunication systems

4.2. Associated facilities

The Batocina junction is being built on the part of the road between Batocina and Lapovo, but since it is not connected with our project, it was concluded that there are no associated facilities on this section of the railway.

5. ASSESSMENT AND ANALYSIS OF ALTERNATIVES FOR THE PROJECT IMPLEMENTATION

5.1. Historical development of the proposed route

The construction of Belgrade-Niš railway line has been an obligation of Serbia, as established at the Berlin Congress in 1878. At the congress, the Great European Empires have acknowledged Serbian independence, but also established an obligation of railway line construction, in order to connect Austro-Hungarian and Turkish railways. The line was finished, and operations started in October 1884.

The significance of the line is reflected in the fact that the importance of the connection of Central and Western Europe with the Middle East, Asia and Greece.

As from this brief historical overview can be seen, the railway was built as a significant traffic connection of international importance, and that importance has remained to this day.

Other studies that have been done in the past and refer to the specific project in terms of design are:

- General design for modernization and reconstruction of railway line Belgrade – Nis with Pre-Feasibility study and Preliminary EIA, done by PPF9 team in 2022.
- Preliminary design and Feasibility study for reconstruction of single railway line and structures on existing railway line Nis – Preševo – border with North Macedonia, section Nis – Brestovac.
- Preliminary design and Feasibility study for construction of bypass railway line in Nis. Environmental Impact Assessment has been carried out by Cestra in 2016 under European Union's 2011 IPA programme for the Republic of Serbia, EuropeAid/131854/C/SER/RS, CRIS 2013/323-409) and includes the construction and reconstruction of the existing single-track railway going from the station Nis marshalling yard, and the double-track railway from the station Trupale through new terminals Nis North, Pantelej and Vrezina, up to the place of joining the existing railway Nis-Dimitrovgrad in the Prosek settlement. The newly designed railway continues as a single-track one, up to the entrance into the station of Sićevo. In its first section, the line mainly follows the corridor of current railway, touches the airport area, goes through city municipalities of Crveni Krst and Pantelej, detaches after the point of the new Pantelej station and continues along the corridor of the E-80 route. In the vicinity of Prosek, it goes under the highway overpass and follows the route of the existing railway Nis-Dimitrovgrad to the point of reaching the Sićevo station. It was a separate project, EU funded. In the project description chapter of this report as well as in the relevant chapter of the PFS, it is described how the currently described project of the report is affected by Nis bypass.
- Preliminary design and Feasibility study for reconstruction and modernization existing tracks and construction of second track of railway line Belgrade – Nis, section Stalać – Djunis. EIA has been prepared for both national and IFIs requirements has been carried out 2018 by Mott MacDonalnd (IPA 2011-WBIF-Infrastructure Project -Serbia Transport, WB8-SER-TRA-14, EuropeAid/131160/C/SER/MULTI/3C)
- Detailed design for reconstruction and modernization of railway line Belgrade – Nis, section Gilje – Ćuprija done by Transport Institute CIP in 2007.

Looking at the scope of this project, the 2007 General Design for the Belgrade-Nis railway is probably the most important document that has been produced so far. The document provided for 4 alternatives:

- Reconstruction and keeping the existing railway route with an increase in speed up to 100 km/h,
- Reconstruction and keeping the existing railway route with an increase in speed up to 120 km/h,
- Abandonment of the existing railway route, for the most part, with an increase in speed up to 160 km/h,
- 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. The General Design selected the alternative 3 that envisages upgrading the railway for a speed of up to 160 km/h along the entire route of Velika Plana–Paraćin section. The new alignment was proposed to enable greater speed and shorten the travel time.

5.2. Review of alternative analysis within Prefeasibility Study (Reconstruction and modernization of the railway line Belgrade – Niš, Preliminary Feasibility Study, PPF9 team, Consortium led by Safege, 2022)

PFS study has been done by the PPF9 team in 2022. It includes scoping report, SEP and preliminary RAP. Within the PFS the MCA was carried out and three variants were considered for the further development, as well as No project scenario.

5.3. Description of alternative railway routes considered in the PFS (2022)

The 2022 PFS, done by PPF9, considered the four new alternatives including the “no - project“ scenario and three alternatives for increasing speed up to 200 km/h with the aim of reducing the travel time and increasing the competitiveness of the national railway traffic.

The main goal of the technical study was to develop basic variants of railway line Belgrade - Niš, combining sections of different speed limits, from 100 km/h up to 200 km/h.

In the “no - project” scenario:

- the current condition of the railway infrastructure on the Belgrade-Nis, therefore also the sub-section Velika Plana–Paraćin, line will continue to be unsatisfactory,
- the electrical equipment will remain to be technologically obsolete,
- the commercial speed of passenger trains will stay at about 50 km/h,
- large number of level crossings will continue to pose danger to road users and will jeopardise safety of both rail and road traffic.

PFS Variant I

Variant I was chosen so that the largest part of the railway is designed for speeds up to 200 km/h, with an expected increase in investment costs. This speed is achieved on 84% of the line, being about 192 km out of the total length of 227,032 km.

Velika Plana station remains in its existing location because of impossibility to find the new location without crossing over the Belgrade-Nis highway and far from the city.

From Velika Plana station to Lapovo Putnička (Passenger) station the existing corridor is retained, due to the existence of the marshalling yard between Lapovo Varoš and Lapovo Putnička (Passenger) station with micro displacement because of bigger curve radii.

Markovac station remains at the same position.

After Markovac station, the line remains in the same corridor as the existing line, except where radii of curves are increased to allow the speed to be 200 km/h. This solution is adopted all the way to Jagodina station which remains in the same position as well as Bagrdan station, and onwards to Gilje within the same corridor. At places with bigger curve radii the new alignment has been moved from the existing one.

The Gilje - Paraćin section was reconstructed several years ago for the design speed of 160 km/h and is not considered.

PFS Variant II

In Variant II, the possibility of achieving speed up to 200 km/h on the entire line from Belgrade to Niš (except for lines in junctions) was deliberated, with the exception of parts of the line where it was estimated that increase of the design speed would lead to a significant increase in investment, mainly due to local restrictions (railway stations located in urban areas), and most stations remain at their existing locations. Thus, Variant II runs through the existing corridor but with increased radii of curve, to achieve speeds of 200 km/h or 160 km/h, depending on the terrain and estimated increase in costs. The total length of Variant II is 228,160 km. The speed of 200 km/h is achieved on 127 km, being 56% of the total length of the line.

After Markovac station, the line remains in the same corridor as the existing line, except where radii of curves are increased to allow the speed to be 200 km/h. This solution is adopted all the way to Jagodina station which remains in the same position as well as Bagrdan station, and onwards to Gilje within the same corridor. At places with bigger

curve radii the new alignment has been moved from the existing one but closer to the existing Belgrade–Nis highway from km 120 to km 124.

Ćićevac station are retained at their existing locations, unlike Variant I and design speed through station is 160 km/h.

PFS Variant III

Variant III was based on the premise of minimum investments with maximum effects, i.e., with the major part of the railway line designed for 200 km/h, incurring the least possible construction costs, while all stations remain at their existing locations, and the design speed being up to 120 km/h in those areas. The total length of Variant III is 228,841 km. The speed of 200 km/h is achieved on 85 km, being 37% of the total length of the line.

Velika Plana station remains in its existing location because of impossibility to find the new location without crossing over the Belgrade-Nis highway and far from the city.

After Markovac station, the line remains in the same corridor as the existing line, except where radii of curves are increased to allow the speed to be 200 km/h. This solution is adopted all the way to Jagodina station which remains in the same position as well as Bagrdan station, and onwards to Gilje within the same corridor. At places with bigger curve radii the new alignment has been moved from the existing one as in the Variant II.

Ćićevac station are retained at their existing locations, unlike Variant I and design speed through station is 160 km/h.

The main objective of the Project is to modernise the existing railway line in compliance with TEN-T standards, making it a reliable and competitive mode of transport and increasing passenger and freight traffic demand. Furthermore, the objective is to be achieved in a cost effective and sustainable way in compliance with strategic plans at national, regional, and local level. Given the category of the line, it should comply with internationally agreed Technical Specifications for Interoperability and with the technical requirements for the core TEN-T.

The goal of the option analysis was to present any significant differential impacts between the proposed alternatives, and in accordance with that, the evaluation criteria are defined. The criteria in which no significant difference between options was observed or assumed were not included in further analyses. List of all adopted criteria with their significance on the evaluation of alternatives (weight) is shown in table below.

Table 7. Main criteria with weighting coefficients

Main criteria	Initial weight for main criteria [%]
Financial	22
Demand	20

Operation	13
Social & Environmental	22
Safety	12
Risks	11

5.4. Environmental and social assessment of alternatives considered in PFS

Social and environmental impacts were sublimated through several indicators that are suitable for detail analysis in this stage of the project. From the aspect of environmental protection, the criteria that initially were screened were biodiversity and protected areas, waters, floods and noise. The results showed that all criteria have some similar scores for all variants, except for noise. The MCA also took into consideration the criterion of reduction of external costs due to modal shift, placing it in the environmental and social category, which has been calculated by the design and CBA team. Regarding the social aspect, the most sensitive is the impact on inhabitants.

The following parameters were considered:

- estimated noise and vibrations'
- impact on the population and
- estimated CO2 emissions.

Environmental impact

Water

All three proposed variants cross the same rivers and streams at different crossings. There have been excluded for the evaluation those ones that all variants cross at the same point, since they may follow the existing alignment. At the PFS phase there were no surface water measurements carried out and therefore it is difficult to estimate the quality of the rivers and streams affected. There are data only for the main river, Great Morava. taking into account the lack of data on the quality of rivers and streams and the very early stage of design, this criterion can be assumed that has an equal result in the evaluation of the alternatives.

Biodiversity

For the evaluation of three proposed variants, the following impacts on biodiversity were taken into consideration in this preliminary analysis:

- direct impact on flora and habitats (occupation, degradation, modification, devastation of habitats and loss of vegetation types and plant species);
- direct impact on fauna (habitat loss, disturbance to animals, casualties during the construction and collisions during the operational phase;

- indirect impacts (habitat modification and fragmentation, behavioral disturbances, changes in ecological preferences).

Ramsar sites and Emerald Areas are not identified within the affected zone. This criterion has an equal result for all variants.

Climate change – floods

More significant problem can be identified in the areas of Paraćin, Ćuprija and Jagodina, while all three variants pass through these areas. Since flood risk maps were not available during PFS stage, taking into account that all three variants cross the flood prone areas, a conclusion can be made that due to the small variations of the three variants, the criterion has an equal result for all variants.

CO_2

CO_2 emissions, which would result from the forecasted amount of railway transport, were determined on the basis of average CO_2 emissions per passenger km, considering passenger transport, i.e. CO_2 emissions per net-tonne km, considering freight railway transport. Since required statistics were not kept in Serbia, data on CO_2 emissions were taken from Annual environmental statistics for passenger and freight transport in Great Britain, for 2019. Average emission values are shown in table below.

Table 8. Average CO_2 emission, in grams per one passenger kilometer and per tonne kilometer

Transport mode	CO_2 [g/pkm]	CO_2 [g/tkm]
road transport	111.33	86.00
rail transport	35.10	27.50

Ongoing ESIA phase will provide detailed statistical data on the age structure and number of road vehicles by type of the fuel and engine, in order to obtain more accurate data on GHG emissions in Serbian road network and especially at Belgrade-Niš corridor.

For the first operational year, comparation in CO_2 emissions from rail transport and reduction in CO_2 emissions due to modal shift are shown in figure below.

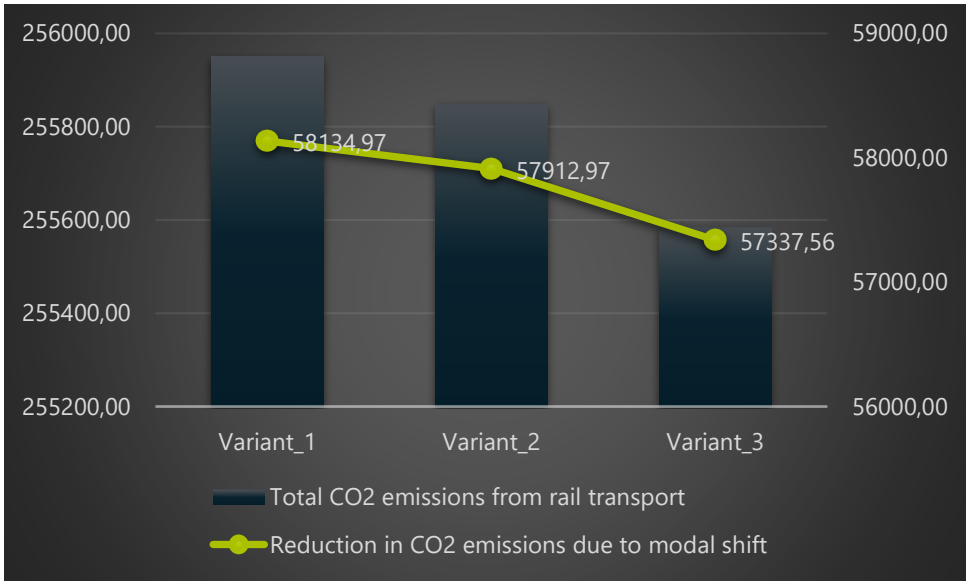


Figure 6. Total CO_2 emissions from rail transport and reduction due to forecasted modal shift

Noise and vibrations

The comparison of noise effects was performed by comparing the position of all three proposed variants in relation to the nearest populated places. Bearing in mind that for the most part all three variants go along the same corridor, we observed only the places where the railway corridors differ. The largest cities through which the railway passes directly were taken into consideration. The following table presents the magnitude of noise impact per affected settlement. Settlements that indicatively selected are those that where the Variants differ when passing by as well as those which are major ones along the corridor to assess the impact. The Variant which is closer/closest to/crosses a settlement and is considered as new is presented as HIGH, the Variant which passes to a more rarely populated area or it is on existing line which is being rehabilitated is presented as MEDIUM and the variant which is in existing line and is being rehabilitated, while other types of activities with noise impact occur or passes far from populated areas is presented as LOW.

Table 9. Average noise impact by variant, considering large settlements

Location	Variant I	Variant II	Variant III
Velika Plana	2	2	2
Novo Lanište	2	3	3
Jagodina	2	2	2
Ćićevac	2	2	2
Sum	**8**	**9**	**9**
Average	**2,0**	**2,25**	**2,25**

Social impact

The approach for social impact comparison requires to specifically identify the magnitude and scope of impacts. This refers to impacts stemming from permanent land acquisition, resettlement and loss of access to assets. The impacts and social considerations throughout all three variants are presented in Table 10:

Table 10. Social impacts on population by variants

Variant	Area of Land affected [ha]	Impacted land parcels [No]	Impacts to residential structures [No]	Auxiliary Structures [No]	Impacts on informal residential structures [No]
Variant 1	*453*	*252*	*196*	*197*	*56*
Variant 2	427	219	178	154	41
Variant 3	386	133	101	36	32

According to Cadastral data and concept designs of the variants, regarding “Population to be resettled” sub-criterion, the smallest impact on residential structures has the Variant 3, with 101 residential structure which would be affected with line construction, while the Variant 2 affects 77 residential structures more.

Alternative 2 is chosen as the final framework for the railway line modernisation. Further development of the selected variant 2 is underway through the Preliminary Design. Chosen variant from PFS is used as basis for the Preliminary Design and some realignments are possible. The design teams are in regular communication with responsible local self-governments departments to discuss local constraints and issues of concern for the local population and all received feedback is being taken into account in the Preliminary Design to the extent possible. The E&S team is included in the process of project design documentation preparation for railway Belgrade—Niš. Railway alignment optimisation is being done with the aim to improve project implementation by avoiding potential adverse environmental and social impacts. EBRD mitigation hierarchy is and will be applied - to avoid and if not possible to minimise and mitigate identified impacts. Defining the position of objects on the alignment, stations, underpasses, overpasses will be defined by the obtained results of different field activities. After the completion of the ongoing hydrological study, which has the task of giving water levels and flows, the definition of the objects on the railway line follows. Further geological research will show whether it is possible to stay in the existing corridor or whether the route will have to undergo certain corrections and redesign. Relevant Stakeholders are involved in all ongoing activities.

5.5. Analysis of existing alternatives

The chosen variant from PFS is used as basis for further development through the Preliminary Design. The goal of further development of the route is additional reduction of the impact on the environment, primarily on biodiversity,

reduction of the impact of noise and vibrations, and expropriation of properties, causing physical and economic displacement. EBRD mitigation hierarchy is and will be applied - to avoid and if not possible to minimize and mitigate identified impacts.

Criteria taken into consideration when considering alternatives are:

- Noise and vibrations
- Biodiversity
- Physical and economic displacement
- Technical requirements
- Occupation of agricultural soil

The following text presents alternative solutions considered in this phase. The alternatives have been compared from the mentioned criteria and summarized in the tables bellow.

Location 1:

Figure 7. Alternatives on the exit of railway station Velika Plana

Criteria	PFS Solution (red)	I Alternative (blue)
Noise and vibrations	Impact of noise and vibrations **-**	Impact of noise and vibrations **+**
Biodiversity	Not significant imapct **0**	Not significant impact **0**
Physical and economic displacement	More than 20 structures, at least 10 residential and a part of a business facility (warehouse), engaged in wholesale of fresh foods) **-**	Estimated 10 structures, of which at least 3 residential with auxiliary structures, as well as a part of a business facility (warehouse), engaged in wholesale of fresh foods) **+**
Technical requirements	Speed 200 km/h **0**	Speed 200 km/h **0**

Occupation of agricultural soil	Approximately 25 ha -	Approximately 23 ha +

- **Conclusion**: Both alternatives will cause physical and economic displacement, but the PFS solution causes impacts on more residential structures. The affected warehouses, belonging to a business facility (wholesale of fresh foods) which could in fact entail the relocation of the whole business complex are affected in both solutions. There is no significant impact on biodiversity with both alternatives, and land use is approximately the same for both variants. From technical aspect of view the better solution would be I alternative because of the Lapovo station location and curve at the exit of the station. With alternative I there will be an impact of noise and vibration but with the application of mitigation measures, it could be reduced.

Location 2:

Figure 8. Alternatives on location Staro Selo

Criteria	PFS Solution (red)	I Alternative (blue)
Noise and vibrations	Impact of noise and vibrations **0**	Impact of noise and vibrations **0**
Biodiversity	Not significant imapct **0**	Not significant impact **0**
Physical and economic displacement	11 structures, of which at least 3 residential with auxiliary structures **0**	Possibly the same impact, on the same structures as in the PFS solution, due to their proximity to the railway and access **0**
Technical requirements	Speed 160 km/h -	Speed 200 km/h +
Occupation of agricultural soil	Approximately 5 ha -	Approximately 3 ha +

- **Conclusion**: The PFS solution implies the certain demolition of at least three houses and auxiliary structures. The alternative option is possibly more favourable, but not certain, as the affected houses could need to be

acquired due to their proximity to the future railway and/or inability to provide adequate access to the properties. There are no significant impacts on biodiversity with both alternatives, and land use is approximately the same for both variants. From a technical aspect of view alternative I is a better solution because of possibility of reaching a speed of 200 km/h.

6. PRELIMINARY DESCRIPTION OF ENVIRONMENT AND SOCIAL BASELINE

6.1. Physical environment features

6.1.1. Climate characteristics

The climate in the project area is continental to moderate-continental, and the amount of precipitation is usually up to 500–600 mm/ year, while the air humidity is moderate. These areas are sparsely forested, but mostly the entire land is cultivated. It is characterized by relatively colder winters, warmer autumns than spring and moderately warm summers. More specifically, low annual precipitation dominates, while summer precipitation is characterized by strong evaporation due to high temperatures, with frequent occurrence of summer storms and showers. Winds are a very important factor causing temperature differences, bringing precipitation or drought, manifested in the penetration of moist and cold air masses from the Atlantic Ocean from the west and southwest, warm from the Mediterranean area, as well as winter penetration of cold air masses from the north and northeast.

The landscape characteristics that include the analysed corridor are an important element for understanding the overall relationship between the planned facility and the environment. The analysis of the established terrain is based on different areas with visual characteristics, which include:

- The valley of the Great Morava river and the hills on the left bank of the Great Morava, the Bagrdan strait, the valley of the South Morava;
- The combination of hills and flat terrain, which is mostly anthropogenically modified arable land;
- Built parts of the route where it passes through the populated areas of Velika Plana, Markovac, Lapovo, Bagrdan, Jagodina, Paraćin) including the E-75 highway corridor; and other infrastructure facilities.

Most of the Serbia has Cfb climate[15] (Köppen climate classification). Only the beginning of the section (city of Velika Plana) is within Cfa climate (humid subtropical climate, also known as warm temperate climate, is characterized by hot and humid summers, and cool to mild winters).

[15] *Climate Regionalization of Serbia According to Köppen Climate Classification, https://doi.org/10.2298/IJGI1702103M*

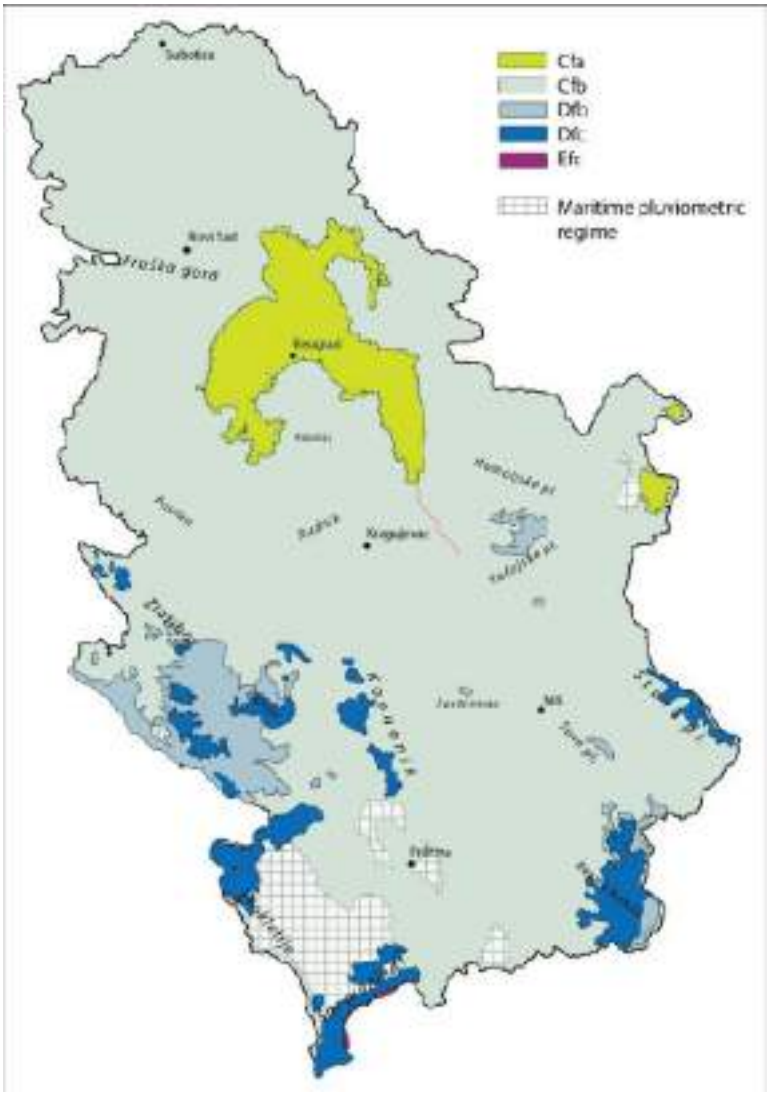


Figure 9. Köppen climate classification for Serbia (railway route marked red)

According to the map of climatic areas of Serbia (Ducić, V. et Radovanović, M., 2005), two main climate areas can be defined, A and B.

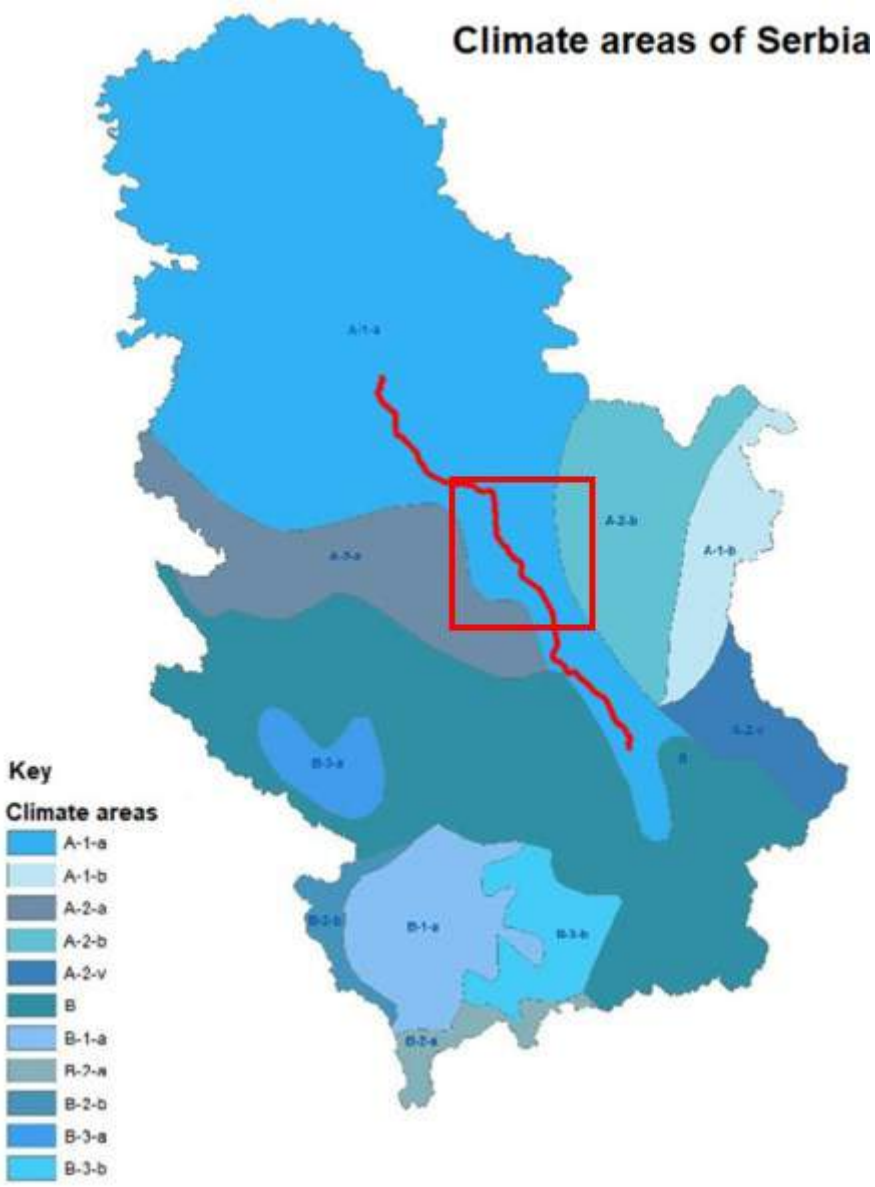


Figure 10. Climate areas of Serbia (red line represents Belgrade – Niš railway, with relevant section in the red rectangle)

Railway route goes only through sub-area A-1-a. Absolute extreme air temperatures in this subregion range from -32.6°C to 42.3°C. The average winter temperature is above 10°C, and in summer it is above 20°C. Spring temperatures are slightly different from autumn temperatures. The average annual amount of precipitation in the lower regions is about 520 mm, and in some places over 650 mm. There is the least precipitation in winter, while spring precipitation is slightly higher than in autumn.

Meteorological data were analysed for the period 2000-2020 for the meteorological stations in Smederevska Palanka and Ćuprija that are part of the Republic Hydrometeorological Service of Serbia along with the data from Meteoblue (https://www.meteoblue.com).

Station: Smederevska Palanka

The lowest average annual air temperature for the observed period 2000-2020 is 5.9°C, and the highest average annual temperature for the same period is 19.8°C. The absolute maximum temperatures in this area reached the value of 44.9°C in 2007. and the absolute minimum temperatures reached the value −22.9°C in 2017. The average annual amount of precipitation for the observed period from 2000-2020 ranged from the lowest 378.0 mm of water column and the highest 1039.6 mm of water column.

The average annual humidity is about 72%.

The average number of days with snow is 31.9, or 41.6 with snow cover. The largest number of days with fog is in the period from October to February, with the appearance of 44.7 days with fog during the year. The highest number of frosty days during the year occurs in the period from October to April, with the average number of frosty days occurring during the year being 84.2 days.

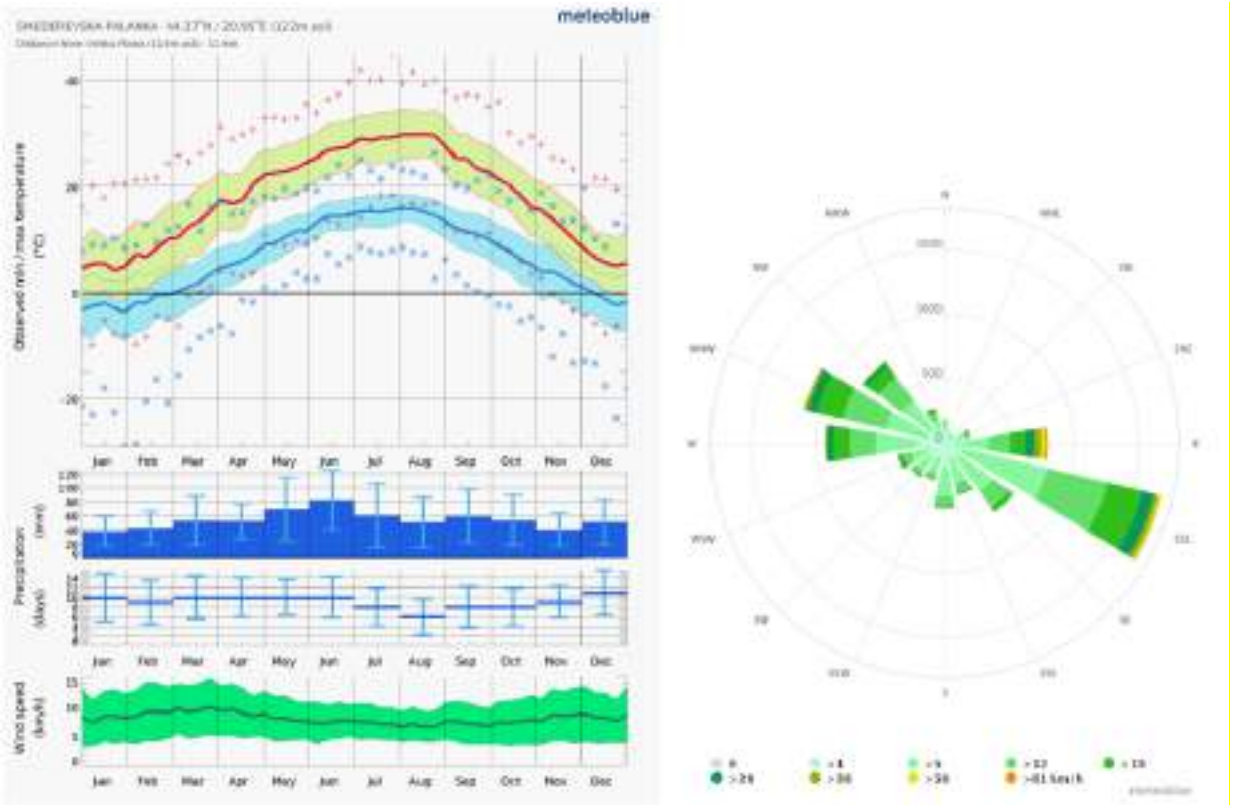


Figure 11. 20 years historical meteorological data – Smederevska Palanka – meteoblue

Station: Ćuprija

The lowest average annual air temperature for the observed period 2000-2020 is 5.2°C (2005), and the highest average annual temperature for the same period is 19.9°C (2019). The absolute maximum temperatures in this area reached the value of 44.6°C in 2007, and the absolute minimum temperatures reached the value of −24.3°C in 2012. The average annual amount of precipitation for the observed period from 2000-2020 ranged from 463.4mm to 910.0mm.

The average annual humidity is about 74%. The northwest wind is the most frequent. The second one is Košava (southeast wind). During the spring and summer, it blows like a dry and quite warm wind, with which precipitation rarely arrives even during the winter, although it brings dry snow and builds high debris, causing an increased feeling of cold. The third most important is the cold north wind.

The average number of days with snow is 34.4, or 46.8 with snow cover. The largest number of days with fog is in the period from October to February - 21.6 days during the year. The highest number of frost days during the year occurs in the period from October to April, with an average number of 91.1.

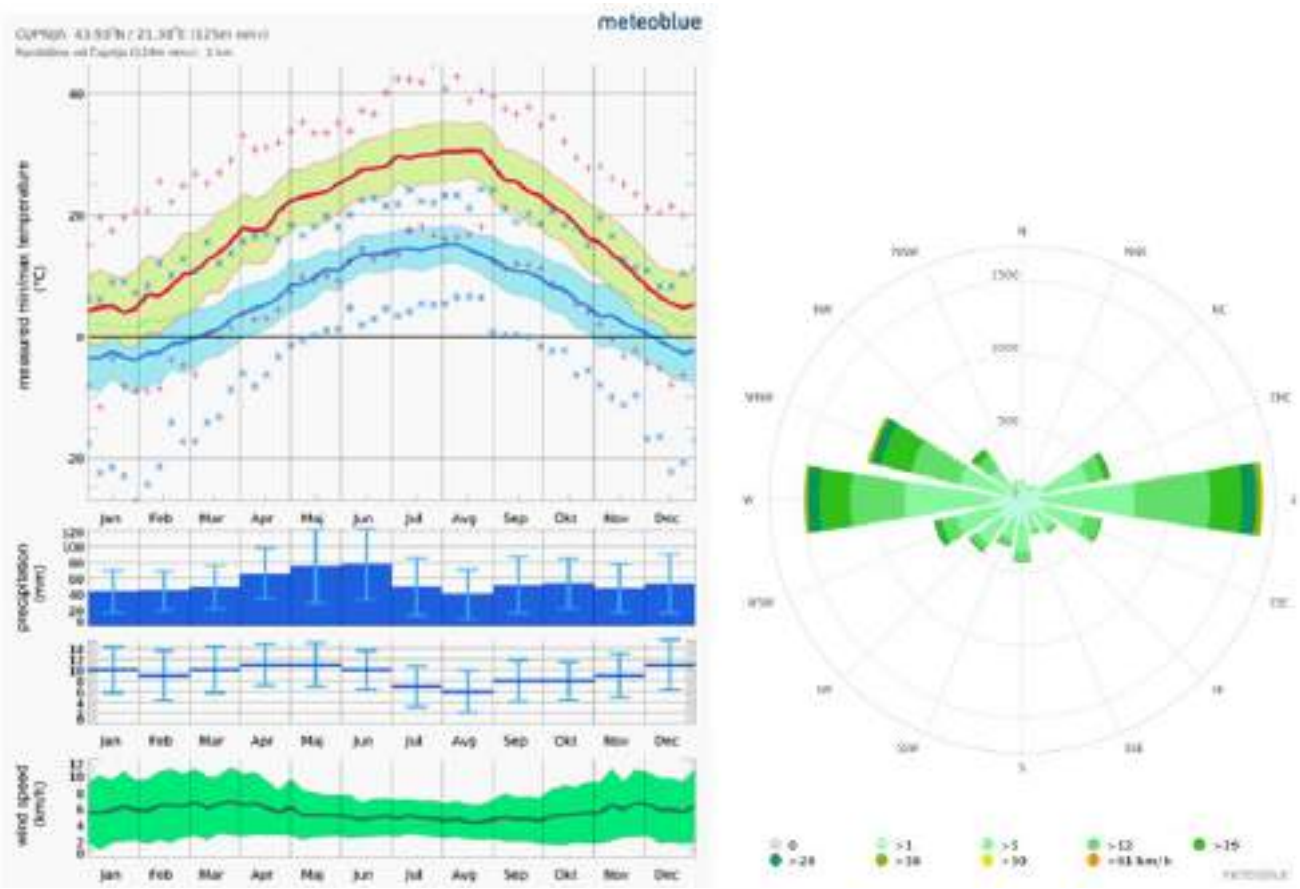


Figure 12. 20 years historical meteorological data – Ćuprija – meteoblue

Climate change

Serbia is positioned on the 155th (of 192) place in the World Risk Index Report 2022 (Institute for the Environment and Human security of the United Nations University) (111th place of 181 countries in 2021. report) with the World Risk Index of 1.84 (very low). Exposure is also very low and vulnerability is medium. Susceptibility is high, which is a change from the 2021 report, when it was assessed as medium. Positive aspect is that lack of adaptive capacities is low. ThinkHazard assesses that in Serbia risk of river floods, urban floods and wildfires is high, while earthquakes, landslides, water scarcity and extreme heat carry medium risk.

In line with the EIB document „Assessing climate change risks at the country level: the EIB scoring model"(EIB Working Paper 2021/03, May 2023), Serbia is, among other 180 countries, assessed for the climate physical and transitional risks. Physical risk covers the direct effect of climate change on assets and productivity. It can be acute if caused by extreme weather events and hazards such as floods, landslides, extreme temperatures, storms and hurricanes, droughts or wildfires, or chronic, if related to a more gradual effect of global warming, so to longer-term shifts in climate patterns, for instance global temperature change. Transition risk refers to the climate risk resulting from mitigation policies as economies move towards a greener, less polluting society. Serbia, along with Bosna& Herzegovina, has elevated levels of physical risks compared to most of Europe. Fact that climate risk scoring results in low physical risk is, having in mind information from „Disaster risk assessment in the Republic of Serbia"(Ministry of Internal Affairs, 2019), „Observed climate changes in Serbia and projections of the future climate based on different scenarios of future emissions" (UNDP, 2018) and Serbian NAP document, maybe understatement, both for acute and chronic risks. Again, mentioned high dependence on coal in Serbia will probably result in high transition risk compared to „elevated" scoring given in EIB scoring model.

Climate projections

Expected changes in temperatures and precipitation in Serbia-wide

The data presented in the document Observed climate changes in Serbia and projections of the future climate based on different scenarios of future emissions (UNDP, 2018) represent the most likely value from the set (ensemble) of solutions obtained using daily values of temperatures and precipitation from nine regional climate models that can be downloaded from the EURO-CORDEX database. The reference period with respect to which the change in future climatic conditions is analysed is 1986-2005 and the analysed future periods are: 2016-2035 (near future), 2046-2065 (mid-century) and 2081-2100 (end of century). The analyses were performed according to two selected greenhouse gas emission scenarios: RCP4.5 (stabilization scenario, which anticipates the stabilisation of emissions from 2040) and RCP8.5 (constant growth scenario), which are assumed to cover the likely range of possible future outcomes.

Over the future periods, an increase in temperature is expected in both scenarios compared to the 1986-2005 reference period. A more intense increase in temperature is anticipated according to RCP8.5, which is expected due to the more intense emissions of GHG and their impact on the energy balance in the climate system. In this scenario, the mean annual temperature, on average for the territory of Serbia, will increase by 1°C in the near future compared to the reference period, in the period attributed to the mid-21st century, it will rise to 2°C, and, by the end of the century, the average annual temperature will be higher by as much as 4.3°C compared to the reference period. The stabilisation scenario, RCP4.5, shows a slightly less increase in mean annual temperature by about 0.5°C compared to RCP8.5 during the first two analysed periods. In this scenario, by the end of the 21st century, the increase in the average annual temperature in the territory of Serbia will reach a much lower value than the value obtained under

the RCP8.5 scenario, which is 2°C higher than the value of the reference period. A spatial analysis of changes in temperatures over future periods indicates an increase in warming from north to south. The selected results obtained from the analysis of future temperature changes are shown in next figure.

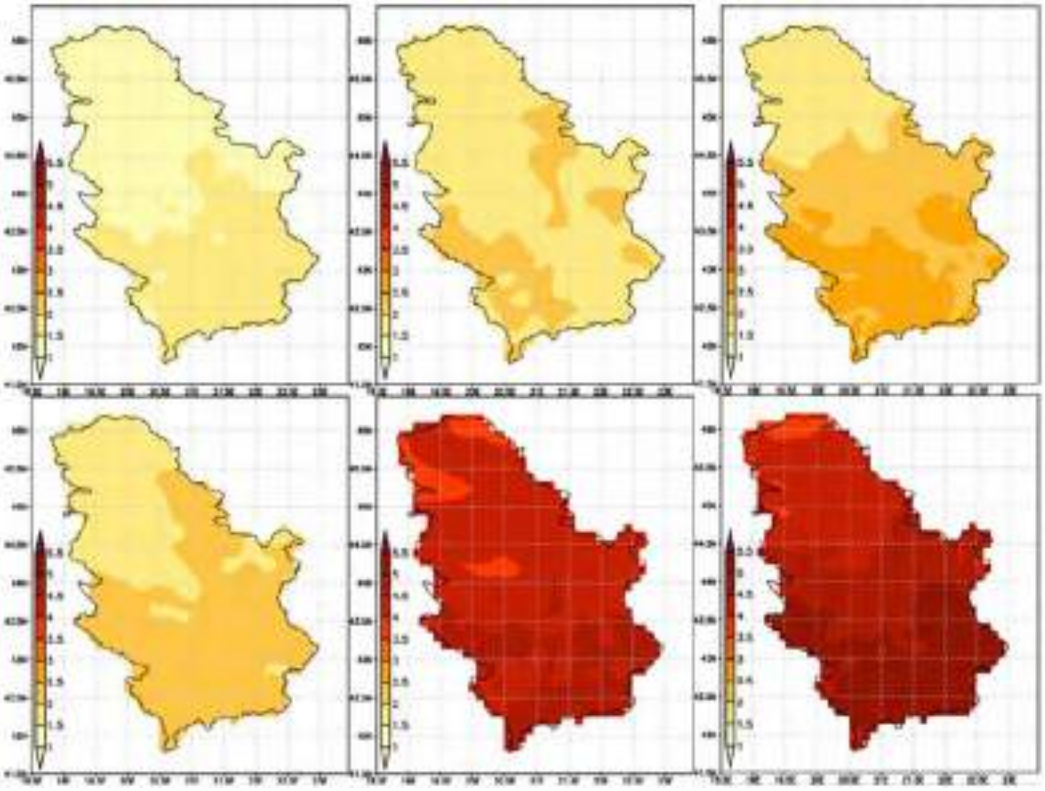


Figure 13. Anomaly of the mean annual temperature (ºC) for the 2046–2065 period (left panel) and for the 2081–2100 period (central panel) relative to the values for the 1986–2005 reference period; anomaly of the mean maximum temperature (ºC) obtained for the June–August 2081–2100 period compared to the maximum temperature values of the period for the 1986–2005 (right panel); the results obtained according to the RCP 8.5 scenario are shown in the bottom panels. Source: climate changes observed in Serbia and future climate projections based on different scenarios of future emissions

The number of frost and ice days will progressively decrease in the future due to the temperature increase. In the near future, there will be almost 10 days less frosty days on average annually in the territory of Serbia compared to the values of the 1986-2005 reference period.

The number of hot and tropical days will continue to increase in the future climate conditions. In the climate of the near future, relative to the reference period, changes indicate an extension of summer season conditions by almost

half a month, and in the second half of the 21st century, an extension of almost a month may occur, after which the change will stabilise according to the RCP4.5 scenario, while according to RCP8.5, by the end of the century, summer conditions will be on average nearly two months longer than during 1986-2005 period. By the end of the 21st century, the expected increase in the average annual number of tropical days will be in the range between 20, according to RCP4.5, up to almost 50 days in the RCP8.5 scenario.

Extreme heat waves in the future climate will occur on average at least 2-3 times a year, while during the 1986-2005 reference period these were very rare events. According to the RCP8.5 scenario, by the end of the 21st century, their average occurrence in the territory of Serbia will be as high as 7 occurrences during the year, and in some areas even more than 10.

The future changes in mean annual accumulated precipitation, averaged for the territory of Serbia, will not have a pronounced trend in future periods, as is the case with temperature. However, in the second half of the 21st century, according to the RCP8.5 scenario, the average annual precipitation will start to decrease and in the period at the end of the 21st century, central and especially southern Serbia will experience the largest precipitation decrease, even exceeding 10% compared to the 1986-2005 reference period. The spatial distribution of change in precipitation shows a declining trend towards the south. Precipitation decrease during the June-August period has already been observed and it will continue during future periods according to both scenarios. In the period at the end of the 21st century, according to RCP8.5, the average precipitation decrease in the territory of Serbia will be 20.5%, with a much larger decrease in the southern regions, of as much as 40%. The selected results obtained from the analysis of future precipitation changes are shown in next figure.

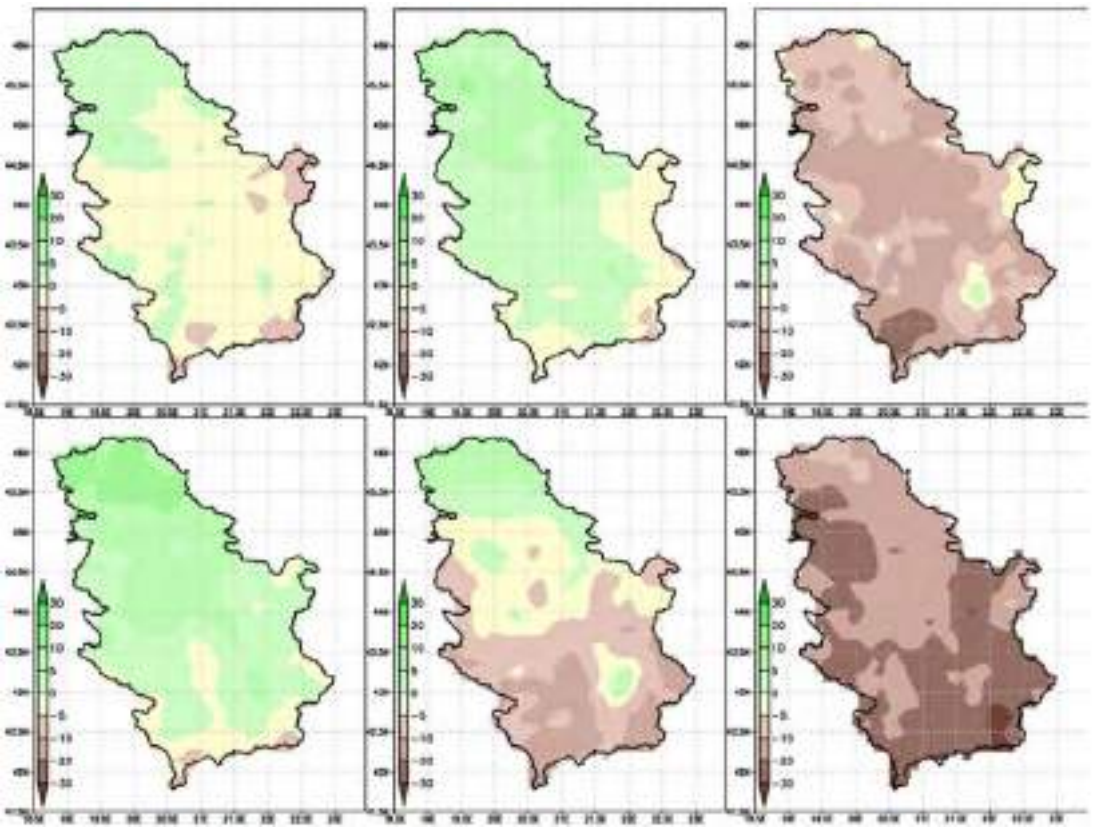


Figure 14. The anomaly of the mean annual precipitation sum (%) for the 2046–2065 period (left panel) and for the 2081–2100 period (central panel) relative to the values for the 1986–2005 reference period; anomaly of mean precipitation sum (%) for the June–August season for the 2081–2100 period compared to the mean seasonal value for the 1986–2005 period (right panel); the results obtained according to the RCP4.5 scenario are shown in the top panels, while the results obtained according to the RCP8.5 are shown in the bottom panels

21st century, according to RCP4.5, as much as 40% more precipitation, accumulated during year, will occur during the days when precipitation is extremely high compared to the precipitation events of the 1986-2005 reference period. According to RCP8.5, these accumulations will increase by 60%.

Site-specific climate projections

Under the “Advancing medium and long-term adaptation planning in the Republic of Serbia (NAP project) “, a Digital Climate Atlas of Serbia (web platform) has been established. Digital Climate Atlas of Serbia is based on the data provided by CORDEX the World Climate Research Programme initiative, Copernicus Climate Change Service that provides climate monitoring products for Europe based on surface in-situ observations by the Republic

Hydrometeorological Service of Serbia, as well as geospatial information system of the Republic of Serbia. Digital Climate Atlas considers two possible climate scenarios- RCP4.5 (mitigation measures employed) and RCP 8.5 (business as usual). Adopting a very conservative approach would mean using RCP8.5 in the 2071–2100 time frame. Nevertheless, having in mind climate commitments of the Republic of Serbia, RCP8.5 is used, but it is balanced by the adoption of near time horizon 2021-2040- infrastructural projects have a lifespan of 30+ years, usually extending well over half a century. RCP8.5 has a steeper curve in period up to 2040. and Serbia GHG emissions should peak until the middle of the century. Reference period 1986–2005 is used instead of 1971–2000 because it, by subjective opinion, better and more uniformly reflects changes of decade-by-decade climate impacts that are experienced in Serbia.

Projections of precipitation from EUROCORDEX show a less clear difference between RCP4.5 and RCP8.5 than are apparent for temperature changes (Extreme weather and climate in Europe- EEA, 2015).

Identified sensitive zones and receptors:

No sensitive zones and receptors have been identified.

Identified and reviewed existing baseline information relevant for the project:

Available meteorological data: Meteorological Yearbooks for the stations in Smederevska Palanka and Ćuprija, 2000-2020, Republic Hydrometeorological Service of Serbia; Meteoblue- https://www.meteoblue.com

Observed climate changes in Serbia and projections of the future climate based on different scenarios of future emissions (UNDP, 2018).

Second Biennial Update Report and Third National Communication to the UNFCCC, Ministry of environmental protection, 2022.

Identified significant gaps in existing baseline data relevant for the project:

No significant gaps in the existing baseline data have been identified.

Method of further ESIA baseline data collection and assessment:

A detailed analysis of the available meteorological data will be made to assess baseline climate conditions. Digital climate atlas will be used to better assess climate indices in different climate scenarios and time horizons. GHG emissions calculation will be made using industry standard methodologies, as technical guidance on the climate proofing of infrastructure in the period 2021-2027 (2021/C 373/01).

6.1.2. Geological characteristics

Along the route of the Velika Plana – Paraćin railway, the oldest lithological members are represented by Proterozoic gneisses and gneiss-micaschists (G), amphibole gneisses (Gam), muscovite micaschists (Sm) and migmatites (Mi), black quartzites (Qgr), micaschiste (Smb), amphibolites and amphibole shales (A), and dolomite marbles and marbles (Md). Postcambrian older Paleozoic is represented by granites (γ) and aplites (φ). On parts of the terrain built of gneisses and shales in the form of wire bodies resistant to weathering, there are register aplites (φ). Jurassic rocks are represented with limestones and dolomites.

Upper Miocene deposits are represented by Sarmatian (M_3^1) and Pannonian (M_3^2) sediments, where the lowest parts of the Sarmatian layers (M_3^1) are made up of weakly bound conglomerates with shale and quartz grains embedded in a carbonate-iron matrix, alternating with yellow sandy clays, siltstones, and conglomerates. In the higher parts of the Sarmatian series (M_3^1) there are siltstones, porous sandy limestones, fine-grained marly sandstones, sandy clays, calcareous sandstones, lenses of conglomerate, less often marly limestones.

The largest parts of the Sarmatian series (M_3^1) are made up of silty-sandy clays, clayey-carbonate siltstones, yellow sands, gravels, carbonaceous clays with layers of coal and less often lenses of sandy limestones. Three coal-bearing layers have been registered, with the lowest layer having a thickness of 0.30–3.60 m, the middle layer having a thickness of 1.20–4 m, while the highest coal layer is economically unprofitable and of variable thickness. The occurrences of coal bearing indicate brackish facies, formation of shoals, which caused the occurrence of coal bearing during swampy periods. The thickness of the Sarmatian series is in the interval of 300–350 m. Caspibrachic Pannonian sediments (M_3^2), about 200 m thick, are represented by clays, siltstone sands, quartz sandstones, sands and less often gray clays [16]. The area along the railway line also includes miocene-pliocene (M,Pl) deposits represented by sands, silts and clays.

Within the Quaternary deposits, a fluvial and slope sequence is registered, within which Pleistocene terrace sediments (t_2, t_1) represented with sands, gravels, siltstone clays and siltstones, as equivalents of the older flood facies; and Holocene deposits represented by deluvial drapes (d), floodplain cones (pr), „mrtvaja“ facies (am), floodplain facies (ap) and bed facies (a). Plavin cones (pr) are built by sands and much less often gravels. Deluvial deposits (dr) are made up of coarse-grained sands and finer gravels, while on the Neogene terrain, deluvial formations (dr) are represented by silts, sands and siltstone sediments. In the composition of alluvium (a), with

[16] *Vujisić, T., Kalenić, M., Navala, M., & Lončarević, Č. (1977b). Interpreter for the Lapovo paper, L 34-139. Belgrade: Federal Geological Institute.*

uneven granulation and change of grains, and a thickness of up to over 20 m, there is a gravelly fraction. Floodplain sediments (ap) consist of clays, sandy loams, siltstone-clay sands, siltstone-sands and siltstone clays. Fine marsh sediments, heterogeneous sandy-clay formations, clayey silts, silty clays, silty sands are deposited within the „mrtvaja“ facies (am) [17]. Figure 15 shows the geological map of an area along the route of the railway on the section Velika Plana–Paraćin.

[17] *Vujisić et al., 1977b*

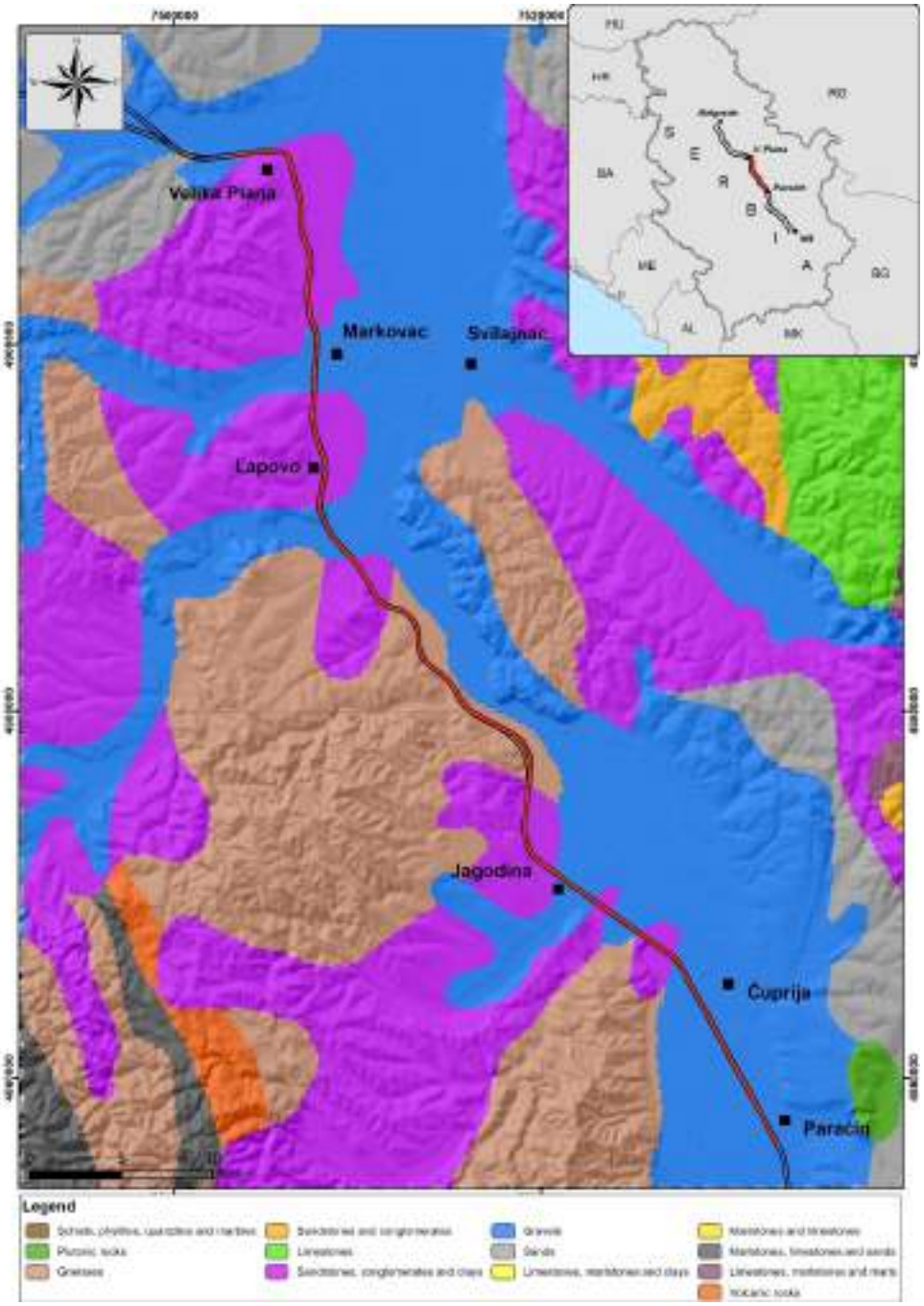


Figure 15. Geological map of project area

European landslide susceptibility ELSUS V2 map shows the landslide susceptibility zonation for individual climate-physiographic zones across Europe at a spatial resolution of 200 × 200 m (Figure 16). Landslide risk is not significant along the railway route, except in the area of Bagrdan where landslide risk ranges from medium to high.

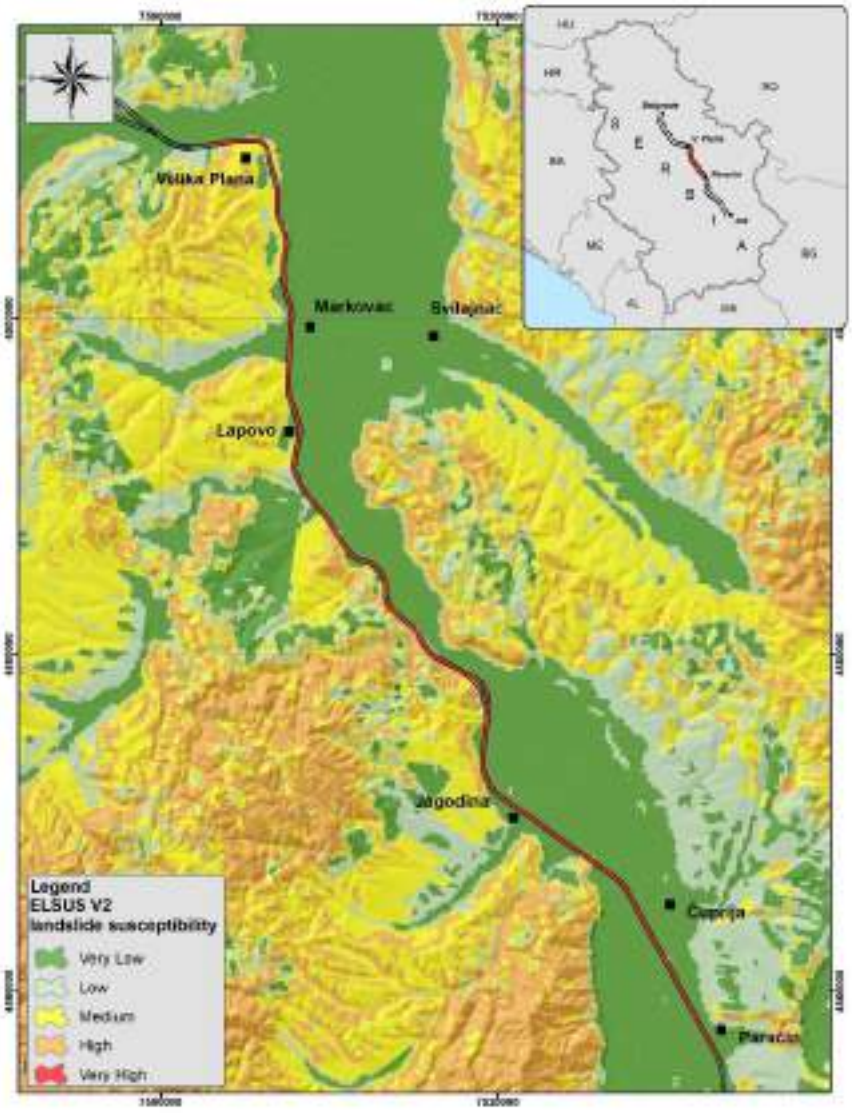


Figure 16. ELSUS V2 landslide susceptibility map for the project area

The spatial Plan of the Republic of Serbia 2021–2035 in „thematic map 19" gives overview of natural hazards (Figure 17). The area along the railway line could be affected by earthquakes (seismic hazard VIII MSC). ThinkHazard assesses that in Serbia risk of river floods (areas along the Great Morava, Lepenica river, and especially municipality

of Ćuprija (Jagodina – Ćuprija)), urban floods and wildfires is high, while earthquakes, landslides, water scarcity and extreme heat carry medium risk.

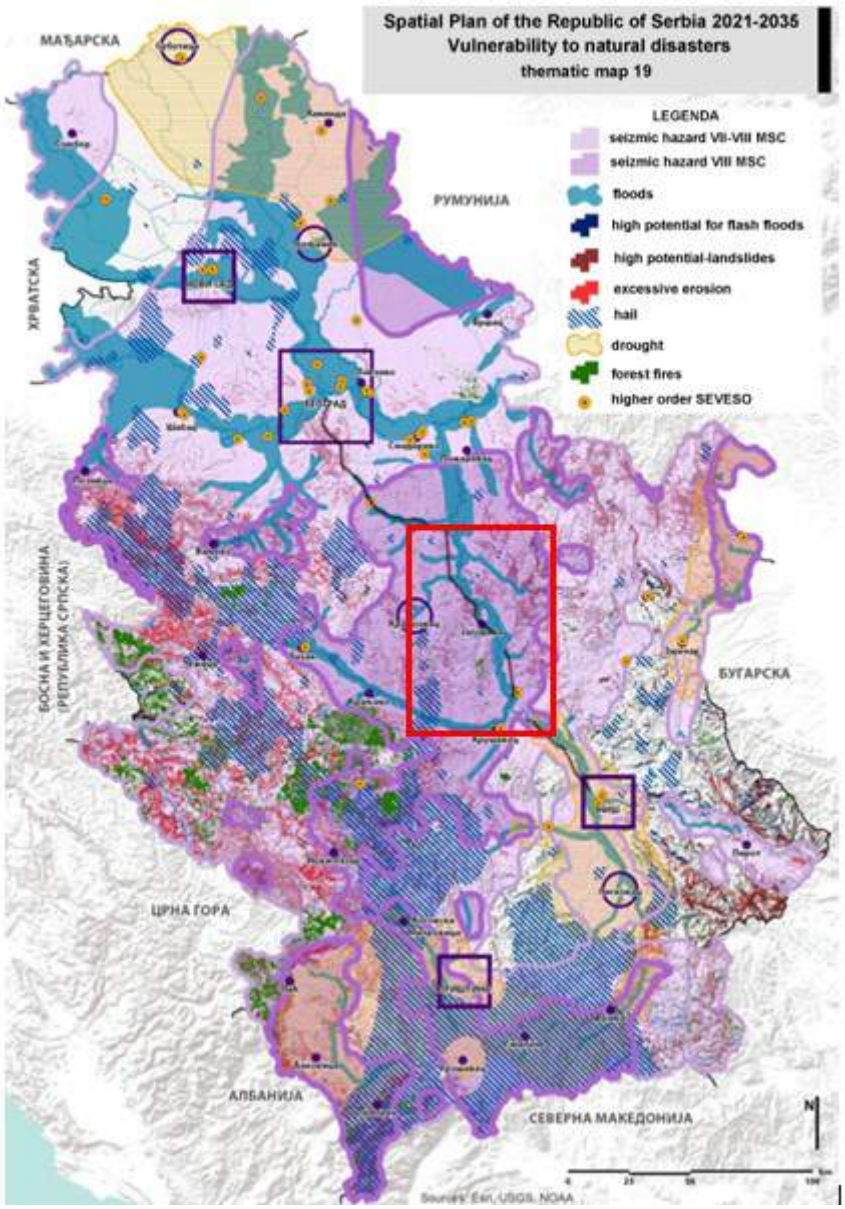


Figure 17. Map of natural hazards in Serbia (spatial plan of Republic of Serbia 2021–2035)

Identified sensitive zones and receptors:

The route from Velika Plana to Paraćin could be affected by earthquakes (seismic hazard VIII MSC).

Identified and reviewed existing baseline information relevant for the project:

Basic geological maps, sheet Lapovo (map scale 1:100 000), Engineering geological map of Serbia (map scale 1:300 000).

Identified significant gaps in existing baseline data relevant for the project:

Data on the geotechnical characteristics of the terrain are missing, detailed research and preparation of the relevant documentation is in progress and the obtained data will be presented within the ESIA.

Method of further ESIA baseline data collection and assessment:

Further assessment should include the results from assessment of available geological maps and explanatory notes (from Geological Survey of Serbia), available engineering geological maps, analysis of digital model of terrain (DMT), available satellite imagery, obtained geotechnical data, as well as other available literary sources. Further data collection should include data acquired from the field visit.

6.1.3. Soil characteristics

In the territory of the Republic of Serbia, including in the Project area itself, there are several types of land. Figure 18 shows the soil map along the railway line. The Project area is mainly characterized by fluvial and fluvioglacial soils. The main soil types are alluvium, cultivated alluvium and alluvial meadow soil.

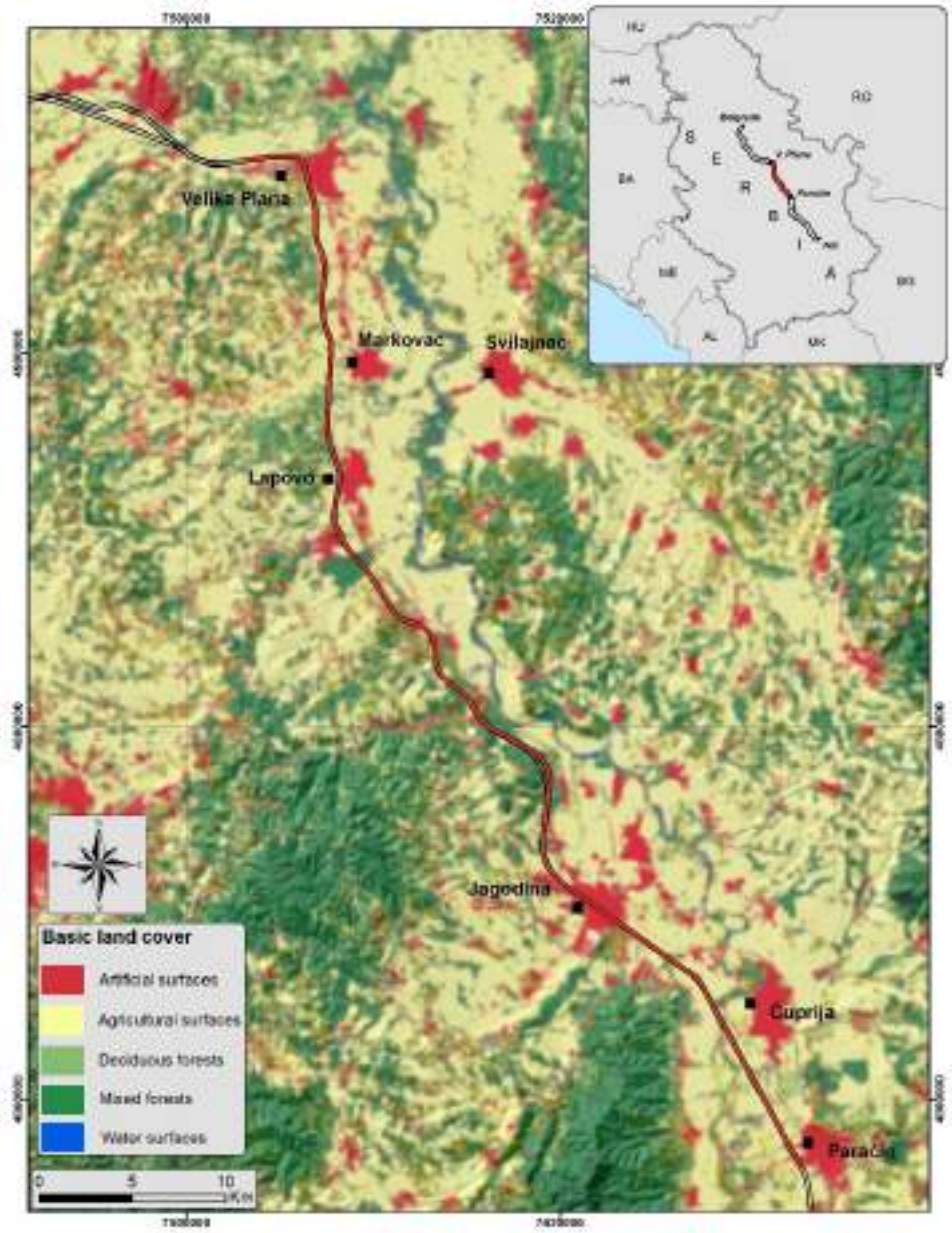


Figure 18. Basic land cover [18]

[18] *Republic Geodetic Institute of Serbia, https://a3.geosrbija.rs*

Many soil types in the Project area are the result of geological basis, richness of flora and fauna, climatic and hydrological diversity, as well as human activities. The railway route passes through the alluvial deposits (alluvial meadow soils), as a very heterogeneous group of soils, which are formed as fresh sediment in the Great Morava River field. By its nature, this sediment can vary from gravel to sand to the finest clay particles. The sedimentation conditions change both during the year and during the longer evolution of the river valley. Alluviums can be very fertile soil of high quality for agriculture and are characteristic of habitats of natural willow and poplar forests, or pedicle flood forests. The railway route also passes through loess terraces and lake terraces below 500 m above sea level. The production value of this soil varies depending on the humus content, depth, and mechanical composition of the substrate. The best are groves on wood and tertiary sediments, which are excellent agricultural land, especially for fruit growing and viticulture, while groves on basic eruptive rocks are good forest lands and are less suitable for agriculture.

According to the data of the Environmental Protection Agency of the Republic of Serbia, the Ministry of Environmental Protection, soil erosion is one of the main processes of soil degradation and the cause of the deterioration of soil quality, and water erosion prevails in the coastal parts of large rivers, central and hilly-mountainous areas [19]. Erosion is particularly pronounced in the coastal part of the Great Morava River, where in the period of high waters coast erodes to case changes in morphology of the riverbed. This phenomenon is partially mitigated by the flood protection structure and landscaping of the coast.

Soil quality is also affected by uncontrolled and inadequate waste disposal and pollution within industrial complexes. Monitoring of the degree of soil endangerment from chemical pollution in urban areas is carried out by cities and municipalities as part of local monitoring.

Identified sensitive zones and receptors:

Alluvial and agricultural land along the watercourses due to risk of floods, and the soil crossed by the railway line.

Locations subject to erosion, coastal part of Great Morava River.

[19] *Status Report of land in the Republic of Serbia for 2016-2017, www.sepa.gov.rs*

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Identified and reviewed existing baseline information relevant for the project:

Republic Geodetic Institute of Serbia, https://a3.geosrbija.rs

Status Report of land in the Republic of Serbia for 2016-2017, www.sepa.gov.rs

Identified significant gaps in existing baseline data relevant for the project:

More detailed data on agricultural land and production and data on soil quality is missing.

Soil map of Republic of Serbia

Method of further ESIA baseline data collection and assessment:

Further assessment should include the results of the soil measurement of the soil quality in Velika Plana, Lapovo, Miloševo, Bagrdan, Lanište, Jagodina and in the area between Jagodina and Gilje, data provided by Republic Institute of Statistics. Detailed analysis of the orthophoto map of the Republic of Serbia.

6.1.4. Agricultural land

The project area is mainly covered by agricultural land (arable fields, sown crops and fields), followed by forests. The Project area is mainly flat-agricultural and mountainous area (orchards and vineyards) and belongs to the alluvial soil. The alluvial deposits in the Great Morava valleys have great agricultural value and belong to the second class of agricultural land. Their morphological, physical, and chemical properties provide favourable conditions for the development of agricultural crops. The railway route, especially on the Velika Plana-Paraćin section, is surrounded by gardens and courtyards, and the woody vegetation is predominantly represented by different types of fruit and nuts, while coniferous species are mainly represented at the railway stations. Agricultural activities also have a great influence on the vegetation along watercourses.

The total area under agricultural land from the CORINE map amounts to 47.71 km^2. On Figure 19 presented area refers to the buffer zone of 500 m around the Velika Plana-Paraćin railway line, and includes the following zones:

- Code 211 - Non-irrigated arable land = 19.65 km^2
- Code 221 - Vineyards = 0.13 km^2
- Code 242 - Complex cultivation patterns = 23.78 km^2
- Code 243 - Land principally occupied by agriculture with significant areas of natural vegetation = 4.14 km^2

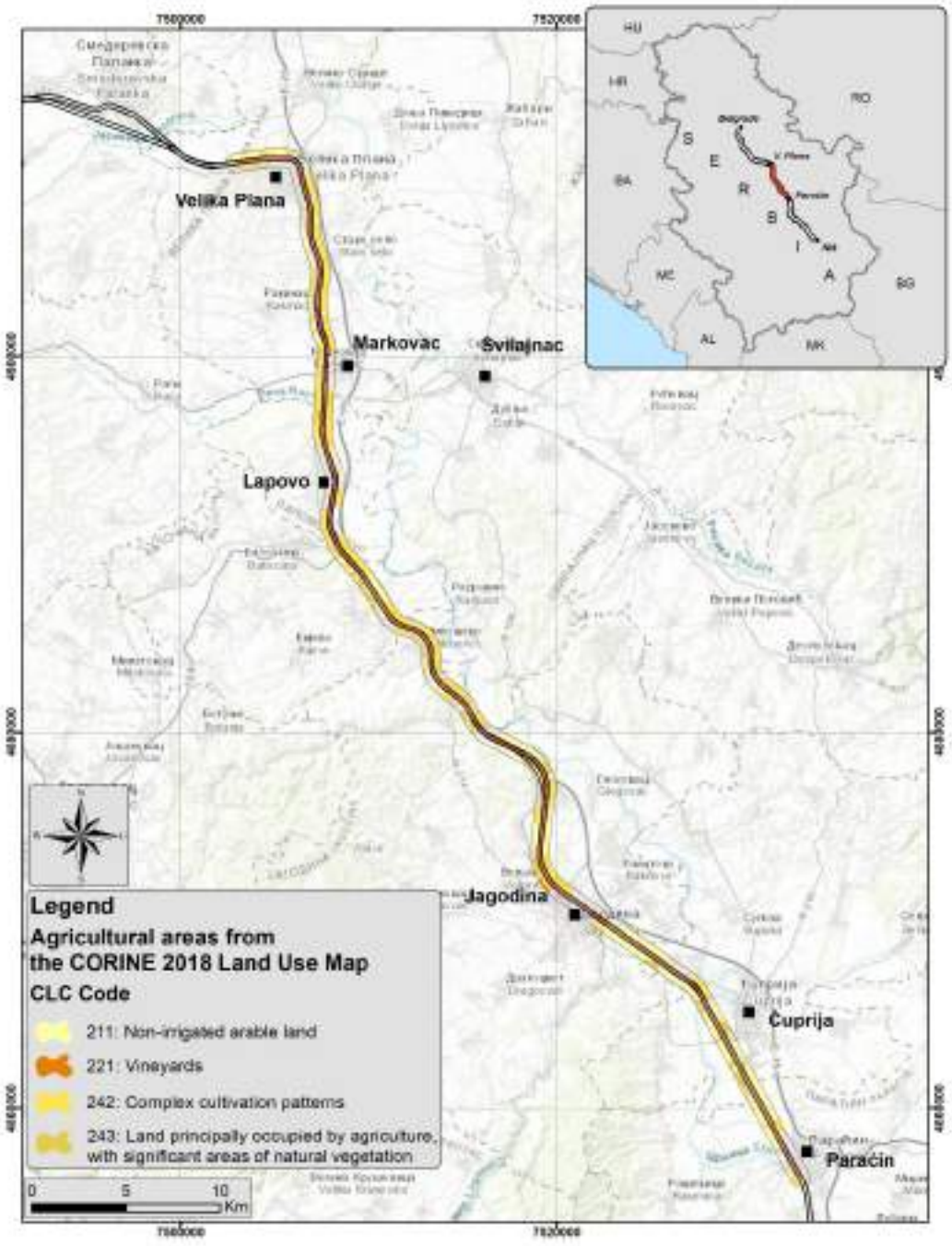


Figure 19. Agricultural areas from the CORINE 2018 land use map

Identified sensitive zones and receptors:

Complex cultivated areas in the part along the Great Morava (vicinity of Velika Plana, Lapovo, Miloševo, Bagrdan, Lanište, Jagodina, and area between Jagodina and Gilje are represented as sensitive zones).

Identified and reviewed existing baseline information relevant for the project:

Corine Land Cover (CLC) 2018.

Identified significant gaps in existing baseline data relevant for the project:

No precise data on the crops grown in the zone of interest is available. Data on the suitability of agricultural land for cultivation primarily in a valuable agricultural area (Great Morava).

Method of further ESIA baseline data collection and assessment:

Data requested and provided by Republic Institute of Statistics will be used. Detailed analysis of the orthophoto map and available satellite images of the subject project area will be performed to determine location of agricultural land and existing types of agricultural crops. Data on the suitability of agricultural land for cultivation will be used to determine the area of valuable arable agricultural land.

6.1.5. Groundwaters

From the aspect of hydrogeological potential, there is a particularly significant aquifer formed in the alluvial deposits of Great Morava, representing an extremely important resource for water supply to the population. The first aquifer was formed in gravel-sand deposits of high permeability, it is about 20 m thick and is protected by clay-dust deposits about 5 m thick, with groundwater bodies registered on the right and left side of Velika Morava [20]. In the profile of alluvial deposits, the basic water-bearing horizon is spread in gravelly and gravelly-sandy sediments, where sands were deposited above the gravelly horizon, while clayey-dusty and loamy sediments were deposited in the near-surface parts of the terrain. In some localities, clayey sands are spread in the subsoil of the gravel series [21].

[20] *Boreli-Zdravković, Đ., & Miljević, N. (2012). Chapter 4.8: Groundwater and nitrogen. In: Dimkić, M., Brauch H. J., & Kavanaugh, M. (Ed.), Groundwater management in large river basins (pp.388-429). Belgrade: Jaroslav Černi Institute for Water Management.*

[21] *Perović, M. (2019). Assessment of the influence and regional specificity of hydrogeochemical conditions on the transformation of nitrogenous compounds in groundwater (doctoral dissertation). Novi Sad: University of Novi Sad, Faculty of Technical Sciences.*

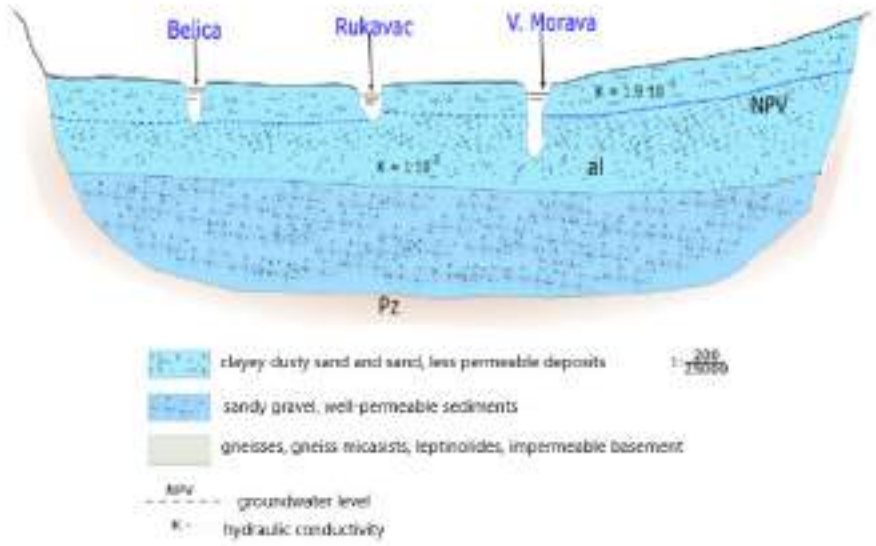


Figure 20. Schematized hydrogeological profile across the Great Morava near Paraćin [22]

In this area of the terrain the following hydrogeological units are distinguished:

- – **Intergranular type, highly yielding aquifers**: Alluvium: gravels and sands (al);
- – **Intergranular type, low yielding aquifers**: flood facies, subsoils and sandy soils (ap); Proluvium (pr); Deluvium (d); Deluvial-proluvial curtains (dpr); Lower river terrace: gravel and sand (t1); Higher river terrace (t2); Lake sediments (j); Sands, clayey sands and sandstones; sandy marls ($^2M_3^2$); Sands, clays, quartz sandstones and gravels (M_3^2); Conglomerates, sands, sandstones and clays; sandy limestones (M_3^1); Sandy and gravelly clays and conglomerates (Belica sediments) (M_2^3); Clays, sands, marls and limestones (M_2^2); Sandstones, bituminous clays and coal (M_1); sands, silts and clays (M,Pl);
- – **Intensively karstified, highly transmissive terrains**: limestones and dolomites (J_3);
- **– Very low yielding terrains:** Facies "mrtvaja": sandy soils and subsoils (am); Amphibolites and amphibole shales (A); mikachists (Smb); Black quartzites (Qgr); Migmatites (Mi); Muscovite micaschists (Sm); Amphibole gneisses (Gam); Gneisses and gneiss-micaschists (G); Dolomite marbles and marbles (Md); Micaschists and leptinolites (Sbm).

[22] *Stojadinović, D. (1992) Hydrogeological characteristics of alluvial deposits and rims of Great Morava from the perspective of the possibility of using spring water (Doctoral dissertation). Belgrade: University of Belgrade, Faculty of Mining and Geology.*

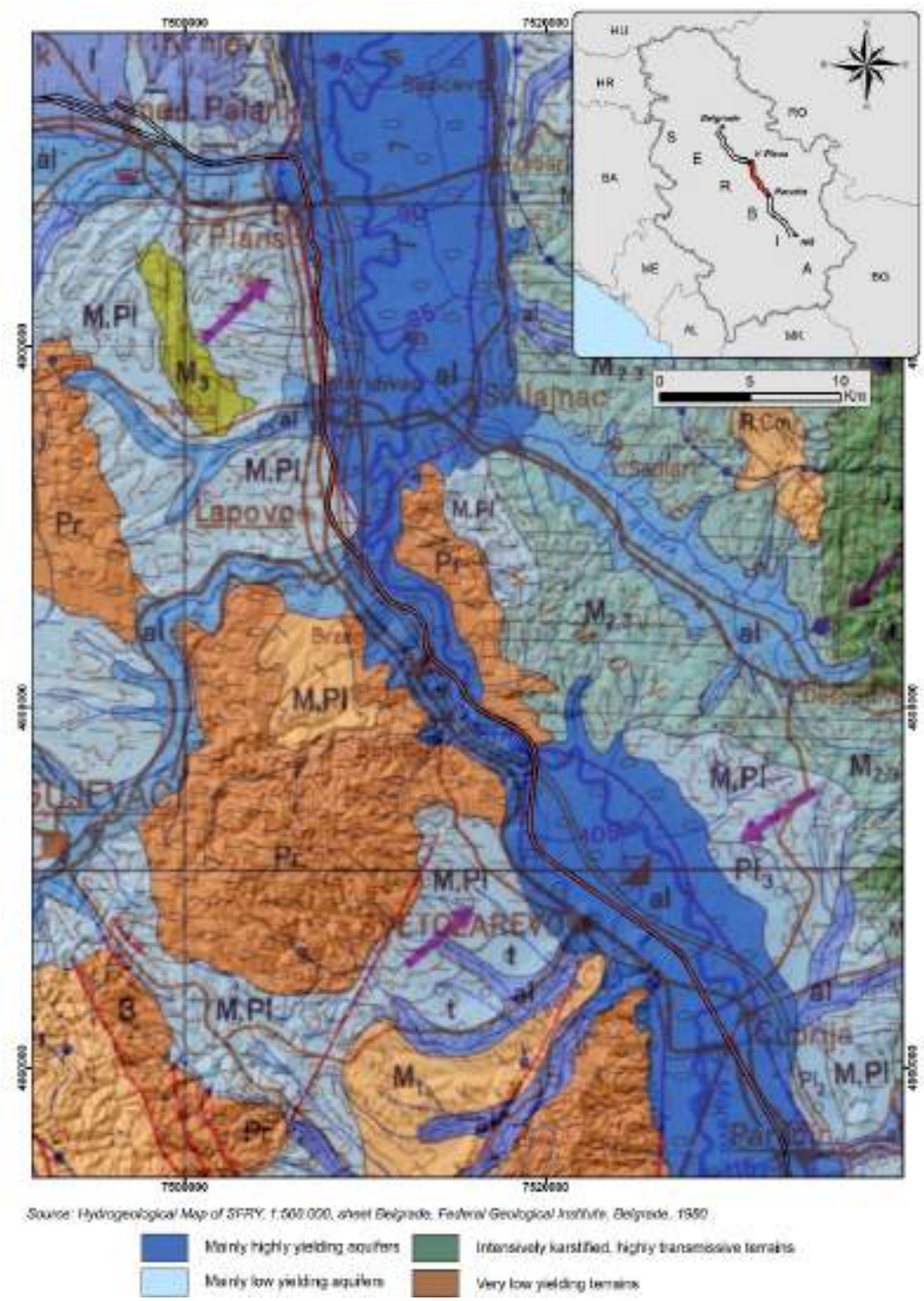


Figure 21. Hydrogeological map of area along the route of the railway of the section Velika Plana – Paracin

The conditions for recharging the alluvial waters of the Great Morava and the lower flows of its tributaries are favourable, which is manifested by a large catchment area, significantly larger in relation to the distribution of the headwaters, and by recharge due to atmospheric sediments, especially in conditions where sandy-gravel deposits are a direct catchment on the surface of the field. Also, recharge takes place at the expense of groundwater coming out of the subsoil or around the aquifer. Unfavourable recharge conditions are manifested by the silting of the riverbed, the water-impermeable layer of the riverbed, the unevenness in the discharge of precipitation, etc. The outflow of groundwaters occurs within surface streams, which in the period of low water represent the main zone of outflow, while in the period of high water in the coastal parts of the aquifer the process of infiltration of river water occurs, which can also cause flooding of the terrain. The depth to the groundwater level is usually less than 3 m [23].

From the aspect of physico-chemical composition, groundwater from alluvial deposits are without smell, taste and color, with moderate to pronounced hardness in the range of 5.5–30 °dH and a pH value in the interval of 6–7.5, while in the puddle conditions can acquire the appropriate taste, smell and color, when the groundwater level is located in poorly water-bearing alluvial deposits. Mineralization values are below 1 g/L [24]. However, due to pronounced agricultural pressures and uncontrolled discharge of wastewater, elevated nitrate concentrations were recorded in the alluvial waters of Great Morava [25]. Changes in the alluvial groundwater regime are the result of external factors, primarily the surface water regime and the rainfall regime, with level fluctuations being the most dynamic element of the regime, so that the groundwater and surface water levels coincide, bearing in mind that the fluctuation amplitudes of the groundwater levels are significantly slower [26].

In the period from 1985–2010 year, the drop in the water level of the Great Morava, at the same time the lowering of the underground water level, amounted to about 3–4 m, and was the result of a change in the geometry of the river bed of the Great Morava, which occurred as a consequence of the exploitation of gravel and the shortening of the river course by cutting meanders, and reducing the average flow by 5–10% [27]. Seasonal changes are also reflected in the physico-chemical properties of groundwater, where the temperature of spring water is within the range of 10–14°C.

In the territory of central Serbia, the largest part of groundwater reserves is in the areas of alluvial sources, primarily in the Great Morava valley. The hydraulic conductivity characteristics of the sandy-gravel layer along the entire length of the alluvium are favourable, and the springs for water supply are mainly formed in lower Pomoravlje. The use of

[23] *Filipović, B., Krunić, O., & Lazić, M. (2005). Regional hydrogeology of Serbia. Belgrade: University of Belgrade, Faculty of Mining and Geology*

[24] *Filipović et al., 2005*

[25] *Vollhofer, O., Dimkić, M., Stevanović, Z., & Đurić, D. (2012). Chapter 2.10: Groundwater management in individual countries. In: Dimkić, M., Brauch, H. J., & Kavanaugh, M. (Ed.), Groundwater Management in Large River Basins (pp.87-109). Belgrade: Jaroslav Černi Institute for Water Management.*

[26] *Filipović et al., 2005*

[27] *Perović, 2019*

groundwater is organized mainly through dug wells for the needs of individual households, while larger quantities are used for organized water supply from the sandy sediments of the Neogene. The catchment area of Great Morava is rich in occurrences of mineral and thermal waters, which is conditioned by the diverse lithostratigraphic composition and complex structural relationships, and the Great Morava Neogene basin abounds in significant hydrogeothermal potentials.

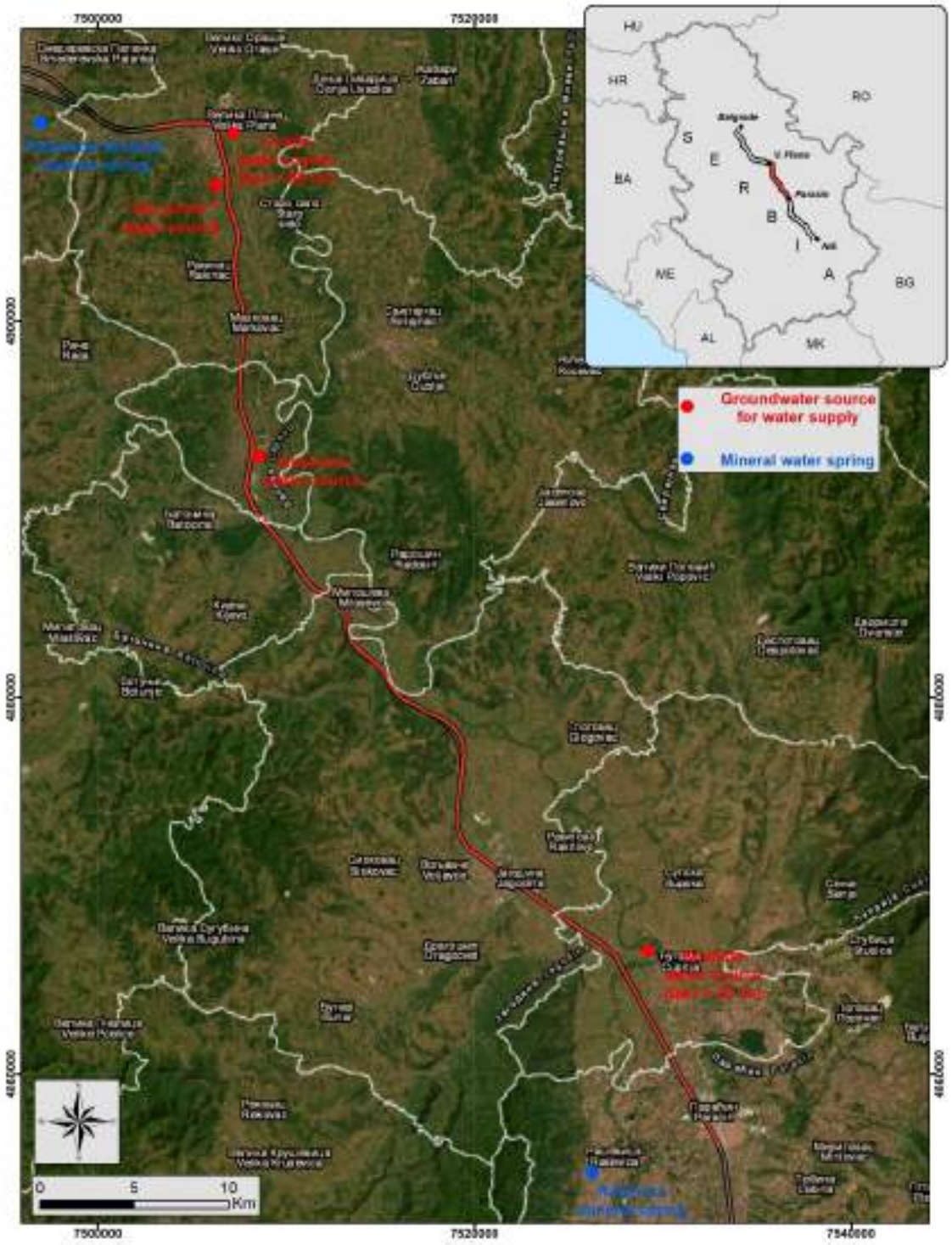


Figure 22. Locations of significant groundwater sources and springs

The water **source of "Livade"** for the water supply needs of the Velika Plana was formed on the rim of the alluvium, near the city itself. 16 wells were drilled at this location, of which 4 wells are in operation. Among the springs located around the corridor route, the Batočina and Kragujevac Brzan springs standout - 300 l/s.

On the territory of the municipality of Batočina, in the village of Jasik in the alluvial plain of the middle course of the Great Morava, there is a spring for water supply. Aquifer was formed within the alluvial deposits of Great Morava, that is, unbound sediments of intergranular porosity. Replenishment of the river takes place, to the greatest extent, by infiltration of surface waters of Great Morava, and significantly less by infiltration of atmospheric precipitation. In addition to the natural outflow into the course of the Great Morava, drainage also takes place artificially, through the exploitation wells of the "**Jasik" spring,** as well as wells with horizontal drains, of the Brzan-Morava spring. The Jasik source has 2 exploitation wells, as well as a collection tank with a pressure pipeline.

The spring "Strelište" was formed on the left bank of the Great Morava River for the water supply of Ćuprija. The border of the immediate protection zone of the "Strelište" source in the meander of the Great Morava River covers an area of 7.5 ha. The border of the narrow zone of sanitary protection covers an area of 39.70 ha.

The groundwater source "Strelište" is, due to its specific location and environment, exposed to the potential danger of groundwater pollution and deterioration of its quality. Groundwater pollution can occur at the source itself and on surfaces used by social or private work organizations located in the zone surrounding the source zone. The main protection against groundwater pollution from the surface of the terrain is represented by the surface layer, which is less permeable. In the wider zone of the source, the situation is similar in terms of the thickness of the underlying layer. Several work organizations representing potential polluters are in the wider zone of the source: gas stations, residential area, agricultural production. The current capacity is 38 l/s. Estimated maximum capacity is 80 l/s.

In the area of the railway route, there aresprings that capture the waters of the Neogene subartesque outcrops, for water supply to the population and for industrial needs. Among the larger springs, the "**Ribare" spring** for the water supply of Jagodina stands out. The Neogene aquifer is hydraulically connected to the alluvial aquifer, and it is partially fed through alluvial deposits, so it is therefore more susceptible to contamination from the surface of the terrain or via surface water. Exploitation reserves of groundwater of this source are estimated at 370 l/s, with the current achieved capacity of 250 l/s. The yield of water catchment facilities, wells is about 40 l/s.

The **source of the company "HP kablovi Jagodina**" is in the central part of the Paracin-Jagodina basin, directly next to the Great Morava, on its left valley side. At this source, exploitation is carried out from a complex aquifer, which includes shallower alluvial deposits and a Neogene subartesque aquifer. The groundwater of this source is used to supply the factory during the technological process of production, as well as for sanitary purposes. The

exploitation of groundwaters varies depending on the production process, and from 8 wells, 120 l/s to 150 l/s are captured. The exploitation capacity of this outlet is estimated at around 250 l/s, with the use of artificial recharge.

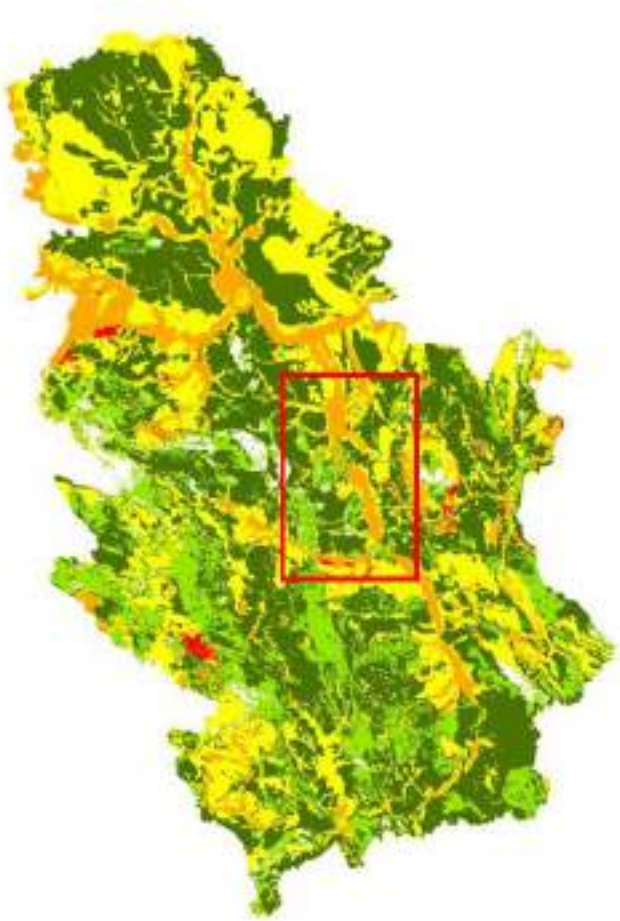
In the wider area of the Project, there are springs of mineral water, such as the one on the southeastern edge of Smederevska Palanka, known as "Palanački kiseljak". The water is clear, odorless, with a significant amount of gas. The water temperature is 12 °C and can vary up to 14 °C.

About 7 km west of Paraćin, in the village of Raševica, at an altitude of 170 m, there is a source of cold mineralized water with a yield of 0.08 L/s, temperature of 16.5°C, HCO_3^- - Na^+ type, total mineralization of 450 mg/l and pH values of 9.0, with a high F^- content of 12.0 mg/l and low values of radioactive elements: Rn – 20.3 Bq/l, Ra – 0.06 Bq/l and U – 0.0004 mg/l. Also, around Paraćin, up to a depth of 304 m, exploratory drilling registered five water-bearing horizons in lithofacies of sandy and sandy-gravelly composition. From aquifers at depths of 229–260 m and 272–282 m, thermal water with a temperature of 22°C was obtained at a rate of 10–12 l/s [28].

According to the hydrogeological characteristics of the area in question, the degree of threat to groundwater also varies. The least threatened areas are represented by pre-Paleozoic and Paleozoic formations, except for those areas where the hydrogeological complex was formed. Partially threatened areas represent less permeable Neogene and quaternary deposits, while extremely threatened areas represent alluvial and terrace deposits. Areas located in the source area, as well as areas in the zone of influence of surface watercourses, are particularly important within the endangered areas.

Maps of groundwater vulnerability from pollution show a view of the ability of the subsurface environment to protect groundwater, primarily its quality. The main purpose of creating a map of groundwater vulnerability is the classification and separation of areas with different levels of groundwater vulnerability due to pollution. Separated areas, i.e., vulnerability classes, are shown in different colours, symbolizing different levels of vulnerability. On Figure 23 is presented a groundwater vulnerability map of Serbia, from which it can be seen that the territory of the railway route is in the zone of high to medium vulnerability.

[28] *Protić, D. (1995). Mineral and thermal waters of Serbia. Belgrade: Geoinstitut.*



Vulnerability of groundwaters	Vulnerability index
Very low level of threat	< 30
Low level of threat	31–40
Medium level of threat	41–55
Medium high level of threat	55–70
High level of threat	71–80
Very high level of threat	> 81

Figure 23. Groundwater Vulnerability Map [29]

[29] *Milanović, S., Stevanović, Z., Đurić, D., Petrović, T., Milovanović, M., Mandić, M. (2011). Project: Monitoring of groundwater resources Srbije. Subproject: Creation of a map of the risk of groundwater in Serbia. https://geoliss.mre.gov.rs/prez/KartaUgrPodVodWeb/index.html*

Elements used in the creation of the groundwater vulnerability map of Serbia are influence of terrain slope on infiltration, the influence of soil type and vegetation cover on the threat of groundwater, the thickness of the upper layer, aquifer (i.e. geological hydrogeological characteristics of the terrain), level of groundwater, i.e. to the depth of the groundwater level).

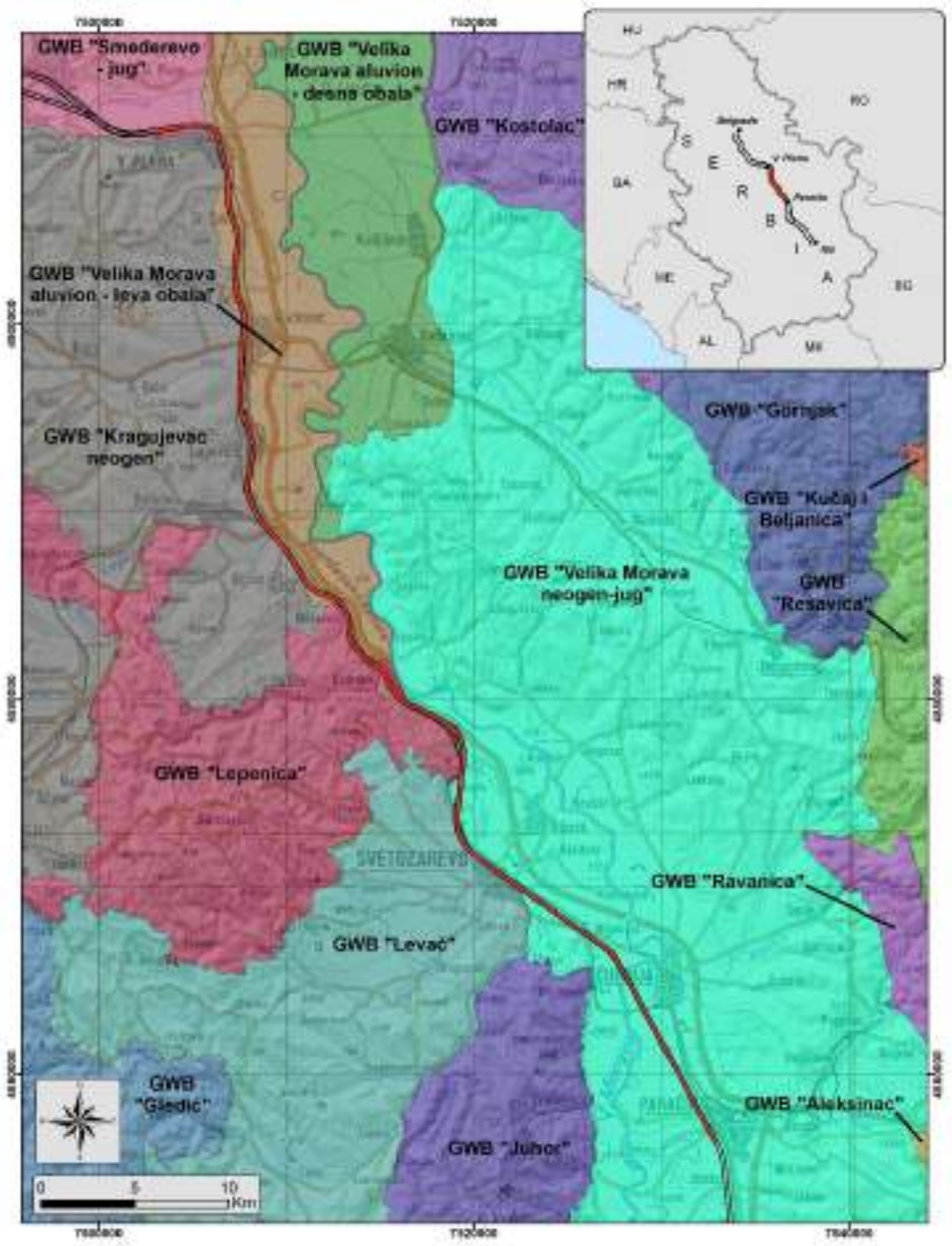


Figure 24. Groundwater bodies in the research area

The groundwater level depends on the hydrological regime of the Great Morava River, but also on the amount and regime of precipitation in the research area. The influence of the Great Morava regime weakens with distance from the river, and then the climatic factor prevails. Thus, the level of groundwaters formed in the sand-gravel layers is directly related to the waters of Great Morava. During intense rains and during the period of melting of the snow cover, the water level in the river rises sharply, and in this period the recharge of spring water is intensified.

The hydrogeological characteristics of the alluvial aquifer were considered on the basis of observation wells, within the framework of the continuous monitoring system by the Republic Hydrometeorological Institute of Serbia in period 2017–2021 year. Below are presented groundwater levels on the following profiles: Velika Plana – Žabari, Markovac – Svilajnac, Bukovče – Glogovac, Jovac, Paraćin – Vrapce.

Table 11. Groundwater level on profile Velika Plana – Zabari PL-142 (left profile) [30]

Groundwater Level H_{avg} (cm)													Yearly Value	
Velika Plana-Žabari	Months													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	H_{min}	H_{max}
2017.	683	723	733	723	710	/	/	740	778	772	/	/	/	/
2018.	790	750	717	690	707	730	647	675	700	669	700	673	795	640
2019.	638	592	693	700	680	668	720	703	743	735	719	705	760	530
2020.	744	744	765	765	763	750	730	745	719	718	723	694	775	688
2021.	705	692	740	697	729	746	729	755	/	/	/	/	/	/

*the "0" elevation of the piezometer: 96.06 (m.a.s.l.); elevation of the terrain: 95.68 (m.a.s.l.)

Table 12. Groundwater level on profile Markovac – Svilajnac PL-151 (left profile) [31]

Groundwater Level H_{avg} (cm)													Yearly Value	
Markovac-Svilajnac	Months													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	H_{min}	H_{max}
2017.	365	327	319	338	336	351	393	372	380	365	345	300	397	280
2018.	/	/	/	/	/	/	/	/	/	/	/	/	/	/
2019.	/	/	/	/	/	/	/	/	/	/	/	/	/	/
2020.	374	338	304	317	340	330	/	/	371	373	376	362	/	/

[30] *Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, Groundwaters 2017-2021, https://www.hidmet.gov.rs/*

[31] *Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, Groundwaters 2017-2021, https://www.hidmet.gov.rs/*

2021.	290	198	283	226	/	/	290	327	329	309	314	286	/	/

*the "0" elevation of the piezometer: 97.42 (m.a.s.l.); elevation of the terrain: / (m.a.s.l.)

Table 13. Groundwater level on profile Bukovče-Glogovac PL-161 [32]

Groundwater Level H_{avg} (cm)													Yearly Value	
Bukovče-Glogovac	Months													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	H_{min}	H_{max}
2017.	706	687	613	605	651	687	706	743	774	758	749	713	784	593
2018.	704	669	585	478	590	696	635	684	733	766	766	759	785	440
2019.	748	684	679	685	677	705	716	757	771	782	781	780	796	663
2020.	781	750	694	691	712	696	682	704	731	764	760	764	785	626
2021.	717	623	619	563	631	700	718	747	775	781	746	720	787	547

*the "0" elevation of the piezometer: 112.52 (m.a.s.l.); elevation of the terrain: / (m.a.s.l.)

Table 14. Groundwater level on profile Jovac [33]

Groundwater Level H_{avg} (cm)													Yearly value	
Jovac	Months													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	H_{min}	H_{max}
2017.	/	/	/	/	/	/	/	/	/	/	/	/	/	/
2018.	433	437	432	428	427	425	/	/	/	/	/	/	/	/
2019.	404	395	403	437	455	493	502	498	503	508	508	508	510	395
2020.	514	513	511	511	511	511	510	511	514	512	510	/	/	/
2021.	507	499	503	500	503	500	499	495	502	508	511	511	553	495

*the "0" elevation of the piezometer: 97.42 (m.a.s.l.); elevation of the terrain: / (m.a.s.l.)

Table 15. Groundwater level on profile Paraćin – Vrapče [34]

Groundwater Level H_{avg} (cm)	Yearly value
Months	

[32] *Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, Groundwaters 2017-2021, https://www.hidmet.gov.rs/*

[33] *Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, Groundwaters 2017-2021, https://www.hidmet.gov.rs/*

[34] *Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, Groundwaters 2017-2021, https://www.hidmet.gov.rs/*

Paraćin–Vrapče	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
													H_{min}	H_{max}
2017.	/	415	412	419	417	429	459	486	503	505	498	479	/	/
2018.	/	446	412	395	424	452	460	468	483	491	495	491	/	/
2019.	462	431	439	437	435	416	421	449	449	515	509	511	518	410
2020.	/	/	/	/	/	/	/	/	/	/	/	/	/	/
2021.	/	/	/	/	/	/	/	/	/	/	/	/	/	/

*the "0" elevation of the piezometer: 130.78 (m.a.s.l.); elevation of the terrain: 130.19 (m.a.s.l.)

Maximum groundwater levels are observed in April and May. In the period of high water, the direction of groundwater movement is directed from the river to the peripheral parts. In the period from June to November, the recession usually lasts - the decline of the groundwater level, and then the flow of groundwater is generally directed towards the river.

The recharging conditions of the artesian type are generally limited, given that this type is widespread in the conditions of semi-open or semi-closed hydrogeological structures. On the peripheral parts of the Tertiary basins, there are feeding zones, mostly marked by Quaternary deposits, or feeding takes place in zones where surface watercourses cross parts of the terrain with more intense infiltration. The limited zone of infiltration, as well as the very frequent lenticular appearance of water-bearing deposits, affects the difficult conditions of recharge, whereby the influence of surface waters can be indirect through the intergranular type issued with a free level. Hydrogeological active fault structures can also contribute to feeding processes, especially in conditions of distribution of karst and fracture type of aquifer, where other types of groundwaters in the bottom of the basin or in the peripheral zones of the basin can also affect the feeding processes. The conditions of discharge in natural conditions are indirect, mainly through alluvial groundwaters, etc., while in artificial conditions, discharge takes place through water catchment facilities. As a rule, the temperature of artesian groundwater rises with depth, so that in the deeper parts of the terrain, groundwaters acquires the character of thermal waters.

Sanitary protection zones

Groundwater represents the most important water resource in the central part of the Great Morava basin, which is used for water supply.

Groundwater protection conditions are very unfavourable in alluvial sand-gravel deposits, as a result of a pronounced hydraulic connection with surface waters, dense population, agricultural activity that implies the use of herbicides,

pesticides and other substances, and as a consequence of the absence of appropriate sewage systems or the result of the presence of industrial facilities, main roads, etc [35].

The current situation in terms of groundwater protection can be characterized as bad, and it refers to all structures in which only the first sanitary protection zone exists, while the second and third sanitary protection zones are usually not even defined or are not respected.

The railway route passes through the zone III of source “Garevina” and “Livade”, and through the zone II of source “Sto posto”.

Based on the Rulebook on the method of determining and maintaining sanitary protection zones of water supply sources [36] ("Official Gazette of RS", No. 92/2008), the method of determining and maintaining sanitary protection zones of the area where the source is located, which in terms of quantity and quality can be used or used for the public supply of drinking water. To protect the water in the spring, this ordinance establishes: zone of immediate sanitary protection (zone I), narrower zone of sanitary protection (zone II) and wider zone of sanitary protection (zone III).

Zone I of the groundwater source is formed in the area of the source immediately around the water intake facility and is separated by a fence that cannot be closer than 3 to 10 m from the surrounding water intake facility.

Zone II of the groundwater source in the porous medium of the intergranular type, when the underground water has a free level and when the aquifer is covered with a protective protective layer that reduces the influence of pollutants from the surface of the terrain, zone II includes the area from which the water reaches the water catchment facility for at least 50 days. In a porous medium of the intergranular type, when the groundwater is under pressure and when the aquifer is covered with a protective protective layer that reduces the impact of pollutants from the surface of the terrain, the extension of zone II cannot be shorter than 50 m from the water intake facility.

Zone III of the groundwater source in the porous medium of the intergranular type. When the underground water has a free level and when the aquifer is covered with a protective protective layer that reduces the impact of pollutants from the surface of the terrain, zone III includes the area from which the water reaches the water catchment facility for at least 200 days. In a porous medium of the intergranular type, when the underground water is under pressure and when the aquifer is covered with a protective protective layer that reduces the impact of pollutants from the surface of the terrain, the extension of zone III cannot be shorter than 500 m from the water intake facility.

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[35] Filipović et al., 2005

[36] Official Gazette, Regulation on water classification: 5/1968-64, https://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgsrs/vlada/uredba/1968/5/1/reg

Below are presented the main restrictions of activities within sanitary protection zones according to "Official Gazette of RS", no. 92/2008 [37].

In zone I, buildings and facilities cannot be built or used, land cannot be used or carry out other activities, if this endangers the qulity of the water at the source, namely:

- construction or use of buildings and facilities, use of land or other activities from Article 28 of this rulebook;
- installation of devices, storage of equipment and performance of activities that are not in operation of water supply;
- movement of vehicles that are in the function of water supply outside of those prepared for it traffic road, access to motorized vehicles that are not in the function of water supply, use of motor-driven vessels, maintenance of water sports and bathing of people and animals;
- livestock feeding;
- fish farming for commercial fishing.

In zone II, it is not possible to build or use buildings and facilities, use land or carry out other activities, if this endangers the quality of the water at the source, namely:

- construction or use of buildings and facilities, use of land or other activities from Article 27 of this rulebook;
- housing construction;
- use of chemical fertilizers, liquid and solid manure;
- use of pesticides, herbicides and insecticides;
- breeding, movement and grazing of livestock;
- camping, fairs and other gatherings of people;
- construction and use of sports facilities;
- construction and use of catering and other facilities for the accommodation of guests;
- deepening of the bed and extraction of gravel and sand;
- establishment of new cemeteries and expansion of existing cemeteries.

In zone III, buildings and facilities cannot be built or used, land cannot be used or carry out other activities, if this endangers the quality of the water at the source:

- permanent underground and above-ground storage of dangerous substances and substances that cannot be mixed directly or indirectly into waters;
- production, transportation and manipulation of hazardous substances and non-hazardous substances may be introduced directly or indirectly into the waters;

[37] *Rulebook on the method of determining and maintaining sanitary protection zones of water supply sources, "Official Gazette of RS", no. 92/2008*

- commercial storage of oil and oil derivatives;
- discharge of waste water and water used for industrial cooling plants;
- construction of traffic roads without channels for drainage of storm water;
- exploitation of oil, gas, radioactive substances, coal and mineral raw materials;
- uncontrolled depositing of communal waste, damaged vehicles, old tires and other substances and materials from which polluting substances can be released by washing or leakage;
- uncontrolled deforestation;
- construction and use of the airport;
- surface and subsurface works, soil blasting, penetration into the layer covering the underground water and removal of the layer covering the aquifer, unless these works are not in operation of water supply;
- maintenance of car and motorcycle races.

Surface flows have a significant influence on the quality of water from springs within alluvial and Neogene deposits because the springs themselves are in the immediate vicinity of rivers with which they have a direct hydraulic connection. In the observed zone, the Great Morava River has a significant influence on water quality, which is exposed to harmful anthropogenic influence and is often the recipient of waste and polluted waters.

Regarding the hydrogeological conditions of groundwater protection in the research area, the threat of alluvial-sandy-gravelly sediments' source waters, whose physical characteristics and chemical composition can be changed as a result of anthropogenic factors, is particularly pronounced, taking into account existing roads, economic activity, population, the absence of communal systems for receiving and processing waste water, etc., in addition to the fact that such hot spots have a tendency to spread. The successful protection of alluvial groundwater involved the protection of larger scales in the catchment areas where the intergranular type of porosity was formed, and above all, the protection of surface water, the quality of which is a necessary condition for preserving the favourable characteristics of groundwater, especially in the zones of direct influence of surface water [38]. Within the alluvial sand and gravel deposits, there are favourable conditions for the harmful influence of groundwater, especially in the period of high water. In those periods, there may be occasional flooding of the terrain [39].

Identified sensitive zones and receptors:

Groundwaters of alluvial deposits, as well as groundwater and sanitary protection zone of sources along the railway line, especially “Livade” and “Sto posto” in the area of Velika Plana and “Garevina” in the area of Lapovo which are in the railway corridor.

[38] *Filipović et al., 2005*

[39] *Filipović et al., 2005*

Identified and reviewed existing baseline information relevant for the project:

Filipović, B., Krunić, O., & Lazić, M. (2005). Regional hydrogeology of Serbia. Belgrade: University of Belgrade, Faculty of Mining and Geology.

Milanović, S., Stevanović, Z., Đurić, D., Petrović, T., Milovanović, M., Mandić, M. Project: Monitoring of groundwater resources Srbije. Subproject: Creation of a map of the risk of groundwater in Serbia.

Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, Groundwaters 2017-2021, https://www.hidmet.gov.rs/

Identified significant gaps in existing baseline data relevant for the project:

Precise data on sanitary protection zones is missing, data has been officially requested from local municipal administrations, and the obtained data will be presented in the ESIA. Data on the quantitative, qualitative, and chemical status of groundwaters are missing and will also be provided by the local municipal administrations that manage their control and it will be presented in ESIA.

Method of further ESIA baseline data collection and assessment:

Data from piezometers in sanitary protection zones at groundwater sources where continuous monitoring is carried out will be requested from local self-governments and presented within the ESIA.

Site visit is also planned, and the eventually new obtained information will be presented in the ESIA.

6.1.6. Surface waters

The hydrographic network is quite dense in the flat terrain through which the existing railway passes and includes larger river Great Morava and its tributaries. In the centre of the Balkan Peninsula is the Great Morava basin, the right tributary of the Danube, covering almost the entire central and southern part of Serbia. The Great Morava is a slow plain river, the width of the riverbed is variable and ranges from 73–325 m, while the depth is in the range of 4.8–11 m [40]. The Great Morava is formed by the joining of the South and West Morava at 129 m above sea level near the town of Stalać, flowing into the Danube near the village of Dubravice at 67 m above sea level. The length of the course of Great Morava is 185 km, extending in the direction SE-SSW [41], often changing the direction of the flow [42]. The total area of Great Morava watershed is 37,996 km^2, including the South and West Morava watersheds [43], making up 42.4% of the territory of Serbia. The Great Morava, flowing through the Stalaćka gorge, continues to flow 45 km through the upper Great Moravian basin, flowing through the relatively wide and shallow Bagrdan gorge, then flowing into the lower Great Moravian basin wide open towards the Danube. A large amount of suspended sediment is deposited around the Great Morava riverbed during flood periods, forming coastal beds. Due to a series

[40] *Perović, 2019*

[41] *Vasiljević, B. (2017). Benthic silicate algae (Bacillariophyta) in the assessment of the ecological status of the Great Morava and Sava rivers (doctoral dissertation). Kragujevac: University of Kragujevac, Faculty of Science.*

[42] *Perović, 2019*

[43] *Boreli-Zdravković & Miljević, 2012*

of floods in the past, numerous regulatory works were carried out on the Great Morava riverbed, which cut the largest number of meanders downstream from the Bagrdan gorge, shortening the original length of the stream from 245.5 km by about 60 km [44]. Figure 25 shows the Morava River basin.

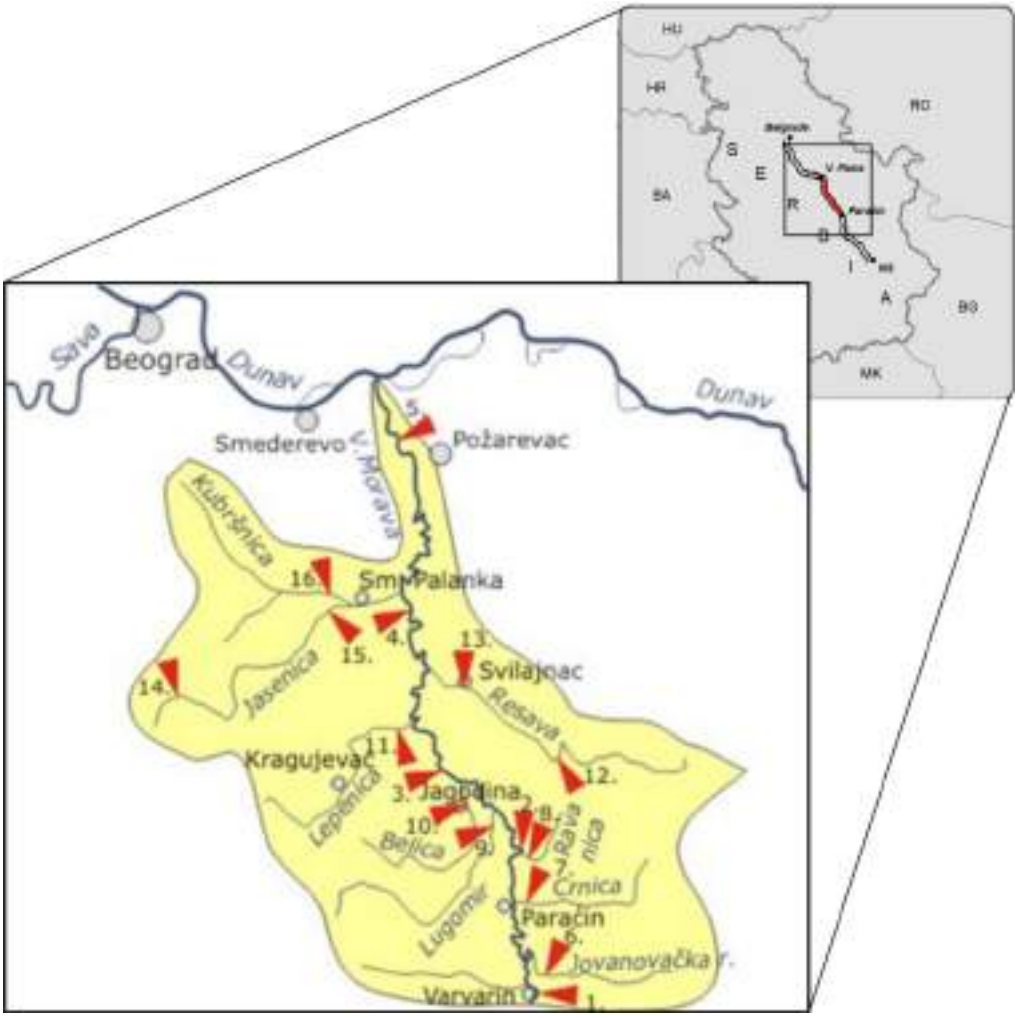


Figure 25. ***Great Morava River basin*** [45]

[44] *Vasiljević, 2017*

[45] *Republic Hydrometeorological Institute of Serbia, https://www.hidmet.gov.rs/*

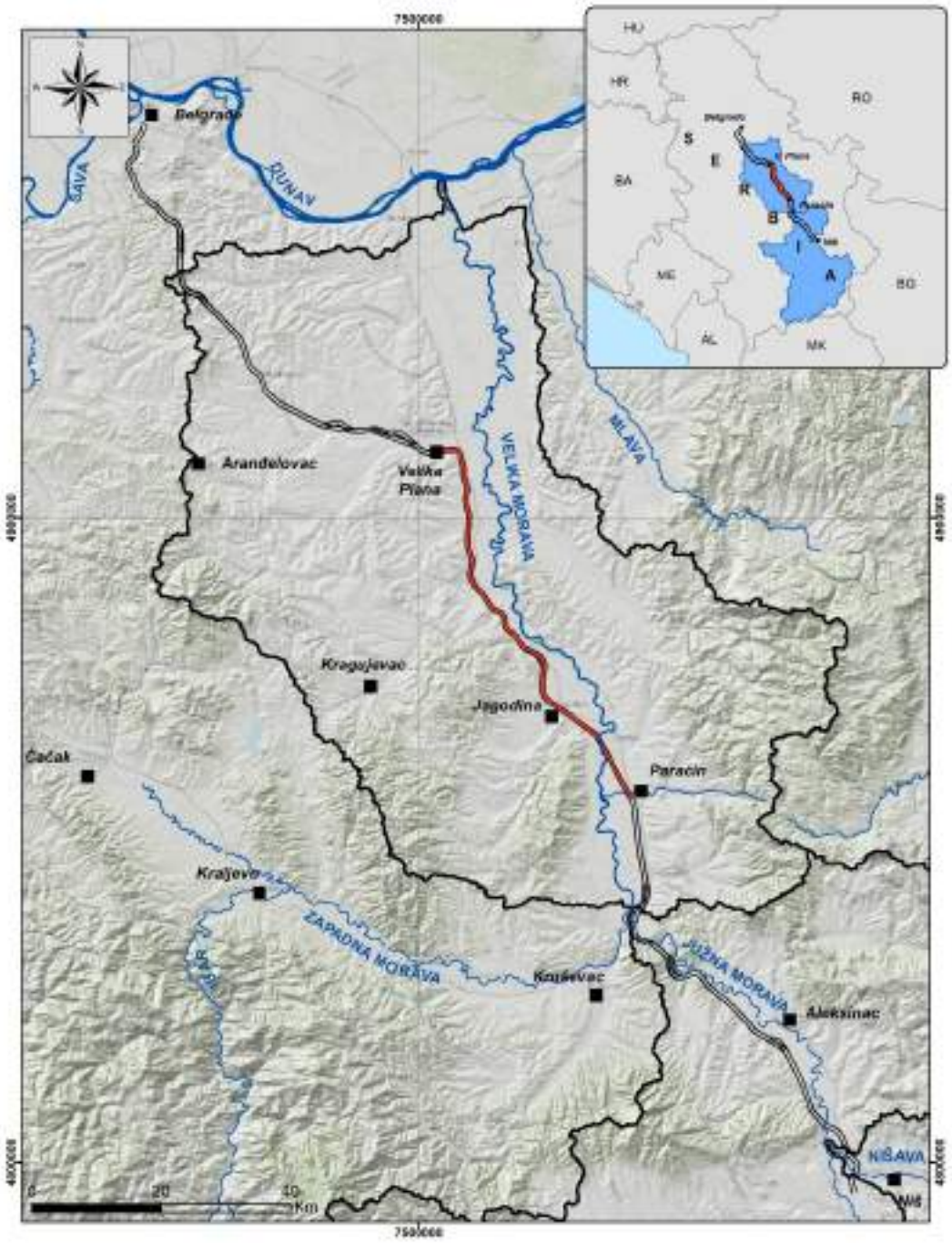


Figure 26. Morava river basin located within the Great and Southern Moravian Basins

Data from the hydrological station for a five-year period were used to analyse the regime of hydrological elements, flows and water levels in Great Morava. Characteristic values of mean annual flows and water levels are shown in Tables 16 and 17. The amplitudes of flow and water level fluctuations during the year were expressed, with the highest values recorded at the beginning of spring (March-April-May), after the melting of snow and spring rains, while the minimum values are characteristic for the end of summer, i.e. the beginning of autumn (August- September), when the level, i.e. the flow, begins to decrease.

Table 16. Overview of average monthly flow (Qavg) values for the Great Morava river* for the period from 2017 to 2021 [46]

FLOW (Q)						
YEAR		2017	2018	2019	2020	2021
		Q_{AVG} (m^3/s)				
MONTHS	1	112	157	110	55.9	450
	2	298	334	309	122	534
	3	310	1030	210	260	411
	4	236	551	160	176	536
	5	232	168	181	139	254
	6	164	157	295	335	163
	7	67.0	285	76.6	145	128
	8	45.0	188	57.9	151	75.6
	9	39.4	81.3	49.1	84.6	70.0
	10	77.0	52.9	41.6	91.8	97.4
	11	76.7	59.6	44.4	84.0	99.6
	12	272	95.1	54.3	99.3	244
YEARLY MIN. Q_{MIN} (m^3/s)		37.1	47.3	39.2	45	58.1
DATE		20. 09.	18. 11.	23. 10.	25. 01.	14. 09.
YEARLY MAX. Q_{MAX} (m^3/s)		792	1440	1120	1480	1120
DATE		09.02.	10. 03.	06. 06.	27. 06.	01. 02.
YEARLY AVERAGE VALUE Q_{AVG} (m^3/s)		161	264	132	145	255

[46] *Republic Hydrometeorological Institute of Serbia, Hydrological yearbook, surface waters 2017–2021, https://www.hidmet.gov.rs/*

* Hydrological station Ćuprija (distance from the confluence: 118.6 km, basin area: 33446 km^2, elevation "0": 100.94 m.a.s.l.)

Table 17. Overview of average monthly water level (Havg) values for the Great Morava river* for the period from 2017 to 2021 [47]

WATER LEVEL (H)						
YEAR		2017	2018	2019	2020	2021
		H_{AVG} (cm)				
MONTHS	1	31	59	33	-11	178
	2	125	149	142	38	210
	3	137	386	95	108	158
	4	100	225	67	61	214
	5	99	65	78	35	85
	6	61	57	127	124	34
	7	-1	125	11	39	11
	8	-23	74	-8	42	-26
	9	-32	10	-19	-8	-30
	10	2	-13	-32	-1	-10
	11	7	-8	-27	-8	-8
	12	116	19	-13	4	77
YEARLY MIN. H_{MIN} (cm)		-37	-19	-38	-29	-40
DATE		20. 09.	18. 11.	28. 10.	23. 09.	14. 09.
YEARLYMAX. H_{MAX} (cm)		315	509	456	516	429
Date		09. 02.	10. 03.	06. 06.	27. 06.	01. 02.
YEARLY AVERAGE VALUE H_{AVG} (cm)		52	96	38	35	74

* Hydrological station Ćuprija (distance from the confluence: 118.6 km, basin area: 33446 km^2, elevation "0": 100.94 m.a.s.l.)

[47] *Republic Hydrometeorological Institute of Serbia, Hydrological yearbook, surface waters 2017–2021, https://www.hidmet.gov.rs/*

Table 18. Water classification [48]

The class	Class characteristics
The class I	This class includes water that, in its natural state or after disinfection, can be used to supply drinking water to settlements, in the food industry, and for the breeding of noble species of fish (salmonids).
The class II	This class includes waters suitable for swimming, recreation and water sports, for breeding less noble species of fish, as well as waters that, in addition to the usual purification methods (coagulation, filtration and disinfection), can be used to supply drinking water to settlements and in the food industry Class II waters are divided into subclasses: Subclass IIa — which includes waters that, in addition to the usual treatment methods (coagulation, filtration and disinfection), can be used to supply drinking water to settlements, for bathing and in the food industry. Subclass IIb — which includes waters that can be exploited or used for water sports, recreation, for the cultivation of less valuable species of fish and for watering livestock.
The class III	This class includes water that can be used for irrigation and in non-food industries.
The Class IV	This class includes waters that can only be used after special treatment.

According to the Regulation on categorization of watercourses [49], water of the Great Morava corresponds to IIa class. The characteristics of each group of waters according to this classification are given in the table Table 18.

The following text on the status of surface waters of Serbia provides an overview of the state of water quality of water bodies covered by monitoring in the period 2017–2019.

Quality elements for assessment of ecological status/potential, for each category of surface water, are divided into three groups: (1) biological elements (2) hydromorphological elements that support biological elements and (3) physicochemical and chemical elements that support biological elements. Physical-chemical and chemical elements that support biological elements include: a) General physico-chemical quality elements and b) Specific non-priority polluting substances that are discharged into the water body in significant quantities [50].

The assessment of ecological status/potential is shown in colors in accordance with the recommendations of the Water Framework Directive of the European Parliament and of the Council (WFD) (Water Framework Directive (WFD 2000/60/EC)) (Tables 19 and 20).

Table 19. Assessments of the ecological status of surface waters

Status rating	Color	
perfect	blue	
good	green	

[48] Official Gazette, Regulation on water classification: 5/1968-64, https://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgsrs/vlada/uredba/1968/5/1/reg

[49] Official Gazette, Regulation on water classification: 5/1968-64, https://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgsrs/vlada/uredba/1968/5/1/reg

[50] Čađo, S., Denić, Lj., Dopuđa-Glišić, T., Đurković, A., Novaković, B., Stojanović, Z., Žarić, D. (2021). Status of surface waters of Serbia during the period 2017–2019. Ministry of Environmental Protection, Environmental Protection Agency.

moderate	yellow	
weak	orange	
bad	red	

Table 20. Assessments of the ecological potential of surface waters

Assessment of potential	Color	
good and better	green	
moderate	yellow	
weak	orange	
bad	red	

To determine the status of the water body, in addition to the assessment of the ecological status, an assessment of the chemical status is also carried out. Environmental quality standards EQS (Environmental Quality Standards) are used to assess the chemical status of the water body. The chemical status of surface waters is determined in relation to the limit values of priority and priority hazardous substances. Chemical status of water of bodies is evaluated as "achieved good status" when not a single one is exceeded prescribed threshold value, or "good status not achieved" in the case when it is exceeded at least one prescribed limit value.

The results of the examination of the ecological status/potential in the period 2017–2019 are shown in Table 21.

Table 21. Assessment of the ecological status/potential of watercourses in the period 2017–2019 [51]

Watercourse	Name of the station	Year of examination	Biological elements of quality			Physico-chemical elements of quality	specific pollutants	Evaluation of ecological status/potential	Reliability level assessment
			Phytobenthos	Watery macroinvertebrates	Fish				
Great Morava	Bagrdan	2019							low

[51] *Čađo et al., 2021.*

Rača	Markovac	2019			-				high
Lugomir	Ribare	2018							high
Belica	Jagodina	2018							high
Lepenica	Lapovo Selo	2018							high

Status monitoring for the period 2017–2019 covered 5 rivers. An ecological potential rating indicates that a good has been established at 0 rives, moderate in 1, weak in 1, bad ecological potential was determined in 2 rivers, while 1 has bad ecological status out of 5 examined stations in this section of railway.

Status assessment was performed at the level of calendar years. For water bodies of surface waters where multi-year monitoring was carried out (2017–2019), the obtained values were statistically processed on an annual level, while the evaluation of the ecological status/potential was performed by comparing multi-year averages with prescribed limit values. In the observed period, the ecological status/potential was determined with a high or medium level of reliability depending on the available indicative biological elements/parameters. On Figure 27 is presented the ecological status/potential of surface waters in Serbia and along the railway.

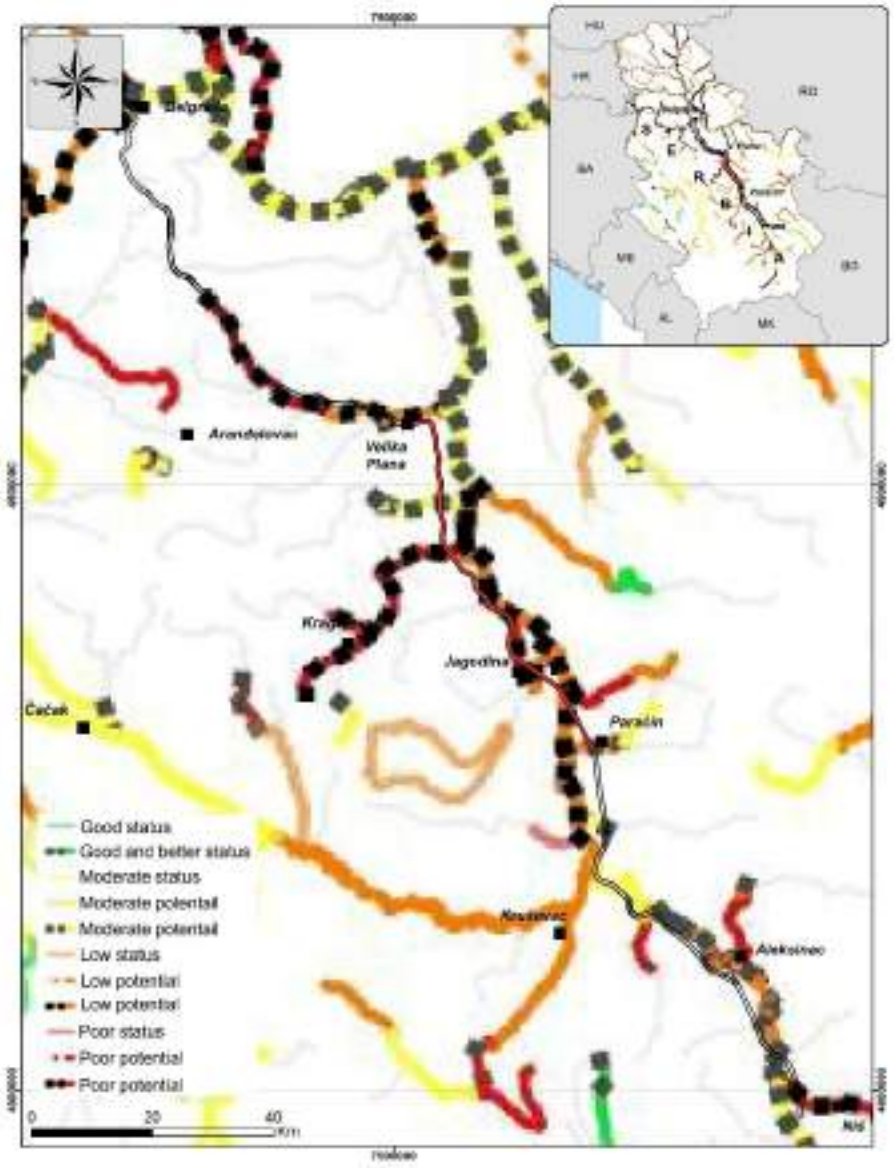


Figure 27. Ecological status/potential of water bodies of surface waters in Serbia in the period 2012(2009)–2019 [52]

[52] *Čađo et al., 2021.*

The chemical status of surface waters is determined by checking whether the environmental quality standards (EQS) for priority and priority hazardous substances are met. The chemical status of water bodies is evaluated based on the monitoring results and is expressed as "good status" and "good status not achieved", in case at least one limit value prescribed by the Regulation (Regulation on limit values of priority and priority hazardous substances that pollute surface waters) is exceeded of water and deadlines for reaching them (Official Gazette of RS No. 24/2014)) and is displayed in appropriate colours in the manner shown in Table 22.

Table 22. Assessments of the chemical status of surface waters

Status rating	color	
good	blue	
good status not achieved	red	

The assessment of the chemical status is carried out with a mandatory indication of the level of reliability. Level reliability of the assessment was carried out on the basis of the criteria given in the Rulebook (Rulebook on parameters of ecological and chemical status of surface waters and parameters of chemical status and quantitative status of groundwater (Official Gazette of the RS No. 74/2011)).

Based on the results of the examination of priority and priority hazardous substances, as part of the three-year monitoring program, authoritative values (average annual values and maximum measured values) were determined, which were compared with the values of the environmental quality standard (EQS), i.e. the average annual concentration (AQC) and the maximum allowed concentration (MDK) prescribed by Regulation. Only parameters where analytical methods with LOD (detection limit), which is equal to or lower than the value of 30% of the relevant environmental quality standard, are included in the assessment and presented in Table 23, and in Figure 28 is presented the map of chemical status of surface waters in Serbia and along the railway.

Table 23. Chemical status of water bodies of surface waters (watercourses) in the period 2017-2019 [53]

[53] *Čađo et al., 2021.*

Watercourse	Profile (measuring point)	Year of examination	Chemical status	Reason for not achieving good status	Annual/multi-year average concentration (µg/l)	Maximum measured concentration (µg/l)	Reliability level assessment
Great Morava	Bagrdan	2017–2019		Ni dissolved	4.4		average
Rača	Markovac	2017–2019		Ni dissolved; Hg dissolved	5.9	0.5	average
Lugomir	Ribare	2018					
Belica	Jagodina	2018		Ni dissolved	4.4		average
Lepenica	Lapovo Selo	2018		Ni dissolved	5.1		average

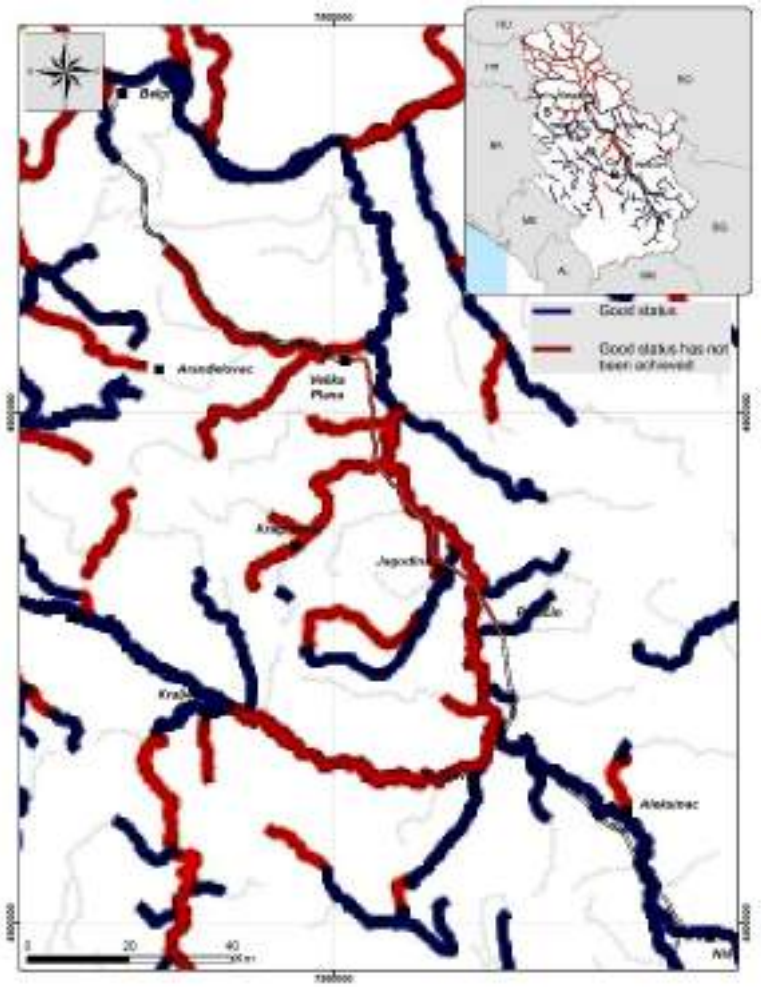


Figure 28. Chemical status of surface waters in Serbia in the period 2012(2009)–2019 [54]

Table 24. Assessment of the ecological status/potential of watercourses based on physical and chemical elements of quality in the period 2017–2019 [55]

[54] *Čađo et al., 2021.*

[55] *Čađo et al., 2021.*

Watercourse	Name of the station	Dissolved oxygen (mg l^{-1}) (C 10)	pH value (C 80)	Ammonium ion (NH4-N) (mg l^{-1}) (C 80)	Nitrites (NO2-N) (mg l^{-1}) (C 80)	Nitrates (NO3-N) (mg l^{-1}) (C 80)	Total nitrogen (mg l^{-1}) (C 80)	Orthophosphates (mg l^{-1}) (C 80)	Total phosphorus (mg l^{-1}) (C 80)	Chlorides (mg l^{-1}) (C 80)	BOD5 (mg l^{-1}) (C 80)	Total Organic Carbon (TOC) (mg l^{-1}) (C 80)	Assessment of ecological status/potential
Great Morava	Bagrdan	7.97	8.28	0.26	0.037	1.26	3.4	0.102	0.240	17.2	4.28	6.2	
Rača	Markovac	3.67	8.05	0.86	0.051	1.70	5.8	0.276	0.503	43.5	7.14	11.8	
Lugomir	Ribare	8.65	8.42	0.30	0.030	1.58	3.2	0.107	0.165	31.7	3.57	6.9	
Belica	Jagodina	0.25	7.81	8.30	0.464	2.50	19.4	1.143	1.296	52.7	-	36.5	
Lepenica	Lapovo Selo	0.25	8.06	6.50	0.644	2.24	16.2	1.103	1.326	59.0	4.94	20.4	

Table 25. Ecological status/potential in relation to the content of specific pollutants in the period 2017–2019[56]

Watercourse	Profile (measuring point)	Ecological status/potential in relation to the content of specific polluting substances	
		Assessment of status/potential	Cause of failure to achieve good status/potential (C80)
Great Morava	Bagrdan		Iron Fe-total (2701.6ug/l); Manganese Mn-total (157.0ug/l)
Rača	Markovac		Iron Fe-total (987.5ug/l); Manganese Mn-total

[56] Čađo et al., 2021.

			(452.6ug/l); Arsenic As-total (10.5ug/l)
Lugomir	Ribare		Iron Fe-total (2773.8ug/l)
Belica	Jagodina		Iron Fe-total (1705.2ug/l); Manganese Mn-total (182.6ug/l)
Lepenica	Lapovo Selo		Iron Fe-total (5883.8ug/l); Manganese Mn-total (434.6ug/l)

The water quality of Velika Morava is greatly influenced by South and West Morava, as well as numerous tributaries. Due to the dense population and developed industry, this area can have a negative effect on the water quality of the Velika Morava, which leads to the fact that at low flows, the Morava sometimes has class IV quality, e.g. In Jagodina, the glass, beverage, food industry, as well as the production of cables and foundries, were developed. Jagodina has a public communal landfill and several wild landfills, the leachate of which, according to the data of the Environmental Protection Agency of the Republic of Serbia (2005), can easily come into contact with groundwater and affect the quality of water in Velika Morava via its tributaries.

According to the Regulation on Water Classification ("Official Gazette of SRS", No. 5/68), the water quality on the Jagodina - Belica, Bagrdan profiles belongs to class IIA, and the water on the Ribare - Lugomir profile is class IV.

Floods

Railway route is planned to go through the Great Morava River basin, as seen on the figure bellow. Considering large and medium watercourses, it crosses river Rača south of Markovac (existing route), river Lepenica south of Lapovo (existing route), rivers Belica and Lugomir in Jagodina (existing route) and Velika Morava in Ćuprija (existing route).

Figure 29. River basins and main river network in Serbia (Republic Hydrometeorological service of Serbia)

Results of the several projects (Danube Floodrisk Project, IPA 2014-2020 Flood recovery Serbia IPA 2014–2020 Flood recovery Serbia, SoFPAS in Serbia (Study of Flood Prone Areas in Serbia - Phase 1& Phase 2)) are vulnerability and flood risk maps.

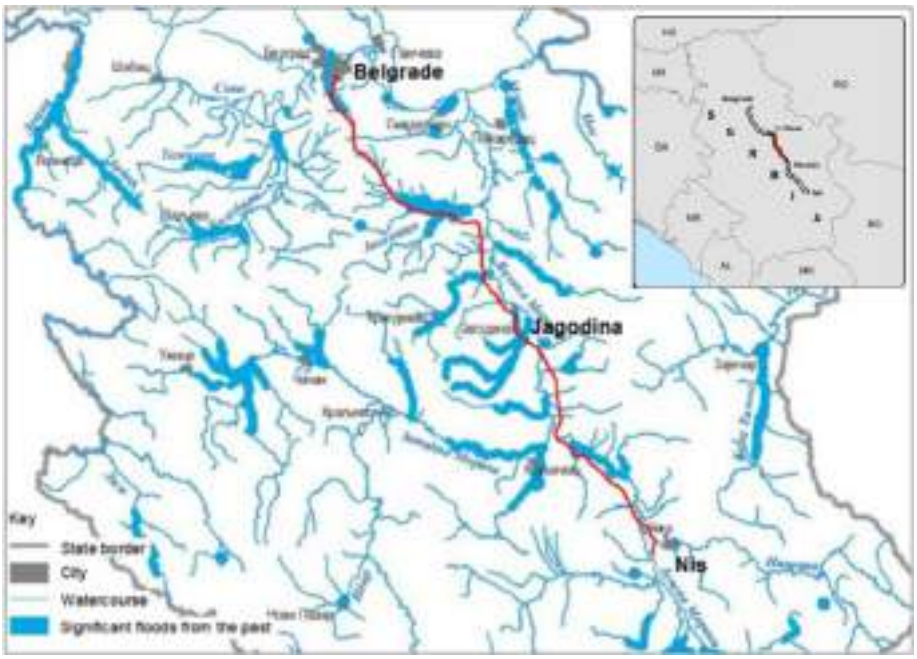


Figure 30. Significant floods from the past in the area of railway

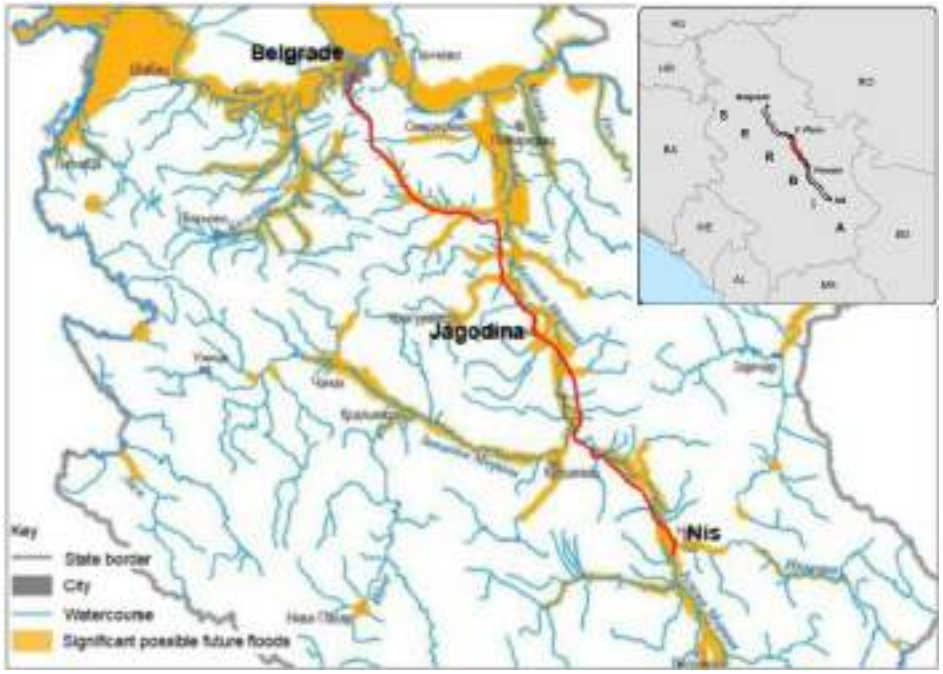


Figure 31. Possible significant floods in the future in the area of railway

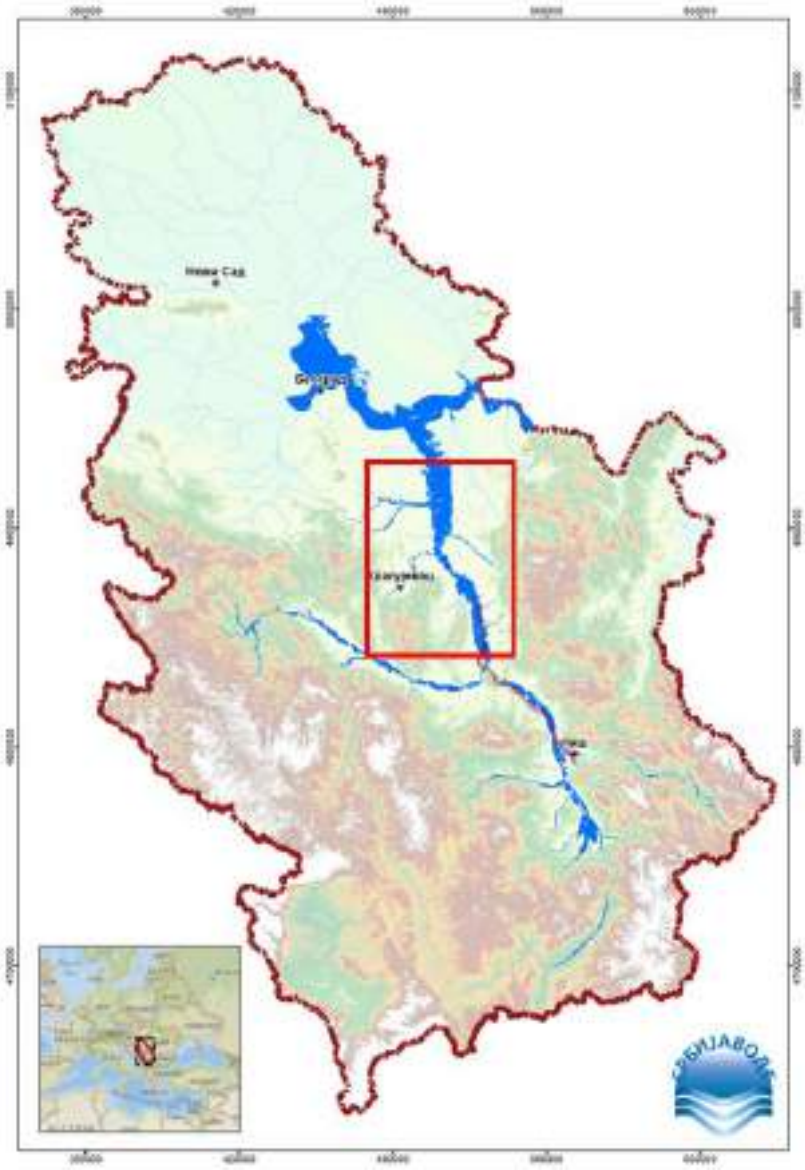


Figure 32. Flood prone areas [57]

Identified sensitive zones and receptors:

[57] *Study of Flood Prone Areas in Serbia - Phase 1 & Phase 2*

Qualitative status of watercourses of the Great Morava along the route of the railway line. Floods can occur in the areas along the Great Morava, Lepenica river, and especially municipality of Cuprija (Jagodina – Cuprija) which has been determined as an area under significant influence of floods.

Bridge over river Lugomir near Jagodina (rail traffic could be influenced/ obstructed by the debris pilled up by the flood waters at the bridge pillars- observed in June 2023). Following same logic, potential sensitive receptors are also bridges over Rača, Lepenica i Belica. Problem stems from inadequate/ irregular maintenance/ clearing of riverbeds and climate perspective reflects in more frequent and intense (in terms of water flow) floods leading to potential railway closure.

Identified and reviewed existing baseline information relevant for the project:

Official Gazette, Regulation on water classification: 5/1968-64, https://www.pravno-informacioni-sistem.rs/SlGlasnikPortal/eli/rep/sgsrs/vlada/uredba/1968/5/1/reg

Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, surface waters 2017–2021, https://www.hidmet.gov.rs/

Čađo, S., Denić, Lj., Dopuđa-Glišić, T., Đurković, A., Novaković, B., Stojanović, Z., Žarić, D. (2021). Status of surface waters of Serbia during the period 2017–2019. Ministry of Environmental Protection, Environmental Protection Agency.

Study of Flood Prone Areas in the Republic of Serbia (SoFPAS), EU, 2012,

Spatial Plan of the Republic of Serbia 2021-2035, Ministry of Construction, Transport and Infrastructure,

European landslide susceptibility ELSUS v2, https://esdac.jrc.ec.europa.eu/content/european-landslide-susceptibility-map-elsus-v2

Identified significant gaps in existing baseline data relevant for the project:

Water quality data is missing and will be provided by local municipal and will be presented in ESIA. There is no accurate baseline data on water quality since the monitoring/measurement stations are not in the vicinity of the identified sensitive zones.

Method of further ESIA baseline data collection and assessment:

Further assessment should include results from baseline survey measurement of the physical and chemical parameters of surface water on determined locations in the vicinity of sensitive zones: River Rača near Markovac, River Lepenica near Batočina, River Great Morava near Bagrdan, River Osaonica near Bagrdan, River Belica near Jagodina, River Lugomir near Jagodina, River Great Morava near Ćuprija, use of other available literary sources. Site visit along the railway line will be done.

Further baseline assessment during the ESIA will include assessment of seasonal discharge rates to a level of detail that will inform construction phase of project regarding high flow regimes low flow regimes, and time of year when flooding is likely for the gauged watercourses, while on ungauged watercourses professional estimation will be carried out.

Further assessment will include detailed analysis of flood hazard maps and flood risk maps for Velika Morava and Južna Morava for Q100 and Q1000 and possible impact of floods on the railway route.

6.1.7. Seismicity

From a seismological point of view, the observed route of the Velika Plana-Paraćin railway is one of the seismic areas in Serbia. This part of the Balkan Peninsula is part of a seismically active area in the area of the Mediterranean-Trans-Asian seismic belt. Neotectonic activity is occasionally expressed in complex fault zones. It is manifested in seismic phenomena with the effects of earthquakes on the hydrological characteristics of groundwaters and surface waters and morphological changes of the relief.

To determine the seismicity of the terrain, the maps of the Republic Seismological Institute of Serbia were used, based on the probability, which corresponds to the return period of the seismic effect of 475 years. The observed area is in the zone of the seventh-eighth degree and the eighth degree of the MSC seismic scale. The first part of the route of the existing line is in the zone of seven-eight degrees of the seismic scale, while the greater part of the route is in the zone of the eighth seismic scale.

Figures 33 and 34 show seismic maps where the seismic scale zones as well as the maximum horizontal acceleration can be seen for the route of the Velika Plana–Paraćin railway.

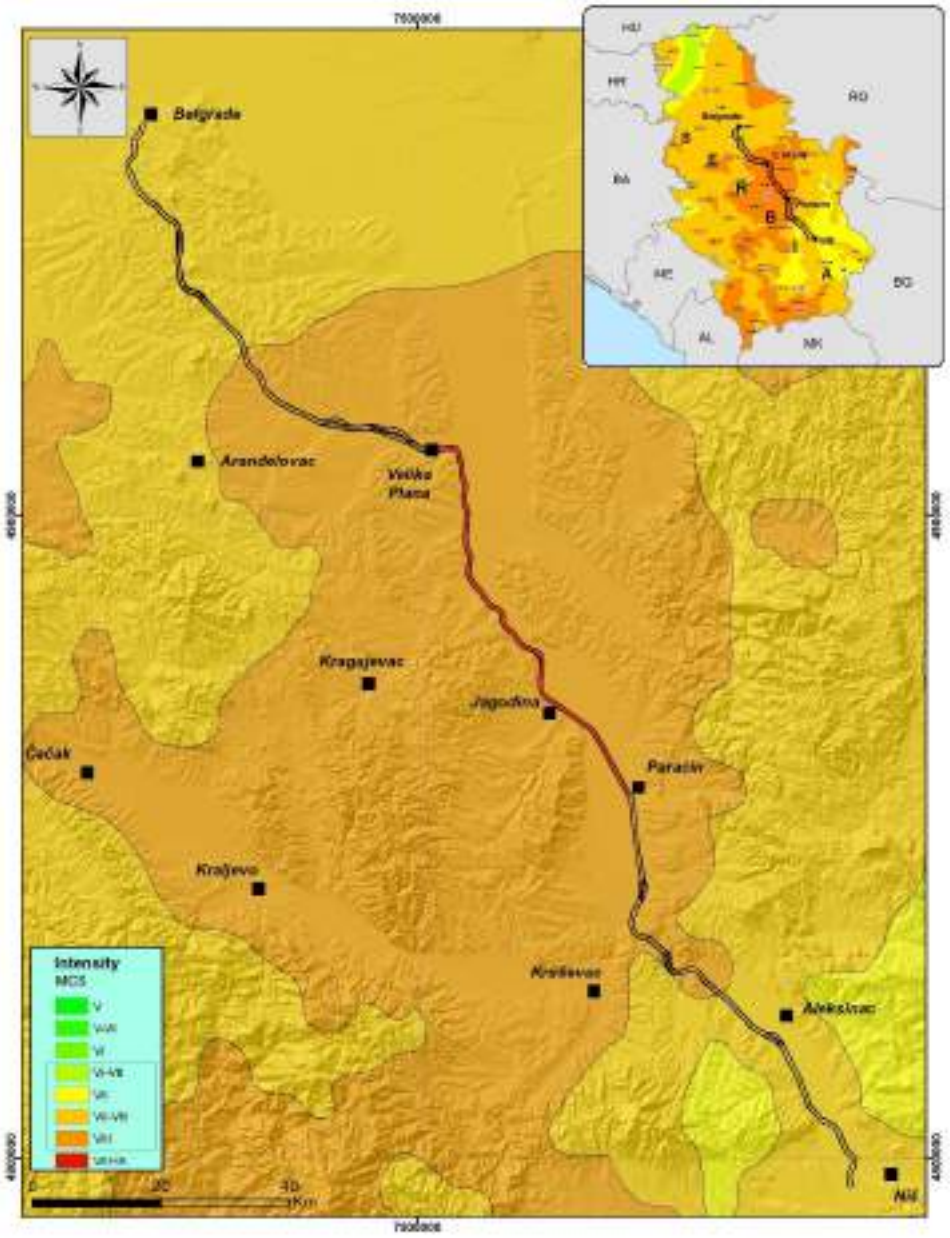


Figure 33. Seismic hazard map of the Republic of Serbia in the project area of the route Velika Plana - Paraćin, hazard expressed in degrees of microseismical intensity [58]

[58] *Republic Seismological Institute of Serbia (Seismic Hazard Maps), https://www.seismo.gov.rs/Seizmicnost/SH_2018_Ubrzanje_cyr_475_WGS84.pdf*

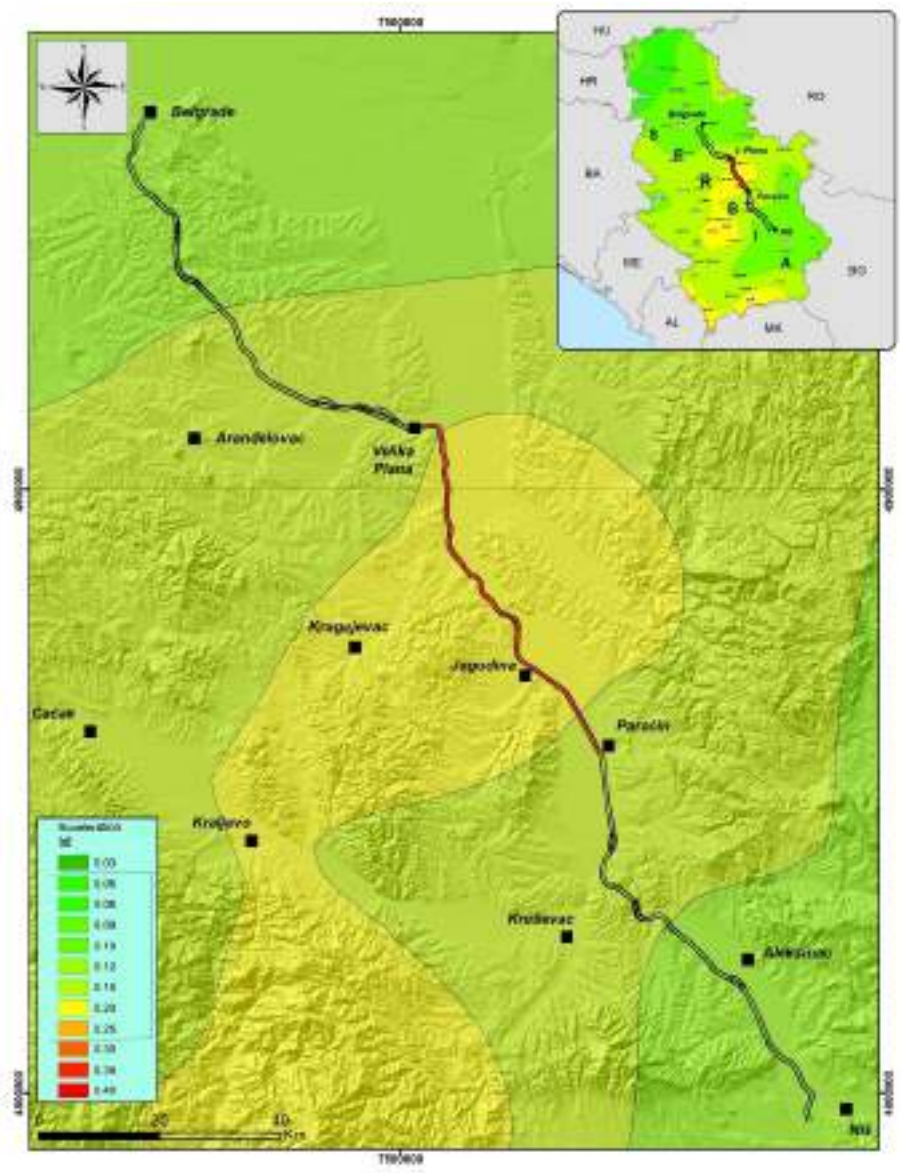


Figure 34. Seismic hazard map of the Republic of Serbia in the project area of the route Velika Plana–Paraćin, hazard expressed in units of gravitational acceleration [g] [59]

[59] *Republic Seismological Institute of Serbia (Seismic Hazard Maps), https://www.seismo.gov.rs/Seizmicnost/SH_2018_Ubrzanje_cyr_475_WGS84.pdf*

Seismic activity was manifested on the territory of Serbia with over 400 moderate and strong earthquakes. According to the available sources of information, about 180 earthquakes occurred with the epicenter in Serbia and the surrounding area, which, in addition to material damage, also resulted in loss of life.

The last earthquake above 5 degrees on the Richter scale occurred in Kraljevo in 2010, which was one of the most destructive earthquakes in Serbia in the last few decades. Its strength was 5.4. Richter scale.

Identified sensitive zones and receptors:

Thanks to the location, which is on the very edge of the plate, earthquakes in Serbia, according to seismologists, cannot be stronger than 6.2 to 6.3 on the Richter scale. The observed area is according to the seismological map created in 2018 for a return period of 475 years in zone VIII of macroseismic intensity.

Identified and reviewed existing baseline information relevant for the project:

Disaster risk assessment in the Republic of Serbia, Ministry of Interior of the Republic of Serbia.

Republic Seismological Institute of Serbia (Seismic Hazard Maps).

Identified significant gaps in existing baseline data relevant for the project:

Open format maps from Republic Seismological Institute of Serbia.

Method of further ESIA baseline data collection and assessment:

Further assessment should include statistical data on earthquakes that occurred in a wider area of the route as well as data on the impact of earthquakes on the terrain in general, data from Seismic Hazard Harmonization in Europe (SHARE) project, data received from the Republic Seismological Institute of Serbia and other available published data.

6.1.8. Noise and vibrations

Noise

The analysis of noise impact on the subject area from both sides of the railway line Belgrade-Nis, as well as measures for environmental protection, will be analysed and defined in Design of Technical Measures for Environmental Protection.

Local valid regulations in the field of noise protection have been harmonized with the relevant EU directives and will be used for analysis of noise impact on environment.

As acoustic zoning does not exist for the subject area, therefore selection of the permissible noise levels was made in accordance with the Regulation on noise indicators, limit values, assessment methods for indicators of noise, disturbance, and harmful effects of noise in the environment (Official Gazette of RS, No. 75/2010).

The Regulation on noise indicators, limit values, assessment methods for indicators of noise, disturbance, and harmful effects of noise in the environment defines the highest permissible levels of external noise (outdoor noise indicators) as shown in following table.

Table 26. Maximum permissible level of external noise dB(A)

Zone	Purpose	Day and evening	Night
1	Areas for rest and recreation, hospital zones and convalescent homes, cultural and historical sites, large parks	50	40
2	Tourist areas, small and rural settlements, camps and school zones	50	45
3	Purely residential areas	55	45
4	Business-residential areas, commercial-residential areas, children's playgrounds	60	50
5	City center, craft, trade, administrative zone with apartments, zones along highways and railways	65	55
6	Industrial, storage and service areas and transport terminals without housing	At this area borders, noise must not exceed the limit value of the neighbouring area	

Based on mentioned Regulation, subject area of railway section Belgrade-Nis belongs to acoustic zone 5 (commercial, administrative-government zone with apartments, zone along motorways, main and city avenues). The limit values for noise in zone 5 are 65 dB(A) for day and evening, and 55 dB(A) for the night. Mentioned limits are required by the local legislation in force. Reference values for noise defined within WHO Environmental Noise Guidelines for European Region (2018) will be used in this study as those requirements are more strict than local and EU one. The WHO guideline recommends reducing average noise levels produced by railway traffic below 54 dB, and for night noise exposure, below 44 dB.

Analysis of noise impact caused by forecasted traffic volume on the railway section Belgrade-Niš will be determined using a software package CadnaA.

Lden, Lday and Lnight will be used for the assessment of noise produced by railway traffic. LAeq will be actually represented by this three indictors (Lden, Lday, and Lnight), and Lmax will be also predicted withih this study.

Noise indicators for noise prediction will be calculated. The provisional method for the calculation of noise indicators for railway traffic in Republic of Serbia is the Dutch national method SRM II - 19961, which is also recommended by the EU Directive 2002/49/EC. Use of the Dutch national method is defined by the Regulation on noise indicators, limit values, methods for assessing noise indicators, disturbing and harmful effects of noise in the environment (Official Gazette of RS No. 75/2010).

The noise impact analysis will be done based on the forecasted traffic volume in the last year of traffic analysis and in a zone of 200 meters left and right of the planned railway section.

As input for the preparation of an acoustic model in software CadnaA different parts of the preliminary design will be used, which includes 3D model of the terrain, technical and technological characteristics of the railway and rolling stock, volume of railway traffic, speed etc.

For noise calculation, inputs such as a number of each type of train, timetable, speed of each type of train, types of disconnections, percentage of breaking vehicles (percentage of all vehicles of a train category to be considered as braking vehicles), superstructure bb (Track Condition) etc. will be used. All inputs will be taken from the traffic tehcnology design and other parts of railway design developed through this project.

Analysed railway section Belgrade-Nis is divided into sections with different characteristics (number of trains, type of railway, speed limits, etc.).

Based on noise level obtained by means of an acoustic calculation, using the CadnaA software, within the Design of technical measures for environmental protection noise barriers (location, height, and length) and other noise protection measures will be defined and noise maps will be provided within ESIA.

The design of noise barriers will comply with provisions of the National and European legislation, the Technical Specifications for Interoperability (TSI), as well as corresponding standards: 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 and SRPS EN 16951-2.

For residential buildings and other sensitive buildings for which protection by noise barriers is not economical or technically possible, and for buildings where exceeding noise level occurs even after installation of noise barriers, some other protection measures shall be planned such as replacement of doors and windows with better sound insulation.

Noise in construction:

Directive 2000/14/EC of the European Parliament and the Council of the European Union should be followed in respect to outdoor equipment noise. The Directive presents noise limits in the form of guaranteed sound power levels for equipment which should not be exceeded during the construction phase of the Project; and includes guidance on the conformity assessment procedures which the equipment should pass before placing into the market and procured for the Project.

BS5228:2009, A1:2014, titled 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' provides guidance that should be used during the Construction of the Project. The note advises to limit the noise levels between 7:00–19:00 hours to 70dB(A) in rural, suburban, and urban areas away from main roads and to 75dB(A) in urban areas near main roads and heavy industrial areas.

Vibrations

The vibrations and low frequency noise generated by railway traffic will be calculated using VIBRA-1 (Ziegler Consultants and Swiss Rail) software package. All inputs which will be used for calculation such as type of train, timetable, speed of each type of train, railway line characteristics (open track, tunnels, switches) etc. will be taken from the traffic technology design and other parts of railway design.

Due to lack of national legislation related to vibration, German standard DIN 4150-2 and DIN 4150-3, will be used as the criteria for assessment.

Vibrations will be calculated based on individual train passing, while the total impact will equal to a sum of standardised procedures in DIN 4150-2.

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.

The data on the prospective scope of railway traffic for modelling and analysis of vibration and low frequency noise will be taken from other parts of preliminary design, such as operational technology.

In the operational phase, 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.

Analysis of vibration and low frequency noise will be done for mentioned distance and if necessary for the wider area where there are residential and other sensitive buildings.

Based on analysis of vibration and low frequency noise caused by forecasted traffic volume at railway station Belgrade-Nis, mitigation measures will be defined to reduce the impact on the environment.

Vibration in construction:

The guideline values for short-term and long-term vibration from the aspect of the impact on the building's structure, according to the DIN 4150-3 standard shown in Tables 70 and 71, shall not be exceeded, for the appropriate structure type, frequency range and floor (e.g. 5mm/s in 1 to 10Hz range for foundations of residential dwellings) to avoid the possibility of damage to buildings.

Daytime: During the day, vibrations from construction activities will meet the standards for construction vibrations from DIN 4150-2 as given in Table 27. The assessment is performed in three orthogonal directions (vertical and two perpendicular horizontal axes) for the floor of the room in question, in the places where the strongest vibrations are expected.

Table 27. Reference values for daytime effects of vibration on people, generated by construction work for comparison with KB_{Fmax} and KB_{FTr} determined in accordance with DIN 4150-2 [60]

Duration, D, in days	Up to 1			Above 6 up to 26			Above 26 up to 78		
Threshold	A_u	A_O*	A_r	A_u	A_O*	A_r	A_u	A_O*	A_r
Level 1	0.8	5	0.4	0.4	5	0.3	0.3	5	0.2
Level 2	1.2	5	0.8	0.8	5	0.6	0.6	5	0.4
Level 3	1.6	5	1.2	1.2	5	0.8	0.8	5	0.6

* For commercial and industrial areas, $A_O = 6$.

KB_{Fmax} and KB_{FTr} are to be determined in accordance with DIN 4150-2. KB_{Fmax} must be lower than A_O and KB_{FTr} must be less than A_r during construction to meet the standard.

The following actions will be taken at the three levels identified in Table 27 dependent on expected duration of exceedance as described in the table.

- Below Level 1: With vibration below this level, it can be assumed that there will be no considerable discomfort and no specific action is required.

[60] *For infrequent, short-term vibration e.g. blasting, with no more than three events per day, the requirements of DIN 4150-2 have been met if KBFmax is less than the values set out in Table 2 of this document and no further assessment is required (further detail provided in subclause 6.5.1 of DIN 4150-2).*

- Above Level 1 and below Level 2: Vibration is not likely to produce considerable discomfort as long as the following measures are taken:
- Informing all those who may be exposed to the vibration, about the construction work, its duration and any expected vibration which may be generated;
- Explaining the inevitability of vibration produced by construction and any related discomforts;
- Introducing additional measures to reduce and limit discomfort;
- Naming a point of contact within the Contractor (the Community Liaison Officer in the first instance) to whom those exposed to the vibration can turn should any problems arise;
- Informing those exposed to the vibration about its effects on the building;
- Measuring the actual vibration and evaluating its effects (in a sample of buildings).
- Above Level 2 but below Level 3: As the vibration thresholds in Level 2 are exceeded, the probability increases that there will be considerable discomfort. Every attempt should be made to use alternative construction methods to reduce vibration.

For infrequent, short-term vibration e.g. blasting, with no more than three events per day, the requirements of DIN 4150-2 have been met if KB_{Fmax} is less than the values set out in Table 28 and no further assessment is required.

Table 28. Reference values for the assessment of vibrations in dwellings and similar buildings according to DIN 4150-2 (Structural Vibration - Human Exposure to Vibration in Buildings)

Use	Day (6^{00}-22^{00})			Night (22^{00}-6^{00})		
	A_u	A_o	A_r	A_u	A_o	A_r
Industrial area	0.4	6	0.2	0.3	0.6	0.15
Predominantly commercial area	0.3	6	0.15	0.2	0.4	0.1
Mixed commercial and residential area	0.2	5	0.1	0.15	0.3	0.07
Mainly residential area	0.15	3	0.07	0.1	0.2	0.05
Special areas (e.g. hospitals) or health resorts	0.1	3	0.05	0.1	0.15	0.05

Night-time: Construction activities during the night-time period will not normally be permitted. Where unavoidable, the vibration levels should meet the standards described above in Table 28 for the night-time period.

Where KB_{FTr} is expected to exceed the A_r given in Table 28 (e.g. 0.05 for predominantly residential areas at night) but KB_{Fmax} is predicted to be below the A_o, every attempt should be made to use alternative construction methods to reduce vibration where practicable**. Identified sensitive zones and receptors:**

Population in settlements along the route Velika Plana, Markovac, Lapovo, Novo Lanište, Jagodina, Ćuprija.

Workers

Habitats and fauna along the route

Small-scale beekeeping along the railway

Identified and reviewed existing baseline information relevant for the project:

Noise maps and calculation outputs presented within Corridor Level Environmental and Social Assessment for the Belgrade-Nis High Speed Railway Corridor, Serbia

Identified significant gaps in existing baseline data relevant for the project:

No acoustic maps in the zone of the railway corridor

No existing data on vibrations.

Method of further ESIA baseline data collection and assessment:

Data collection in the determination of the baseline noise and vibration levels in the observed area (site and surrounding area) by field noise and vibration measurements. Assessment of the impact of noise and vibration using appropriate software for modelling.

Bearing in mind that the works will be carried out under traffic, it is necessary to measure the existing state of vibrations in sensitive zones. The results obtained from the measurements will be combined with the results obtained from the vibration model and based on that we will be able to prescribe protection measures. Measurements will be made at sample locations where the houses are closest to the railway. This will be presented in more detail in the ESIA.

6.1.9. Landscape

No landscape groups have been defined on the level of the Republic of Serbia or even on the wider project level. Therefore, to determine landscape baseline, LANDSAT CORINE land cover classes 2018 maps with 100m resolution were used as a proxy. Satellite imagery with railway route is presented in parallel.

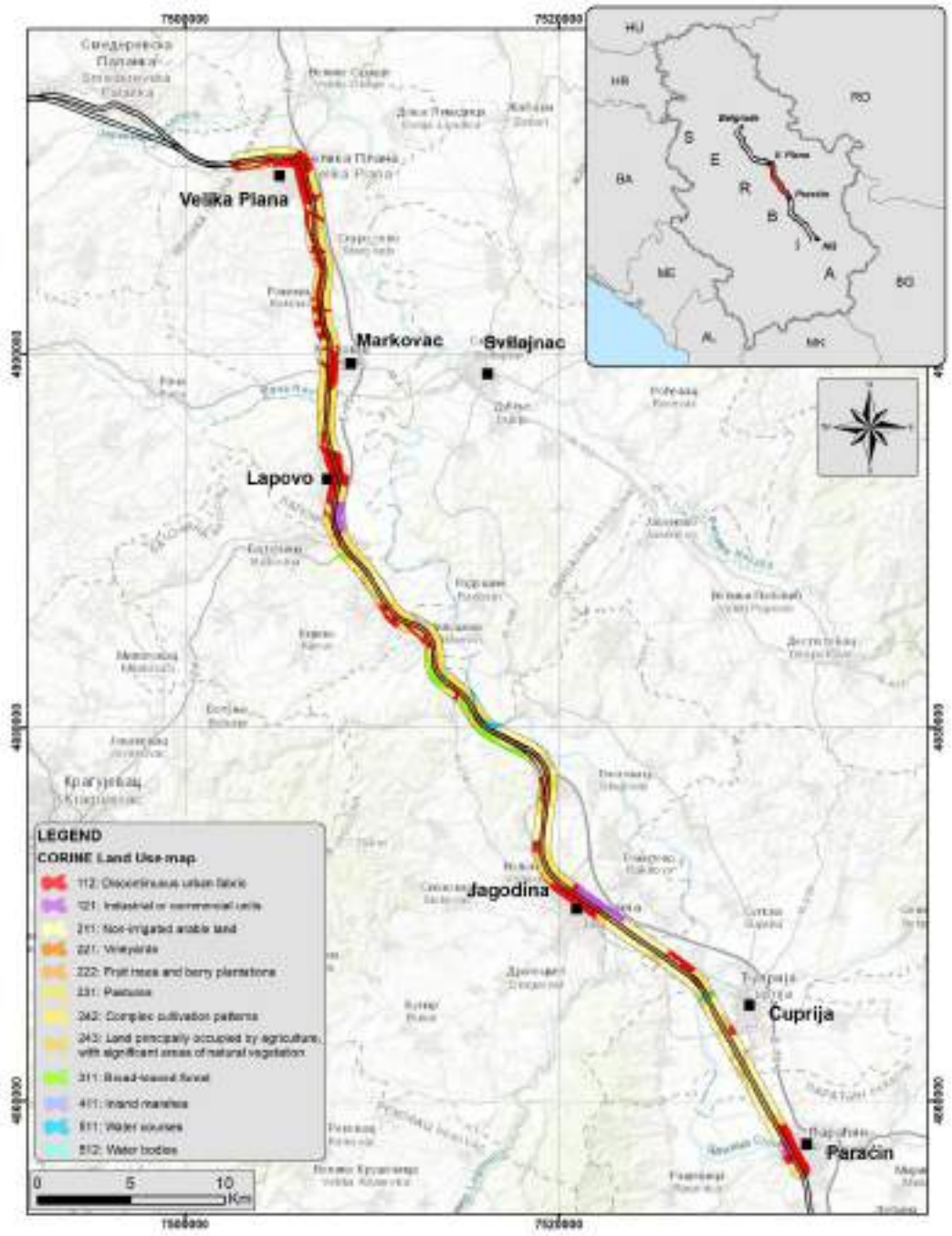


Figure 35. LANDSAT 2018 maps with 100m resolution—railway route market black

Identified landscape groups are:

- urban (cities of Velika Plana, Lapovo, Jagodina and Paraćin)

Figure 36. Example of urban landscape type – city of Velika Plana

- semi-urban (numerous settlements of various size throughout the route), usually surrounded by arable fields, meadows and patches of bush and higher vegetation,

Figure 37. Example of semi-urban landscape type – settlement of Brzan

- agricultural (section Markovac- Lapovo and Jagodina- Paraćin). Large areas of arable land mostly planted with annual crops. Majority of the area around the railway falls under this category- predominantly lowland-agricultural areas and hilly (orchards and vineyards) that belongs to the alluvial land. The presence of man and the lowland area with easy access to water has led to the spread of agricultural arable land between populated areas,

Figure 38. Example of agricultural landscape type southeast of Jagodina

- hilly terrain on the sides of Velika Morava valley (section between Lapovo and Novo Lanište). Mostly deciduous vegetation.

Figure 39. Example of hilly landscape type between Đunis and Jagodina

Transition between different landscape groups is on a contact of hills and settlements with plain terrain which is mainly anthropogenically altered arable land. Vegetation along watercourses, as well as on the entire line of the railway, is greatly influenced by agricultural activities, by the maintenance of the railway, as well as activities on the maintenance of natural and artificial watercourses which are carried out in different locations.

The terrain in the corridor of the existing railway route from Velika Plana to Paraćin is slightly undulating and generally sloping down from Velika Plana (110m asl) to Paraćin (129m asl).

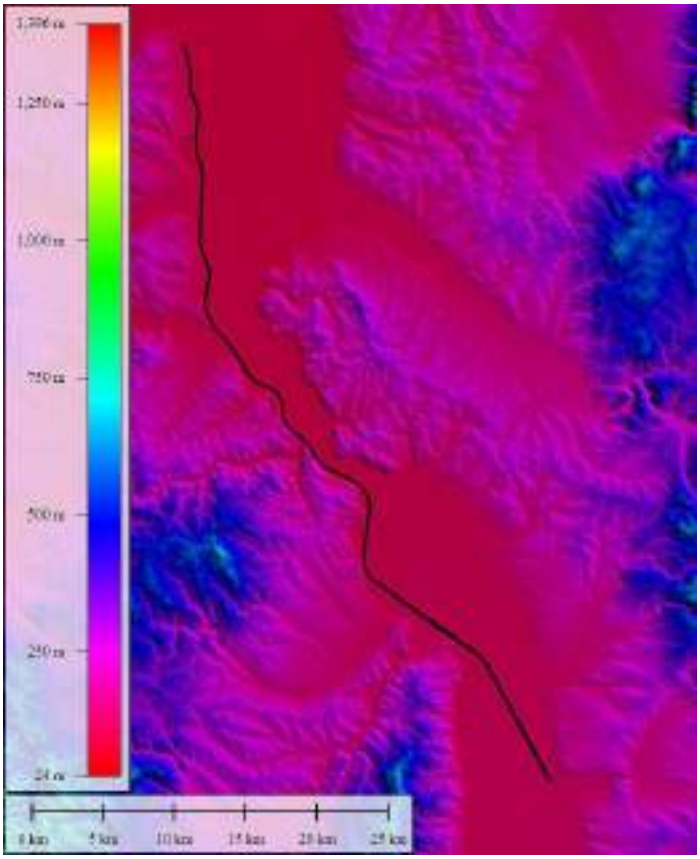


Figure 40. Elevation map for the project area with railway route (black line) – SRTM V3 worldwide elevation data – 1 ARC second resolution

The hydrographic network is medium dense in the plain terrain through which the existing railway passes and includes one large river- Velika Morava and a number of tributaries (Rača, Belica, Lugomir…). Watercourses are typically flat, with small gradients and predominantly large amounts of water. With the distance from the lowlands, the gradients of watercourses increase, and their erosion-torrent activity also increases. The terrain is less forested, while most of the land is arable.

The information system of immovable cultural property is an information system intended for the storage of digital and digitized data on immovable cultural property, i.e., the immovable heritage of the Republic of Serbia[61].

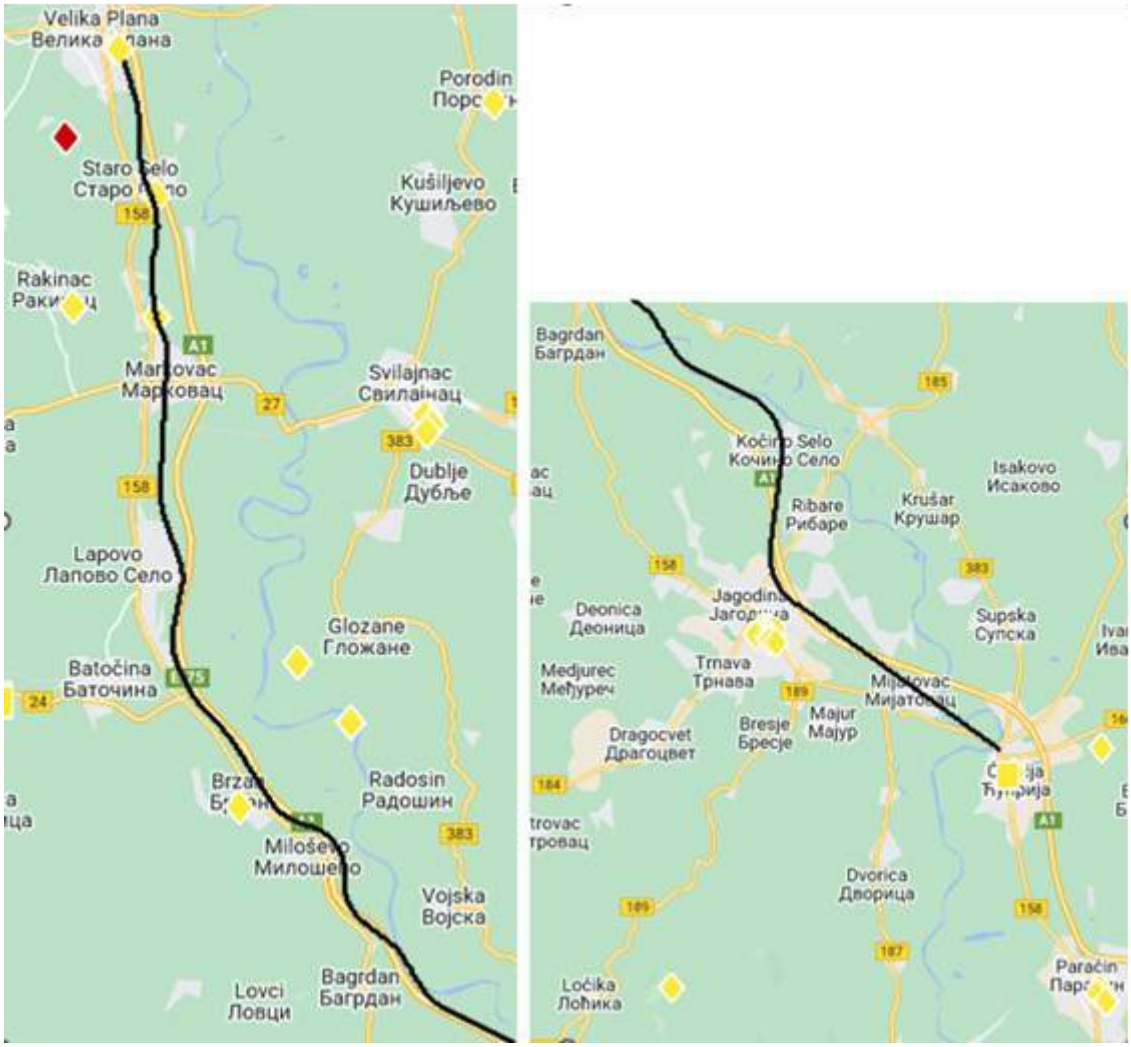


Figure 41. Immovable cultural property along the railway route (yellow diamonds are cultural monuments and yellow square is archeological site)

[61] *https://nasledje.gov.rs/index.cfm?jezik=Serbian_CIR*

Railway section mostly follows existing railway, with a couple of deviations due to the curve rectification in length of 200m to 2000m. Largest deviation (around 7500m) from the existing route is between settlement Novo Lanište and the suburb of Jagodina. With a planned railway moving away from the settlements (Novo Lanište, Ribnik, Bukovče), visual impact will be low to medium positive for their residents. Also, landscape character of the arable land that railway is planned to move through is also going to change.

Figure 42. Deviation of the new railway (red line) in reference to the existing one (black one)

Fact that Velika Plana–Paraćin railway section mostly follows existing railway significantly reduces the magnitude of change and impact on surrounding receptors. Therefore, is not expected for the project to be significantly at odds with the existing landscape character or to produce even medium adverse visual impact.

Identified sensitive zones and receptors:

Initial analysis of the zone of theoretical visibility (ZVI) shows that train with wagons will be visible for the viewers situated within Velika Morava valley (up to 10km between Velika Plana and Lapovo, around 3km between Lapovo and Novo Lanište and around 10 km between Novo Lanište and Paraćin). Due to the terrain configuration, railway will be visible to the larger population in its northern section (Velika Plana to Lapovo).

Identified and reviewed existing baseline information relevant for the project:

LANDSAT CORINE land cover classes 2018, satellite imagery

Institute for Nature Conservation of Serbia web portal

Institute for the Protection of Cultural Monuments of Serbia web portal

Conditions from different institutions and organizations regarding construction of the railway corridor

Nature protection strategy of the Republic of Serbia for the period 2019 -2025, 2018- draft

Identified significant gaps in existing baseline data relevant for the project:

None identified.

Method of further ESIA baseline data collection and assessment:

Analysis of the existing landscape and visual amenity will be carried out at the ESIA stage and will be based on a desk-based review of the relevant guidance, video recording taken from the current railway and planning policy context (where possible), in a review of local landscape character, including the existing site and features on the site, on a review of surrounding potential visual receptors, located within study area, including identification of representative viewpoint locations. Field survey of sections where new railway route deviates from the older one. Assessment and verbal quantification of changes to the landscape character and to the visual exposure.

6.2. Biodiversity and protected areas

6.2.1. Biodiversity baseline

Introduction

The Nature Conservation Strategy of the Republic of Serbia is a basic instrument for the implementation of ratified international agreements in the field of nature protection, establishing long-term objectives and measures for the conservation of biological and geological diversity and the manner of their implementation.

The Law on nature protection regulates planning, regulation and use of space, natural resources, protected areas and ecological network, to be implemented on the basis of spatial and urban development plans, planning and design documentation, bases and programs for the management and use of natural resources and goods in mining, energy, transport, water management, agriculture, forestry, hunting, fisheries, tourism and other activities affecting the nature, in compliance with measures and conditions of nature protection.

Pursuant to the Law on nature protection, wild species which are endangered or can become endangered, have a special significance from the genetic, ecological, ecosystem, scientific, health, economic, or other aspects, and are protected as strictly protected or protected wild species. There are 1760 strictly protected and 853 protected wild species of plants, animals, and fungi in Serbia (The Rulebook on a proclamation and protection of strictly protected and protected wild species of plants, animals, and fungi, "The Official Gazette of the Republic of Serbia", No. 5/2010 and 47/2011-134, 32/2016-59, 98/2016-97) (Table 29). These species will be considered in preparation of ESIA.

Table 29. Strictly protected and protected fauna species at the national level

Group of organisms	Mammalians	Birds	Reptiles	Amphibians	Fishes	Invertebrates	Total
Strictly protected species	50	307	18	18	30	609	1032
Protected species	30	35	2	3	34	154	258

In accordance with the Decree on the Ecological Network ("Official Gazette of RS", No. 102/2010), the Ecological Network of the Republic of Serbia involves 101 ecologically significant areas with a total area of 1,849,201.77 ha, which represents 20.93% of the country's territory. The ecological network of Serbia consists of protected areas, areas important for plants (Important Plant Areas, IPA), birds (Important Bird Areas, IBA) and butterflies (Prime Butterfly Areas, PBA), Ramsar sites, Emerald Areas (according to the Council of Europe Convention on the Conservation of European Wildlife and Natural Habitats), as well as certain coastal watercourses that represent ecological corridors of international importance because enable connection to the ecological networks of neighbouring countries. The ecological network of the Republic of Serbia will be considered in the process of ESIA preparation.

The vegetation of Serbia is characterized by great diversity, which indicates great habitat diversity. According to Radović and Kozomara (2011) between 700 and 800 different types of plant communities have been recorded on the territory of Serbia. Climazonal vegetation of Serbia is forests of Hungarian oak (Quercus frainetto) and Austrian oak (Quercus cerris) - Quercetum frainetto-cerris. Quercetum frainetto-cerris is the most widespread forest in Serbia. However, it should be borne in mind that the large areas of these forests are degraded, along the planned railway, and occupied with other habitat types. The highland and mountainous area of Serbia, as part of the Balkan Peninsula, is one of the 6 centers of European biodiversity.

The Republic of Serbia is characterized by a great diversity of vascular flora. 3730 autochthonous taxa of vascular flora have been recorded so far, assuming that their total number ranges between 3900 and 4000. Of the total number of plant species, 14.94% (547 taxa) are Balkan endemics and 1.5% (59 taxa) are local endemics. 627 plant species

are strictly protected, and 559 plants are protected by national Low on nature protection ("The Official Gazette of the Republic of Serbia", No. 5/2010, 47/2011 and 32/2016 and 98/2016).

Serbia is characterized by high species diversity, despite the fact that its territory covers only 1.9% of the European continent. In Table 30 number of fauna species and subspecies is presented [62]:

Table 30. Species diversity in Serbia

Taxon	No. of species and subspecies in Serbia
Mammals	96
Birds	360
Reptiles	25
Amphibians	21
Fishes	98
Invertebrates	12000

Methodology for biodiversity surveys

Primary and secondary data will be collected to understand the terrestrial biodiversity values in the project area of influence and to identify the presence or potential presence of critical habitat and priority biodiversity features (according to EBRD PR6).

A desktop review of the project area of influence is undertaken using the existing project documents, relevant available literature, online databases (e.g. Integrated Biodiversity Assessment Tool IBAT, International Union for Conservation of Nature - IUCN Red List, Birdlife Data Zone), satellite imagery and maps concerning the area of influence and surrounding ecosystems; migration and movement corridors; endemic/restricted-range species, invasive species; IUCN and nationally threatened (red-listed) species; species and their habitats that are a priority for conservation, including species listed by the EU Habitats Directive and Birds Directive, Bern Convention, IUCN Red List of Threatened, Bonn convention and CITES convention, Law on Nature protection of the Republic of Serbia.

Ecosystems that are a priority for conservation (habitats listed by the EU Habitats Directive (Annex I), Bern Convention (Resolution 4), Key Biodiversity Areas, Alliance for Zero Extinction (AZE) sites, Red List of Threatened Ecosystems (IUCN) and ecosystems recognized by the scientific community as being associated with key

[62] *Biodiversity of Serbia", Institute for Nature Conservation of the Republic of Serbia, Belgrade, 2012 (in Serbian) (Biodiverzitet Srbije, stanje i perspektive, Zavod za zaštitu prirode Srbije, Beograd, 2012)*

evolutionary processes will be defined during the field surveys. Also, species and their habitats that are a priority for conservation, including species listed by the EU Habitats Directive and Birds Directive, Bern Convention, IUCN Red List of Threatened, Bonn convention and CITES convention, Law on Nature protection of the Republic of Serbia will be determined during the field research, covering different vegetation seasons.

The main aim of the field survey is to collect data on flora and fauna species of interest for protection, as well as data on important habitat types to predict the possible effects of the construction work on biodiversity. The scope of all foreseen activities within biodiversity surveys include research on natural habitats, flora and fauna species; Mapping of natural habitats within the Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance.

The field survey will be undertaken in four seasons (winter, spring, summer, and autumn;) and will involve the following:

- Identification, mapping, and description of the natural, semi-natural, and artificial habitats along the corridor. The classification of the present habitat types follows EUNIS version 2012 (amended 2019), and the digitalization will be performed using ArcGISPro.
- Recording species associated with each habitat, with emphasis on species of conservation concern (globally/nationally threatened species, endemic/restricted range species, migratory/congregatory species, and bird flyways, Annex II/Annex IV species protected under the EU Habitats Directive, invasive species, and nationally protected species).
- Flora surveys will be performed by visual method, by collecting plants in order to determine the most important ones, and by taking photos.
- The habitat/flora survey will include more effort in the natural and semi-natural habitats and less effort in the modified/anthropogenic habitats such as agricultural fields.
- The fauna surveys will cover terrestrial mammals, birds, reptiles, amphibians, and insects and ichtyofauna. Field surveys will involve a range of methods including direct observations, listening, collection of increments, and taking photos.

The area of influence (study area) will encompass 500 m of the corridor on both sides of the railway. In addition, the study area will be expanded to fully encompass the ecologically appropriate areas of analysis (EAAA) for features that require additional focused study. In accordance with existing data on the biodiversity of the project area, the study area will be expanded in the zone of ecosystems that are a priority for conservation, habitats that are a priority for conservation, and protected areas. The EAAAs will be defined further, once field work would be undertaken.

Experts for insects, reptiles and amphibians, fish, birds, mammals, and flora experts are engaged to perform all these surveys.

6.2.2. Habitats and Flora

The potential natural vegetation of project area is degraded by urbanization, forming different plant plantations and forest cutting to form arable land. In accordance with this fact, large area of this area is composed of artificial habitats. These are arable land, constructed, industrial, and other artificial habitats, hedgerows etc. The habitat types that can be found below are made based on desk research. During the field surveys, the list of habitats will be updated.

Natural habitats that can be recorded along the project area are forests, shrublands, grasslands, and water habitats. As anthropogenic influence is very strong along the whole area, the natural vegetation along the railway corridor is reduced to small fragments.

- Natural habitats

Reference to EUNIS Habitats: G.1 Broadleaved deciduous woodland.

Reference to EU HD Annex I: none

Reference to CoE BC Res. none

Broadleaved deciduous woodland is presented fragmentary and occupied small areas within the project area. These habitats are developed in hilly areas along the area of influence. At these localities different autochthonous plant species are recorded, such as: *Quercus robur* (Europaean oak), *Carpinus betulus* (common hornbeam), *Crataegus monogyna* (common hawthorn), *Fraxinus angustifolia* (narrow-leafed ash), *Acer campestre* (field maple), *Evonymus europaeus* (European spindle), *Prunus spinosa* (blackthorn), *Rosa canina* (dog rose), *Cornus sanguine* (common dogwood), *Crataegus monogyna* (common hawthorn), *Ulmus minor* (field elm), *Clematis vitalba* (Old man's beard) etc. At the edges of these habitats ruderal and invasive plants can be recorded. *Amorpha fruticosa* (indigo bush), *Robinia pseudoaccacia* (black locust), *Ailanthus altissima* (Tree of heaven) are some of the invasive plants which are present along the edges of the Broadleaved deciduous woodland. Some of ruderal plants that are present along the edges of this habitats are: *Sambucus ebulus* (Danewort), *Daucus carota* (Wild carrot), *Dactylis glomerata* (Cat grass), *Dipsacus laciniatus* (Cut-leaved teasel), *Urtica dioica* (Common nettle), *Rubus sp.* (Brambles), *Cichorium intybus* (Common chicory), *Cirsium arvense* (Creeping thistle), *Chelidonium majus* (Greater celandine), and others.

Reference to EUNIS Habitats: G1.1 - Riparian and gallery woodland, with dominant Alnus, Betula, Populus, or Salix

Reference to EU HD Annex I: 92A0 - *Salix alba* and *Populus alba* galleries

Reference to CoE BC Res. No. 4 1996: G1. 1 - *Salix alba* and *Populus alba* galleries

Generally, these habitats are situated along rivers (South Morava River and Nišava) and in the lower parts of the alluvial plain, where there is a high level of groundwater. However, today willow and poplar forests are almost completely disturbed and represented only by small groups or individual trees *Salix alba* (White willo), *Salix purpurea*

(Purple willow), *Salix fragilis* (Crack willow), and *Populus alba* (White poplar). According to the national *RULE BOOK on criteria for the selection of habitat types, sensitive, endangered, rare, and for the protection of priority habitat types and protection measures for their preservation* (Official Gazette of RS", No. 36/09), these habitats belong to the group of "fragile habitats (A)". These habitats belong to the mentioned type due to functional instability and sensitivity to degradation. *Salix alba* and *Populus alba* galleries are situated along rivers and they are very degraded in the area of the railway corridor. Following EBRD Environmental and Social Policy (2022) and Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, *Salix alba* and *Populus alba* galleries present Priority biodiversity features (threatened habitats).

In addition to the aforementioned species, *Populus tremula* (European aspen), *Populus nigra* (Black poplar), *Acer campestre* (field maple), *Fraxinus angustifolia* (Narrow-leaved ash), *Evonymus europaeus* (European spindle), *Cornus sanguine* (common dogwood), *Crataegus monogyna* (common hawthorn), *Ulmus minor* (field elm), *Clematis vitalba* (Old man's beard) are some of species which are characteristic for this habitat type. Due to intensive anthroporessure ruderal and invasive plants have high presence degree. Some of ruderal plants are: *Dactylis glomerata* (Cat grass), *Urtica dioica* (Common nettle), *Chelidonium majus* (Greater celandine), *Rubus sp.* (Brambles), *Bromus sterilis* (barren brome), *Sambucus ebulus* (danewort) and others. Also, at the edges of forests some invasive plants are prewsent, such as: *Amorpha fruticosa* (indigo bush), *Robinia pseudoaccacia* (black locust), *Acer negundo* (Boxelder maple), *Reynouria japonica* (Japanese knotweed) etc.

Reference to EUNIS Habitats: C3.2 - Water-fringing reedbeds and tall helophytes other than canes

Reference to EU HD Annex I: none

Reference to CoE BC Res. No. 4 1996: none (**used for designation of Emerald sites**)

This habitat has been recorded in the valleys of watercourses located in the corridor zone. Some of characteristic species are: *Schoenoplectus lacustris, Typha angustifolia, T. latifolia, Glyceria maxima, Carex acutiformis, Carex hirta,C. vulpina, Epilobium palustre, Iris pseudacorus, Lythrum salicaria, Mentha longifolia, Ranunculus sceleratus, Ranunculus trichophyllus, Scutellaria galericulata, Veronica anagallis-aquatica,* etc. According to the national *RULE BOOK on criteria for the selection of habitat types, sensitive, endangered, rare and for the protection of priority habitat types and protection measures for their preservation* (Official Gazette of RS", No. 36/09), these habitats belong to the group of "fragile habitats (A)/Ret". These habitats belong to the mentioned type due to functional instability and sensitivity to degradation and they are rare in Serbia. Following EBRD Environmental and Social Policy (2022) and Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, this habitat presents Priority biodiversity features (threatened habitats).

- Anthropogenic habitats

Anthropogenic influence is very strong and ubiquitous in the whole area. Urbanization (settlements and road construction), land reclamation, regulation of watercourses, expansion of arable land, presence of herbicides, and other pollutants led to the degradation of natural vegetation. All this conditioned domination of anthropogenic habitats along the railway corridor. Anthropogenic habitats include agricultural land, grasslands, and urban areas. Given the constant anthropogenic influence within these sites, domination of ruderal and invasive plants in their surrounding is expected. The list of these habitats with a brief description can be found below:

Reference to EUNIS Habitats: I1.1 Intensive unmixed crops

The **arable land** is the dominant habitat along the entire railway corridor. The agroecosystems along the corridor are represented by individual parcels of different types of agricultural crops. The dominant agricultural crop is corn. After corn, the important agricultural crops are wheat, barley, and sunflower. Species *Lolium perenne* (Perennial ryegrass), *Daucus carota* (Wild carrot), *Urtica dioica* (Common nettle), *Artemisia vulgaris* (Mugwort), *Raphanus raphanistrum* (Wild radish), *Chenopodium album* (White goosefoot), *Consolida regalis* (Forking larkspur), *Cichorium intybus* (Chicory), *Cirsium arvense* (Creeping thistle) and others are species which are present along the edges of arable lands.

Reference to EUNIS Habitats: E5.1 Anthropogenic herb stands

The **ruderal vegetation** is widely present throughout the corridor. Most of the grasslands in the area of the railway corridor are of anthropogenic origin. They occupy small areas since most of the agricultural land is usually permanently arable. Ruderal and weedy plant species are dominant within these habitat types. Some of them are: *Cynodon dactylon* (Scutch grass), *Lolium perenne* (Perennial ryegrass), *Bromus spp.*(Bromes), *Hordeum vulgare* (Hordeum vulgare), *Sambucus ebulus* (Danewort), *Anthemis arvensis* (Corn chamomile), *Artemisia vulgaris* (Mugwort), *Cichorium intybus* (Chicory), *Cirsium arvense* (Canada thistle), *Dipsacus laciniatus* (Cutleaf teasel), *Chenopodium album* (White goosefoot), *Arctium lappa* (Greater burdock), *etc*. Also, these habitats are suitable for the development of invasive plants, such as *Datura stramonium* (Jimsonweed), *Ambrosia artemisifolia* (Annual ragweed), *Syphiotrichum lanceolatum* (Panicled aster), *Sorghum halepense* (Johnson grass) etc.

Reference to EUNIS Habitats: FB.4 - Vineyards

Plantations of grapevine *Vitis vinifera* are located in the surrounding of Jagodina village.

Urban and suburban areas along the proposed railway corridor are very densely populated. There are two urban centers (Paraćin and Niš), and several villages and settlements along the corridor. The presence of isolated houses is also common. The urban and suburban habitats along the railway corridor are:

Reference to EUNIS Habitats J1.1 Residential buildings of city and town centers;

Reference to EUNIS Habitats: J1.2 Residential buildings of villages and urban peripheries;

Reference to EUNIS Habitats: J1.4 Urban and suburban industrial and commercial sites still in active use

Reference to EUNIS Habitats: J4.3 Rail networks

Reference to EUNIS Habitats: J4.2 Road networks

The primary characteristic of these habitat types is the presence of numerous allochthonous plants, essentially decorative trees and shrubs. Also, most plant species are strictly adapted to urban environmental conditions. Ruderal plant species have a dominant presence within all mentioned urbanized areas. These are common ruderal plants of urbanized areas, such as *Daucus carota* (Wild carrot), *Urtica dioica* (Common nettle), *Artemisia vulgaris* (Mugwort), *Chenopodium album* (White goosefoot), *Cichorium intybus* (Chicory), *Cirsium arvense* (Creeping thistle), *Atriplex hastata* (Spear-leaved orache), *Amaranthus sp.* (Amaranth), *Parietaria officinalis* (Eastern pellitory-of-the-wall), *Conium maculatum* (Wild hemlock), *Daucus carota* (Wild carrot), *Dipsacus laciniatus* (Cutleaf teasel), *Arctium lappa* (Greater burdock), *Setaria glauca* (Yellow foxtail), *Sambucus ebulus* (Danewort), *Bidens tripartite* (Three-lobe beggarticks), *Senecio vulgaris* (Common groundsel), *Dactilys glomerata* (Cat grass) etc. The urban environment is very suitable for plant invasions. In these areas the habitats are fragmented, climate conditions are specific, and soil is nitrophilous. All these characteristics make urban and suburban areas congenial to the invasive plants colonization and spread. Some of them are: *Ailanthus altissima* (Tree of heaven), *Acer negundo* (Boxelder maple), *Amorpha fruticose* (Indigo bush), *Phytolacca americana* (American pokeweed), *Robinia pseudoacacia* (Black locust), *Erigeron annus* (Annual fleabane), *Echinocystis lobata* (Wild cucumber), *Syphiotrichum lanceolatum* (Panicled aster), *Sorghum halepense* (Johnson grass), *Xantium strumarium* (Rough cocklebur).

- *Reference to EUNIS Habitats: X07 - Intensively-farmed crops interspersed with strips of natural and/or semi-natural vegetation*

This habitat occupies a large area in some parts of the project area. These are intensively grown crops interspersed with strips of natural and/or semi-natural vegetation. They are formed on the sites of natural forest, grass and shrub vegetation that was widespread in the past and destroyed by man. *Prunus spinosa* (blackthorn), *Cornus sanguinea* (common dogwood), and *Acer campestre* (field maple) are shrub species that make the floristic composition of the habitat. Also, some ruderal species are recorded within this habitat, such as *Lamium purpureum* (Red deadnettle), *Silene latifolia* (White campion), *Erodium cicutarium* (Common stork's-bill), *Euphorbia platyphyllos* (broad-leaved spurge), etc.

The list of endemics, rare and protected plants will be established after a completed field investigation.

Also, the complete list of habitats along project area will be presented after the field surveys. **Preliminary map (Figure 43) of potential habitats along the project area is presented based on CORINE land cover data and EUNIS habitat classification.** After the completed field research, the habitat map will be modified and supplemented.

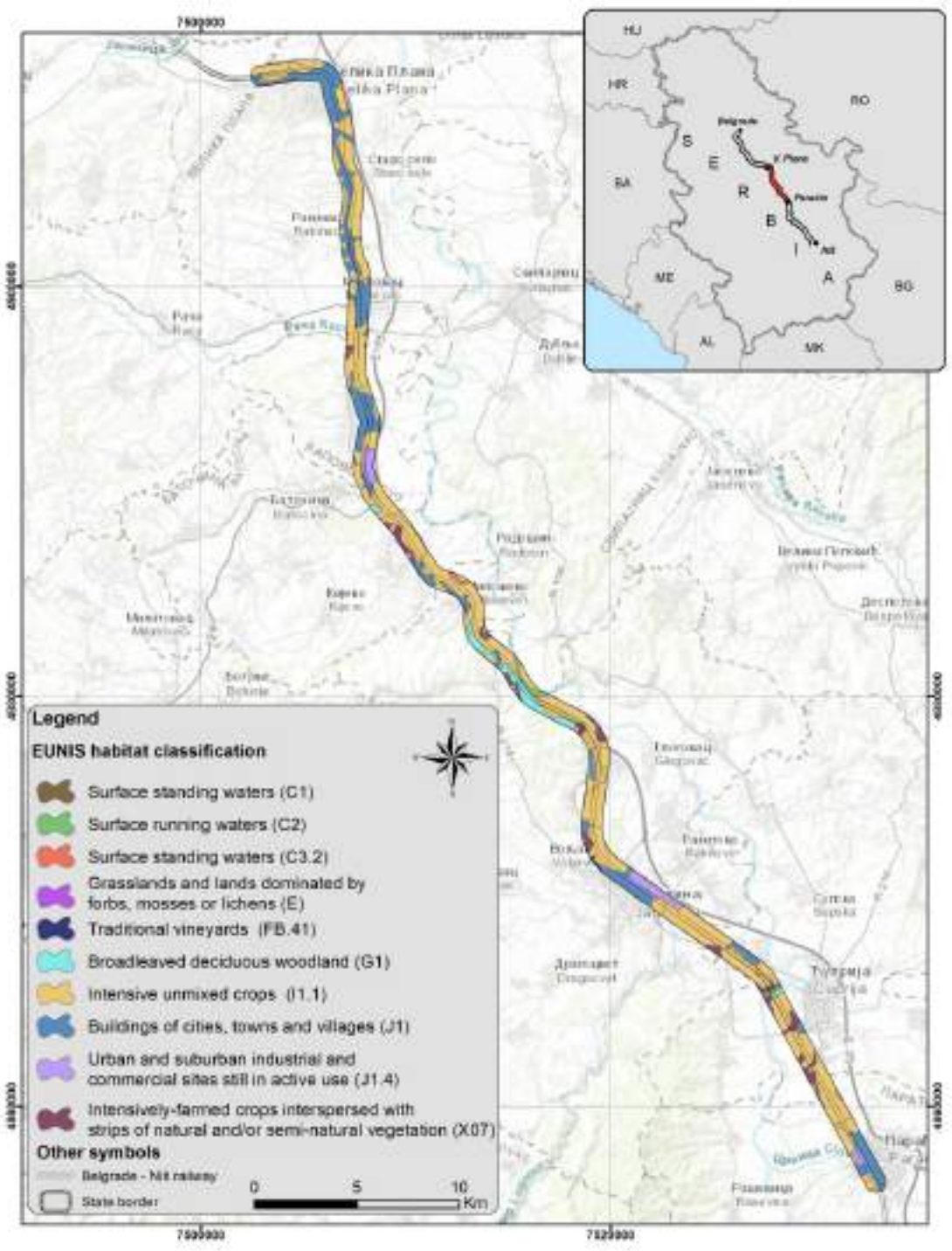


Figure 43. Preliminary habitat map along the project area

Identified sensitive zones and receptors:

Habitats and flora species within the project area.

Identified and reviewed existing baseline information relevant for the project:

Stevanović V. and Vasić V. (Eds.) (1995): Biodiversity of Yugoslavia with an overview of species of international importance. Faculty of the biology of the University of Belgrade.

Tomović G. (2007): Phytogeographic affiliation, distribution and centers of diversity of Balkan endemic flora in Serbia. Doctoral dissertation. Faculty of Biology, University of Belgrade, Belgrade (in Serbian)

Radović, I. and Kozomara, M. (Eds.) (2011): Biodiversity strategy of the Republic of Serbia for the period from 2011 to 2018. Ministry of Environment and Spatial Planning. Belgrade (in Serbian)

“Biodiversity of Serbia”, Institute for Nature Conservation of the Republic of Serbia, Belgrade, 2012 (in Serbian) (Biodiverzitet Srbije, stanje i perspektive, Zavod za zaštitu prirode Srbije, Beograd, 2012)

Law on Nature Protection ("Official Gazette of the RS", No. 36/2009, 88/2010, 91/2010 – corr., 14/2016 and 71/21)

The web portal of the Institute for Nature Conservation of Serbia

Nature Conservation Strategy of the Republic of Serbia, Nature Conservation Programs of the autonomous province and local government units and State of Nature Reports

Integrated Biodiversity Assessment Tool IBAT, International Union for Conservation of Nature - IUCN Red List, Birdlife Data Zone

CORINE land cover of the area; EUNIS habitat type map of the area

Preliminary Feasibility Study for the Reconstruction and modernization of the railway line Belgrade – Niš up to speed of 200 km/h (part of the project EUROPEAID/139687/DH/SER/RS) – Biodiversity report (2021.-2022.)

Identified significant gaps in existing baseline data relevant for the project:

The lack of the official habitat map on national level.

Method of further ESIA baseline data collection and assessment:

For the ESIA baseline preparation a set of documentation is available that include national (laws and sub laws, strategies) and international (EU Directives, Conventions, etc.) legislation, various reports on state of environment and on biodiversity prepared by international and national institutions etc. Additionally, due to the project's characteristics (long linear infrastructure project) and sensitivity of the area, a biodiversity survey throughout one year period (habitats, flora and fauna) will be done. Baseline study and surveys shall include Desktop review of project area and species and habitats potentially distributed within area of project influence, particularly those that are recognized as priority biodiversity features (PBF) and/or critical habitat (CH) according to EBRD PR6 and Baseline survey of species and habitats identified through desktop review, within the appropriate area of assessment. The scope of all foreseen activities within biodiversity surveys includes Research on natural habitats, flora and fauna species; Mapping of natural habitats within the Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance. An important source of data and information for baseline description is envisaged to be given from NGOs dealing with environmental protection, national authorities (Institute for Nature Conservation of Serbia) with whom consultations will be held. Results of the biodiversity surveys will be used for ESIA baseline description and impact assessment.

6.2.3. Fauna

Fauna of the region around the area of the railway is sporadically investigated. During the assessment process, with planned field research and newly obtained data, the number (list) of species will be confirmed and/or amended.

Insects

Information about insects exists in the individual findings of researchers are also participating in planned field surveys for Section 2 between Velika Plana and Paraćin. There is data in the literature presenting previous research in the wider environment of the project area. Some of the findings must be carefully interpreted because the locations of species findings (1) are outside the project area or (2) the exact locality where the species was recorded is not known. Some data are available through Alciphron—Database of insects of Serbia [63], (Lepidoptera, Heteroptera, Odonata, Coleoptera, Orthoptera, Diptera (Syrphidae) and others).

During field research, data of insect groups, namely butterflies, beetles, and dragonflies, will be collected, from the locations determined by overlaying satellite images and project infrastructure. For a data review will be used Biologer

[63] Miljević, M. & Popović, M. (2014) Alciphron—Database of insects of Serbia: Lepidoptera, Papilionoidea. HabiProt, Belgrade. Available from: http://alciphron.habiprot.org.rs (accessed 6 December 2017)

platform (Popovic et al., 2020), to confirm previous findings of almost 200 insect species within the project area – a zone of 500 meters on both sides of the railway. So far, recorded species of protection interest, such as the European stag beetle *Lucanus cervus*, the Beech longhorn beetle *Morimus asper*, the European rhinoceros beetle *Oryctes nasicornis*, etc. These species are specific for forests and wooded areas, which are fragmentarily presented and occupy small areas within the project area. These habitats are developed in hilly areas along the area of influence of Section 2 between Velika Plana and Paraćin. In this Section 2 there are two protected areas: Rogot and Brzansko Moravište, with specific fauna of insects, connected with specific habitats registered in protected areas. A detailed list of species along the area of influence under Section 2 will be provided in ESIA.

Fish

There are data from sporadic fish surveys, which were conducted to determine fishing areas (according to the Law on Protection and Sustainable Use of Fish Stock -"Official Gazette of RS" no. 36/2009). There are data from the locality Velika Morava, which confirm the presence of representatives of four families (Esocidae, Cyprinidae, Siluridae, Gobiidae). During the investigations, species will be determined together with the category of protection.

Herpetofauna

Some data related to herpetofauna, for example, refer to the 2010s ([64],[65]). Based on literature data at least thirteen species of herpetofauna evidenced in this area belong to the strictly protected or protected species in Serbia (*Lissotriton vulgaris, Triturus macedonicus, Triturus ivanbureschi, Bombina variegata*, *Bufo bufo, Rana dalmatina, Pelophylax ridibundus, Hyla arborea, Coronella austriaca, Dolichophis caspius, Zamenis longissimus, Natrix natrix, Natrix tessellata*). Species that can be found in this area and are not protected in Serbia are *Anguis fragilis, Podarcis muralis* and *Lacerta viridis.* All the mentioned species are internationally significant and are on the lists of protected species of the Berne Convention and the Habitats Directive. During spring and summer field research in 2023, only 2 species of amphibians (*Bombina variegata* and *Pelophylax ridibundus*) and 4 species of reptiles (*Podarcis muralis, Lacerta viridis, Dolichophis caspius and Zamenis longissimus*) were recorded in the section between Velika Plana and Paraćin. The most numerous amphibian species found is *Pelophylax ridibundus,* very common in wet habitats, such as lakes, ponds and canals near the planned railway (near Brzan, Great Morava and Bagrdan). The most common reptiles species in this area are *Podarcis muralis* and *Lacerta viridis,* mostly found on rocky ground and bushes around the railway. Species for which there are literature data on their presence and suitable habitats in this

[64] *Vukov, T., Kalezić, M. L., Tomović, L., Krizmanić, I., Jović, D., Labus, N. and Džukić, G. (2013): Amphibians in Serbia: distribution and diversity patterns. Bulletin of the Natural History Museum, (6), 90-112.*

[65] *Tomović, L., Ajtić, R., Ljubisavljević, K., Urošević, A., Jović, D., Krizmanić, I., Labus, N., Đorđević, S., Kalezić, M.L., Vukov, T. and Džukić, G. (2014): Reptiles in Serbia: Distribution and diversity patterns. Bulletin of the Natural History Museum, (7), 129-158.*

area, which have not yet been found by field research are *Lissotriton vulgaris, Triturus macedonicus, Triturus ivabbureschi, Bufo bufo, Rana dalmatina, Hyla arborea, Natrix natrix* and *Coronella austriaca*).

Birds

Regarding bird fauna, some data available dated from the beginning of twenty century and some newly references also. It is evidenced mix of different types of fauna, as a consequence of significant changes in habitats due to anthropogenic factors. Characteristic species that nest in such mosaic habitats between Paraćin and Velika Plana are, for example, *Buteo buteo*, *Streptopelia turtur*, *Sylvia atricapilla*, *Columba palumbus*, *Dendrocopos major*, *Ciconia ciconia*, *Ardea alba*, *Alcedo atthis*, *Lanius collurio*, *Emberiza citrinella* and *Cygnus olor*. Almost 70 bird species registered in the project area are protected by national law as strictly protected or protected species. In addition, following the Convention on the Protection of European Wildlife and Natural Habitats (Law on Ratification of the Convention on the Protection of European Wildlife and Natural Habitats, "Official Gazette – International agreements no. 102/07), more than 55 species are found in Annex II to this Convention which implies their strict protection, while the other species are listed in Annex III, which implies the possibility of controlled use of these species.

Turtle Dove *Streptopelia turtur* is a species whose population status is assessed as vulnerable in the Red Book of Fauna 3 - Birds. Also, *Ciconia ciconia*, *Ardea alba*, *Alcedo atthis* and *Lanius collurio* are listed in Annex I Bird Directive.

During the field investigation, special attention will be given to birds in Special Nature Reserve "Brzansko Moraviste". It is expected to find a larger congregation of individuals of different species, such as the White Stork *Ciconia ciconia.* According to literature data, these birds can fly 1 km above the ground (in this case railway line) and observation will cover the range of AoI (500 m far from both sides of the railway). In this sense, attention will be paid to this potential risk, which will be further explained under the ESIA.

All other recorded species, which have a certain international importance or have a significantly threatening conservation status (e.g. Great Egret, Turtle Dove and Kingfisher) will be observed with special attention and the risk of suffering on the railway route will be assessed.

Mammals

Based on literature data, at least thirty-four mammal species evidenced in this area (Section 2 – Velika Plana–Paraćin) belong to the strictly protected or protected species in Serbia.

Insectivores (*Eulipotyphla)* are represented in Section 2 by 3 protected species (*Erinaceus roumanicus* , *Sorex araneus* and *Talpa europaea*). There are still no documented findings for three species (*Sorex minutus*, *Neomys*

fodiens and *Sorex alpinus*). There are species that inhabit forests and forest-like habitats (*Talpa europaea and Sorex araneus*), and habitats of ecotonic character (*Erinaceus roumanicus*)

The newest data (Paunović, 2016; Paunović *et al.*, 2020) indicate the occurrence of about 16 species of **Bats** (Chiroptera) along the railroad in Section 2. (*Rhinolophus blasii, Rhinolophus euryale, Rhinolophus ferrumequinum, Rhinolophus hipposideros, Eptesicus serotinus, Eptesicus serotinus, Myotis bechsteinii, Myotis capaccinii, Myotis emarginatus, Myotis myotis, Nyctalus noctula, Pipistrellus kuhlii, Pipistrellus nathusii, Pipistrellus pipistrellus, Pipistrellus pygmaeus, Plecotus austriacus* and *Miniopterus schreibersii*). All bat species in Serbia are under strict protection.

Only one **Rodent** species (Rodentia) – *Spalax leucodon* is a strictly protected species, while *Sciurus vulgaris* is a protected species. The rest (*Ondatra zibethica, Microtus subterraneus, Microtus arvalis, Apodemus sylvaticus, Mus musculus, Mus spicilegus* and *Rattus norvegicus*) have no special protection status. These are mainly species of the wide ecological spectrum that inhabit different types of habitats, from the forest, steppe-like, to significantly anthropogenically modified habitats.

The only representation of **Lagomorphs** (Lagomorpha) – *Lepus europaeus*, is a protected species.

There are also 10 recorded species of **Carnivores** (*Carnivora*). These are: *Canis lupus, Canis aureus, Vulpes vulpes, Mustela nivalis, Mustela putorius, Martes martes, Martes foina, Meles meles, Lutra lutra* and *Felis silvestris.* Given the general ecological and trophic status of Carnivora, of the second and higher ranks, numerous populations of most of these species are not expected along the proposed route. On the other hand, in recent years there has been a significant increase in some species, more adaptable to changes in the environment. Such species are the Red fox (*Vulpes vulpes*), the European badger (*Meles meles*), and especially the Golden jackal (*Canis aureus*). Only the European otter (*Lutra lutra*) is a strictly protected species. The others are protected species.

The Fauna of the **Even-toed ungulates** (*Artiodactyla*) is typically represented by species that are characteristic of almost the entire territory of Serbia (Roe deer – *Capreolus capreolus* and Wild boar – *Sus scrofa*). These are species with relatively wide ecological niches in terms of the selection of habitats and food preferences, so they present in the wider area of the projected route.

Identified sensitive zones and receptors:

Fauna within the project area.

Identified and reviewed existing baseline information relevant for the project:

Vukov, T., Kalezić, M. L., Tomović, L., Krizmanić, I., Jović, D., Labus, N. and Džukić, G. (2013): Amphibians in Serbia: distribution and diversity patterns. Bulletin of the Natural History Museum, (6), 90-112.

Tomović, L., Ajtić, R., Ljubisavljević, K., Urošević, A., Jović, D., Krizmanić, I., Labus, N., Đorđević, S., Kalezić, M.L., Vukov, T. and Džukić, G. (2014): Reptiles in Serbia: Distribution and diversity patterns. Bulletin of the Natural History Museum, (7), 129-158.

Matvejev, S.D. (1950): Distribution and life of birds in Serbia. SASA, Belgrade (in Serbian)

Stevanović V. and Vasić V. (Eds.) (1995): Biodiversity of Yugoslavia with an overview of species of international importance. Faculty of the biology of the University of Belgrade.

Radović, I. and Kozomara, M. (Eds.) (2011): Biodiversity strategy of the Republic of Serbia for the period from 2011 to 2018. Ministry of Environment and Spatial Planning. Belgrade (in Serbian)

“Biodiversity of Serbia”, Institute for Nature Conservation of the Republic of Serbia, Belgrade, 2012 (in Serbian) (Biodiverzitet Srbije, stanje i perspektive, Zavod za zaštitu prirode Srbije, Beograd, 2012)

Law on Nature Protection ("Official Gazette of the RS", No. 36/2009, 88/2010, 91/2010 – corr., 14/2016 and 71/21)

https://www.birdlife.org/

The web portal of the Institute for Nature Conservation of Serbia

Nature Conservation Strategy of the Republic of Serbia, Nature Conservation Programs of the autonomous province and local government units and State of Nature Reports

Integrated Biodiversity Assessment Tool IBAT, International Union for Conservation of Nature - IUCN Red List, Birdlife Data Zone

CORINE land cover of the area; EUNIS habitat type map of the area

Preliminary Feasibility Study for the Reconstruction and modernization of the railway line Belgrade – Niš up to speed of 200 km/h (part of the project EUROPEAID/139687/DH/SER/RS) – Biodiversity report (2021.-2022.)

Identified significant gaps in existing baseline data relevant for the project:

The lack of the official habitat map on national level.

Method of further ESIA baseline data collection and assessment:

For the ESIA baseline preparation a set of documentation is available that include national (laws and sub laws, strategies) and international (EU Directives, Conventions, etc.) legislation, various reports on state of environment and on biodiversity prepared by international and national institutions etc. Additionally, due to the project's characteristics (long linear infrastructure project) and sensitivity of the area, a biodiversity survey throughout one year period (habitats, flora and fauna) will be done. Baseline study and surveys shall include Desktop review of project area and species and habitats potentially distributed within area of project influence, particularly those that are recognized as priority biodiversity features (PBF) and/or critical habitat (CH) according to EBRD PR6 and EIB Standrad 4 and Baseline survey of species and habitats identified through desktop review, within the appropriate area of assessment. The scope of all foreseen activities within biodiversity surveys includes Research on natural habitats, flora and fauna species; Mapping of natural habitats within the Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance. An important source of data and information for baseline description is envisaged to be given from NGOs dealing with environmental protection, national authorities (Institute for Nature Conservation of Serbia) with whom consultations will be held. Results of the biodiversity surveys will be used for ESIA baseline description and impact assessment.

6.2.4. Protected areas

Two protected areas (Natural monument "Rogot" and The Special nature reserve "Brzansko Moravište") are identified within the area of influence, in the zone of 500 m on both sides of the line (Table 31).

Table 31. Protected areas along the railway corridor

Name of protected area	National Category	IUCN category	Distance from the railway corridor (km)	The reason for protection
Rogot	Natural monument	III	0.1	Conservation of the last remnants of the *Quercus robur forest*
Brzansko Moravište	The Special nature reserve	IV	0.35	Conservation of swamp which presents very rare habitat type in Serbia

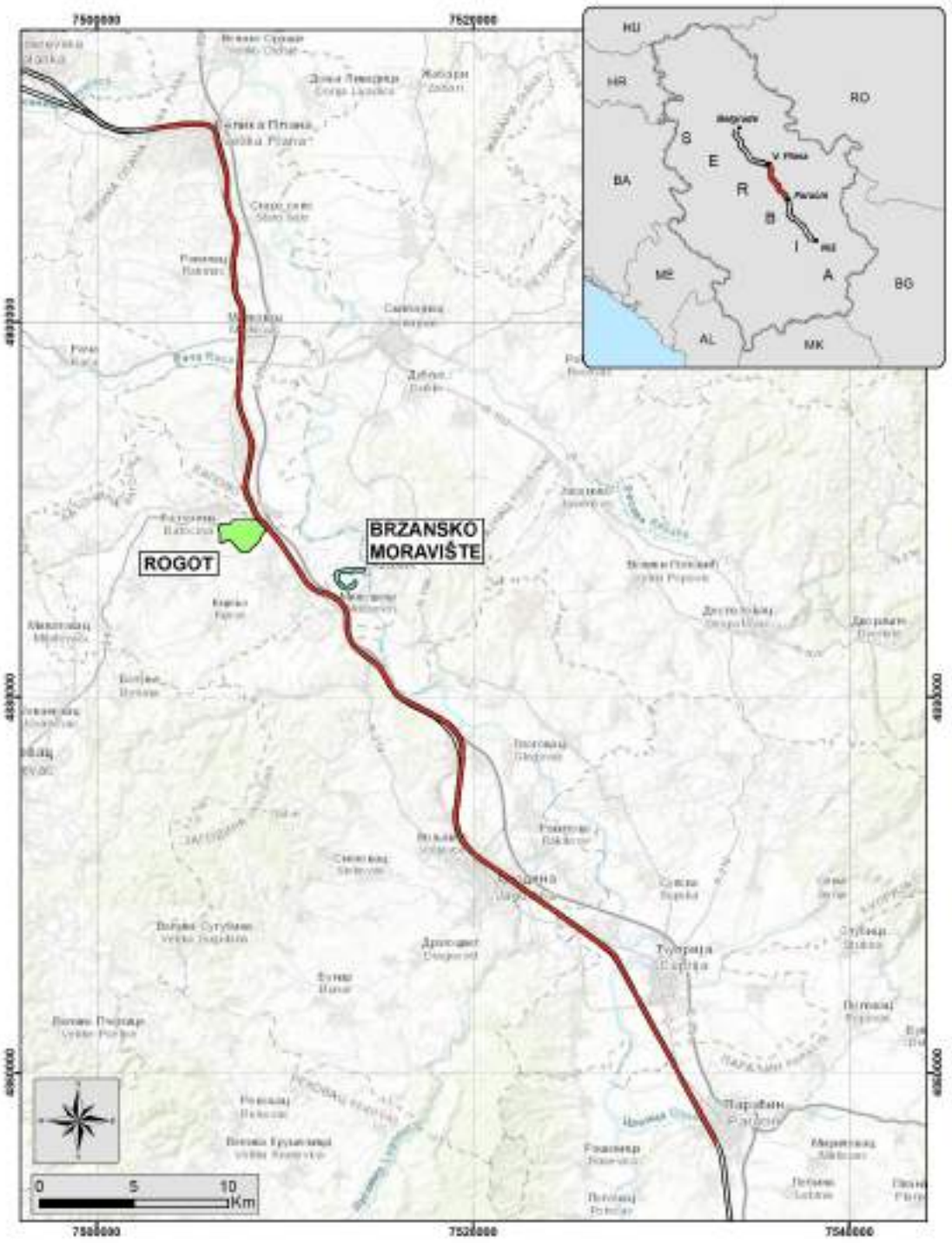


Figure 44. Protected areas within the area of influence

One Important Bird Area (IBA) is identified within the area of influence of the railway corridor for Section 2: Gornje Pomoravlje (Table 33), out of a total of four IBA along the entire railway corridor (for all three sections) (Figure 45). Gornje Pomoravlje IBA is located in Central Serbia in the valley of Great Morava River in the vicinity of Paraćin municipality. The habitats of this area are presented by remnants of *Salix sp., Populus sp., Alnus sp., Fraxinus sp.,* and *Quercus sp.* forests.

Table 32. Important bird areas identified along the corridor

Name	Area	IBA criteria	Distance	Decree on ecological network
Gornje Pomoravlje	4,265 ha	B1b, C6 (2019)	Cross	YES RS044

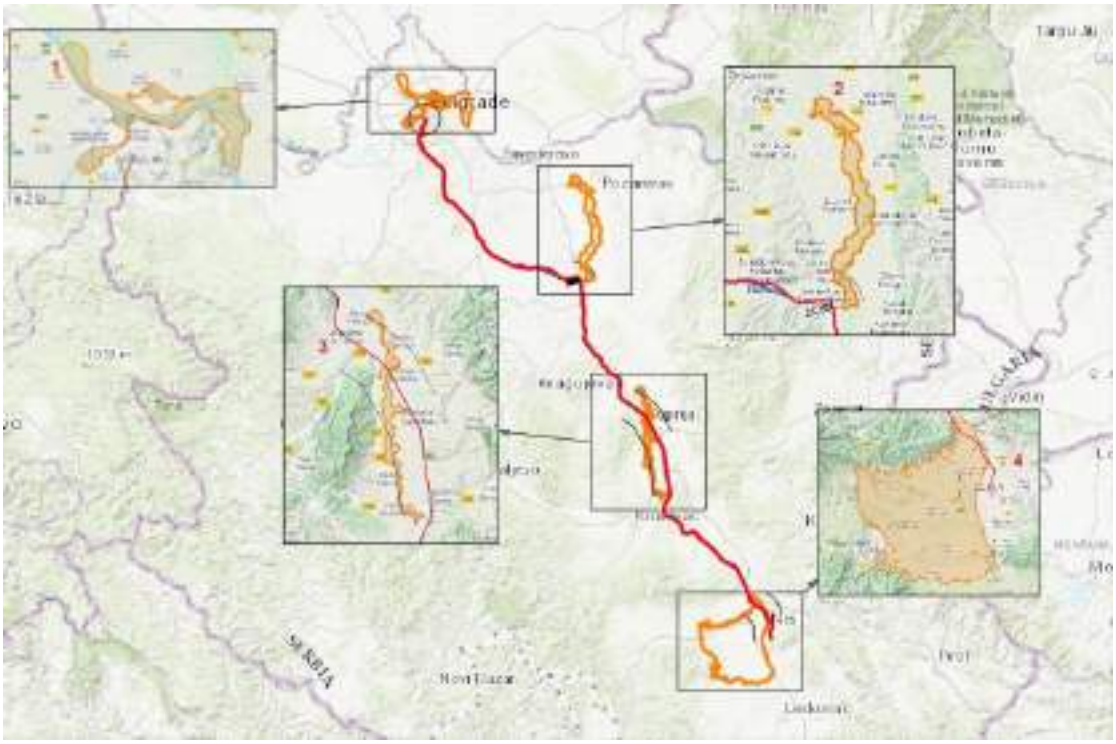


Figure 45. IBA areas along the corridor 1. Ušće Save u Dunav, 2. Donje Pomoravlje, 3. Gornje Pomoravlje, 4. Dobrić-Nišava

The IBA Gornje Pomoravlje is also an alluvial area in Central Serbia along Great Morava River. It is more than 40 km far from Ćićevac and Stalać in the south to Krušar and Ribare in the north. The area is composed of several smaller units: Vidovački ključ, Čepursko, Moravište, the mouth of Crnica river and Supski rukavac. On the Great Morava River, there is a huge number of meanders, gravel islands, riparian woods, and a lot of active and old gravel

pits. At the borders of IBA are situated more than 20 settlements belonging to five municipalities (Paraćin, Varvarin, Ćićevac, Ćuprija, and Jagodina). In the Table 33 the list of IBA trigger species are presented.

Table 33. Population of IBA trigger species – Gornje Pomoravlje

Species	Current IUCN Red List Category	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered
Common Tern *Sterna hirundo*	LC	breeding	2016-2019	max 20 breeding pairs	C6
Common Kingfisher *Alcedo atthis*	LC	Resident	2010-2019	20-40 breeding pairs	B1b, C6
Collared Sand Martin *Riparia riparia*	LC	breeding	2017-2019	1,500-2,500 breeding pairs	B1b

Within the affected zone of the railway corridor, one ecological corridor is identified: Velika Morava River. According to the Decree on ecological network, this corridor has international importance and presents ecological pathways and connection that enables the movement of individuals of populations and the genes flow between protected areas and ecologically important areas. According to the Law on nature protection, Article 130, the ecological network will be established and become part of the European ecological network Natura 2000 by the day of the accession of the Republic of Serbia to the European Union.

The planned railway route does not pass directly through the national protected areas. However, Section 2 crosses IBA “Gornje Pomoravlje, as part of the ecological network, which is also defined as pSPA, designated based on the presence of 40 Natura 2000 bird species, along with 97 other bird species. pSPAs are areas designated according to the criteria given in the EU Birds Directive and are selected to protect one or more rare, threatened, or vulnerable bird species. Similar principles are used in the designation of IBAs. There are currently 79 areas in Serbia that meet the IBA criteria. IBA and pSPA network will be assessed jointly as a part of ESIA, because determination of pSPA relied heavily on IBA areas. All accepted IBA sites have been included within the pSPA network, although with minor alterations of site limits (predominantly minor enlargements). Six additional areas that are important for bird conservation but do not meet IBA criteria are included in pSPAs.

pSCIs were determined in Serbia based on the “EU for Natura 2000 in Serbia”. The determination of pSCIs in Serbia was based on criteria given in the Habitats Directive. A review of available data on pSCI areas in the Project’s wider area has shown that a total of 19 pSCIs are within that zone. The Railway Section 2 will pass through two pSCIs:

pSCI Velika Morava – the size of the pSCI is 25,328 ha. It is selected based on the presence of eight species of conservation concern: *Emys orbicularis, Lutra lutra, Lycaena dispar, Nyctalus noctule, Pipistrellus nathusii, Plecotus austriacus, Theodoxus transversalis, Zerynthia polyxena*.

pSCI Juzna Morava – the size of the pSCI is 12,745 ha and spreads along Section 2 and Section 3. It is selected for one habitat type: 91M0 Pannonian-Balkanic turkey oak – sessile oak forests, and seven species: *Lutra lutra, Lycaena dispar, Nyctalus noctula, Pipistrellus nathusii, Plecotus austriacus, Theodoxus transversalis, Unio crassus*.

All areas of interest for the protection will be considered and further assessed in ESIA.

IPAs, Ramsar sites, and Emerald Areas are not identified within areas of influence.

Identified sensitive zones and receptors:

Recognized and identified protected areas and areas designated for protection within the possible impact area.

Identified and reviewed existing baseline information relevant to the project:

Radović, I. and Kozomara, M. (Eds.) (2011): Biodiversity strategy of the Republic of Serbia for the period from 2011 to 2018. Ministry of Environment and Spatial Planning. Belgrade (in Serbian)

https://www.birdlife.org/

The web portal of the Institute for Nature Conservation of Serbia

Tomović G. (2007): Phytogeographic affiliation, distribution and centers of diversity of Balkan endemic flora in Serbia. Doctoral dissertation. Faculty of Biology, University of Belgrade, Belgrade (in Serbian)

Preliminary Feasibility Study for the Reconstruction and modernization of the railway line Belgrade – Niš up to speed of 200 km/h (part of the project EUROPEAID/139687/DH/SER/RS) – Biodiversity report (2021–2022.)

Identified significant gaps in existing baseline data relevant to the project:

The lack of the official habitat map on national level.

Method of further ESIA baseline data collection and assessment:

To perceive position of protected areas, a detail map of protected areas and areas designated for protection, will be made. Protected areas within following categories will be analysed: national protected areas, Ramsar areas,

Important Bird Areas, Important Plant Areas, Key Biodiversity Areas and Emerald Network candidate sites/ potential NATURA 2000 sites. Detail desktop study will be performed to grasp the main values of these areas, identify potential conflicts in this area and future drivers of spatial and temporal changes. Additionally, due to the project's characteristics (long linear infrastructure project) and sensitivity of the area, a biodiversity survey throughout one year period (habitats, flora and fauna) will be done. Baseline study and surveys shall include Desktop review of project area and species and habitats potentially distributed within area of project influence, particularly those that are recognized as priority biodiversity features (PBF) and/or critical habitat (CH) according to EBRD PR6 and Baseline survey of species and habitats identified through desktop review, within the appropriate area of assessment. The scope of all foreseen activities within biodiversity surveys includes research on natural habitats, flora and fauna species; Mapping of natural habitats within the Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance. An important source of data and information for baseline description is envisaged to be given from NGOs dealing with environmental protection, national authorities (Institute for Nature Conservation of Serbia) with whom consultations will be held. Results of the biodiversity surveys will be used for ESIA baseline description.

6.2.5. Priority biodiversity features and Critical habitats

During the scoping, it was evident that some habitats and species within the railway route are potential candidates for the designation of priority biodiversity features (PBF) and critical habitats (CH). Potential impacts on sensitive biodiversity features that could be considered a "Critical Habitat" and/or "Priority Biodiversity Feature" will be assessed in accordance with EBRD PR 6 and EIB Standard 4.

Species and habitats recognized as priority biodiversity features (PBF) and/or critical habitat (CH) that will be identified during ESIA preparation include:

- Ecosystems that are a priority for conservation – habitats listed by the EU Habitats Directive (Annex 1), Bern Convention (Resolution 4), Key Biodiversity Areas (including Important Bird Areas and Ramsar sites), UNESCO Natural World Heritage Sites, Alliance for Zero Extinction (AZE) sites, ecosystems evaluated using the International Union for the Conservation of Nature (IUCN) Red List of Threatened Ecosystems method with a status of Vulnerable, Endangered, or Critically Endangered, and ecosystems recognized by the scientific community as being associated with key evolutionary processes.
- Species and habitats that are a priority for conservation including – a) species listed by the EU Habitats Directive and Birds Directive, Bern Convention, IUCN Red List of Threatened Species with a status of Vulnerable, Endangered, or Critically Endangered, or listed at a national level using the IUCN Red List methodology (national Red List); b) species with restricted ranges; and, c) migratory and congregatory species that utilize the area.
- Protected areas – areas with existing or planned legal conservation protection in the relevant jurisdiction(s). This includes Natura2000 and Emerald sites, as well as protected areas that are not within those networks.

Identification of species and habitats against PBF/ CH criteria will be done upon following criteria:

- Species from National and Red Lists
- Species from IUCN European Red List
- Species from IUCN Global Red List
- Species from Lists of strictly protected and protected wild species
- Species listed in Annex I, II and III of the Bern Convention
- Species listed in Annex II and IV from Habitat Directive
- Species listed in Annex to Birds Directive
- Endemic species
- Rare and relict species
- Emerald species/ potential NATURA 2000 species

In addition, ESIA will address the national priority ecosystems and species, restoration and conservation objectives in the relevant national systematic conservation planning.

Ecosystem services assessment will be considered in the ESIA as defined in EIB's Standard 4.

Based on the defined criteria potential priority biodiversity features and critical habitats are identified based on desktop assessment of previously carried investigations, prepared documentation, and available literature sources and presented in Table 34.

The Preliminary Feasibility Study for the Reconstruction and modernization of the railway line Belgrade – Niš up to speed of 200 km/h has been carried out in 2021–2022., includes Biodiversity survey during spring and summer period. Results of this survey have served as starting point in determining potential PBFs and CHs for this project.

Table 34. Preliminary identified PBFS and CHS

Habitats/species	PBFs/CHs	Criterion
Habitats		
G1.1 - Riparian and gallery woodland, with dominant *Alnus, Betula, Populus*, or *Salix*	PBF	Annex 1 of the EU Habitats Directive, Resolution 4 of the Bern Convention
C3.2 - Water-fringing reedbeds and tall helophytes other than canes No sensitive zones and receptors have been identified	PBF	Annex 1 of the EU Habitats Directive
Insects		
***Euphydryas aurinia* (Marsh fritillary)**	PBF	Annex 2 of the Habitats Directive and Annex 2 of the Berne Convention
***Lycaena dispar* (Large copper)**	CH	Annex 2 and 4 of the Habitats Directive, Annex 2 and Resolution 6 of the Berne Convention, globally Near Threatened (NT)

***Nymphalis vaualbum* (Compton tortoiseshell)**	CH	Annexes 2 and 4 of the Habitats Directive, Annex 2 and Resolution 6 of the Berne Convention
***Phengaris arion* (Large blue)**	CH	Annex 4 of the Habitats Directive. Near-threatened species at the global level (NT), an endangered species in Europe (EN), in the territory of Serbia - Least Concern (LC)
***Parnassius mnemosyne* (Clouded Apollo)**	CH	Annex 4 of the Habitats Directive and Annex 2 of the Berne Convention. Near-threatened species in Europe (NT)
***Zerynthia polyxena* (Southern festoon)**	CH	Annex 4 of the Habitats Directive
***Lucanus cervus* (Stag beetle)**	PBF	Annex 2 of the Habitats Directive and Annex 3 and Resolution 6 of the Berne Convention
***Morimus asper* (Beech Longhorn Beetle)**	PBF	Annex 2 of the Habitats Directive. Globally endangered species (EN), its endangered status is not known at the European and national level
***Coenagrion ornatum* (Ornate bluet)**	PBF	Populations of these species are very rare and have local character
Herpetofauna		
Bombina variegata	PBF	Annex 2 of the Habitats Directive and Annex 2 and Resolution 6 of the Berne Convention
Emys orbicularis	PBF, CH	Annexes 2 and 4 of the Habitats Directive and Annex 2 and Resolution 6 of the Berne Convention
Podarcis muralis	PBF	Annex 2 of the Berne Convention
Lacerta viridis	PBF	Annex 2 of the Berne Convention
Dolichophis caspius	PBF, CH	Annex 4 of the Habitats Directive and Annex 2 of the Berne Convention
Birds		
***Accipiter gentilis* (Northern goshawk)**	PBF	National VU status in Serbia, and LC according to the IUCN.
***Alcedo atthis* (Common Kingfisher)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN
***Cettia cetti* (Cetti's Warbler)**	PBF	Strictly protected species in Serbia; national VU status in Serbia, and LC according to the IUCN.
***Circus aeruginosus* (Western Marsh Harrier)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Leiopicus medius* (Middle Spotted Woodpecker)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Dendrocopos syriacus* (Syrian Woodpecker)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Dryocopus martius* (Black Woodpecker)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.

***Emberiza hortulana* (Ortolan Bunting)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Lanius collurio* (Red-backed shrike)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Lanius minor* (Lesser Grey Shrike)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Nycticorax nycticorax* (Black-crowned Night Heron)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Perdix perdix* (Grey Partridge)**	PBF	Annexes IIA and IIIA of the Birds Directive; protected in Serbia, national VU status in Serbia, and LC according to the IUCN.
***Pernis apivorus* (Honey buzzard)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Sterna hirundo* (Common Tern)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national VU status in Serbia, and LC according to the IUCN.
***Streptopelia turtur* (Turtle dove)**	PBF	Annex IIB of the Birds Directive; protected species in Serbia, national VU status in Serbia, and VU according to the IUCN.
Mammals		
Canis lupus	PBF	Annexes 2 and 4 of the Habitats Directive; Resolution 6 of the Bern Convention
Felis silvestris	PBF	Annexes 2 and 4 of the Habitats Directive
Mustela putorius	PBF	Annex 5 of the Habitats Directive
Vormela peregusna	PBF	Resolution 6 of Bern Convention; IUCN – VU category
Lutra lutra	PBF	Annexes 2 and 4 of the Habitats Directive; Resolution 6 of the Bern Convention
Myotis daubentoniid	PBF	Annexes 2 and 4 of the Habitats Directive
Nyctalus noctule	PBF	Annexes 2 and 4 of the Habitats Directive
Pipistrellus kuhlii	PBF	Annexes 2 and 4 of the Habitats Directive
Plecotus austriacus	PBF	Annexes 2 and 4 of the Habitats Directive
Vespertilio murinus	PBF	Annexes 2 and 4 of the Habitats Directive

One year biodiversity survey, as well as additional site visits are currently ongoing and will be conducted as input to ESIA, to confirm and/or modify presence of species and habitats identified as PBFs/CHs during the desktop study.

Identified sensitive zones and receptors:

Recognized and identified PBFs and CHs.

Identified and reviewed existing baseline information relevant to the project:

Radović, I. and Kozomara, M. (Eds.) (2011): Biodiversity strategy of the Republic of Serbia for the period from 2011 to 2018. Ministry of Environment and Spatial Planning. Belgrade (in Serbian)

https://www.birdlife.org/

The web portal of the Institute for Nature Conservation of Serbia

Tomović G. (2007): Phytogeographic affiliation, distribution and centers of diversity of Balkan endemic flora in Serbia. Doctoral dissertation. Faculty of Biology, University of Belgrade, Belgrade (in Serbian)

Preliminary Feasibility Study for the Reconstruction and modernization of the railway line Belgrade – Niš up to speed of 200 km/h (part of the project EUROPEAID/139687/DH/SER/RS) – Biodiversity report (2021.-2022.)

Identified significant gaps in existing baseline data relevant to the project:

The lack of the official habitat map on national level.

Method of further ESIA baseline data collection and assessment:

A biodiversity survey throughout one year period (habitats, flora and fauna) will be done. Baseline study and surveys shall include Desktop review of project area and species and habitats potentially distributed within area of project influence, particularly those that are recognized as priority biodiversity features (PBF) and/or critical habitat (CH) according to EBRD PR6 and Baseline survey of species and habitats identified through desktop review, within the appropriate area of assessment. The scope of all foreseen activities within biodiversity surveys includes research on natural habitats, flora and fauna species; Mapping of natural habitats within the Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance. An important source of data and information for baseline description is envisaged to be given from NGOs dealing with environmental protection, national authorities (Institute for Nature Conservation of Serbia) with whom consultations will be held. Results of the biodiversity surveys will be used for ESIA baseline description and impact assessment.

6.3. Environmental quality

6.3.1. Air quality

Monitoring of air quality indicators in the Republic of Serbia is carried out by the Environmental Protection Agency. The obligations and tasks of the Environmental Protection Agency in air quality management are more closely defined by the Law on Air Protection (31 "Official Gazette of RS" no. 36/09,10/13 and 26/21).

The annual report on the state of air quality in the Republic of Serbia stems from the Agency's obligation based on Article 67 of the Air Protection Act. It represents one of the results of the multi-year activity of the Environmental Protection Agency on the establishment and maintenance of an operational system for automatic monitoring of air quality in the Republic of Serbia. The network of stations for automatic monitoring of air quality, AMSKV, is, in accordance with the Law on Air Protection, recognized as a national network for air quality monitoring at the level of the Republic of Serbia. Air quality measurement and reporting is done in accordance with existing regulations.

The observed section of the Velika Plana–Paraćin line is electrified, so it has a minimal impact on air quality, regardless of which variant it is. Air pollution is possibly caused by the evaporation of means used for the maintenance of turnouts. In the part of the corridor where the railway and the highway are located nearby, there will be an increase in the concentration of pollutants emitted into the air by the exploitation of road vehicles. As a source of air pollution in the researched corridor, there are individual industrial plants that represent the source of harmful pollutant emissions into the atmosphere, as well as individual pollution created as a product of burning solid and liquid fuels, as well as other substances.

The network of stations for automatic monitoring of air quality is, in accordance with the Air Protection Act, recognized as a national network for air quality monitoring at the level of the Republic of Serbia. Considering the route of the Velika Plana-Paraćin railway, the relevant stations for automatic monitoring of air quality are located in Ćuprija, while the Kragujevac station is located in the wider area and further from the railway.

Figure 46 shows the locations of the air quality monitoring stations. Concentrations of SO_2, NO_2, O_3, CO, PM_{10} and $PM_{2.5}$ are measured at the measuring stations. Table 35 shows the concentrations of the mean annual values of the mentioned parameters for the year 2022. In the territory of Jagodina, the air was excessively polluted due to exceeding the limit values of suspended particles PM_{10}.

Table 35. Statistical presentation of SO_2, NO_2, O_3, PM_{10} and $PM_{2.5}$ concentrations in (mg/m^3) and CO in mg/m^3 during 2022 [66]

[66] Source: Annual report on the state of air quality in the Republic of Serbia 2021, Environmental Protection Agency

Average annual value	SO2 µg/m3	NO2 µg/m3	O3 µg/m3	CO mg/m3	PM10 µg/m3	PM2.5 µg/m3
Jagodina	18	6	-	-	-	-
Ćuprija	17	4	-	-	39	-

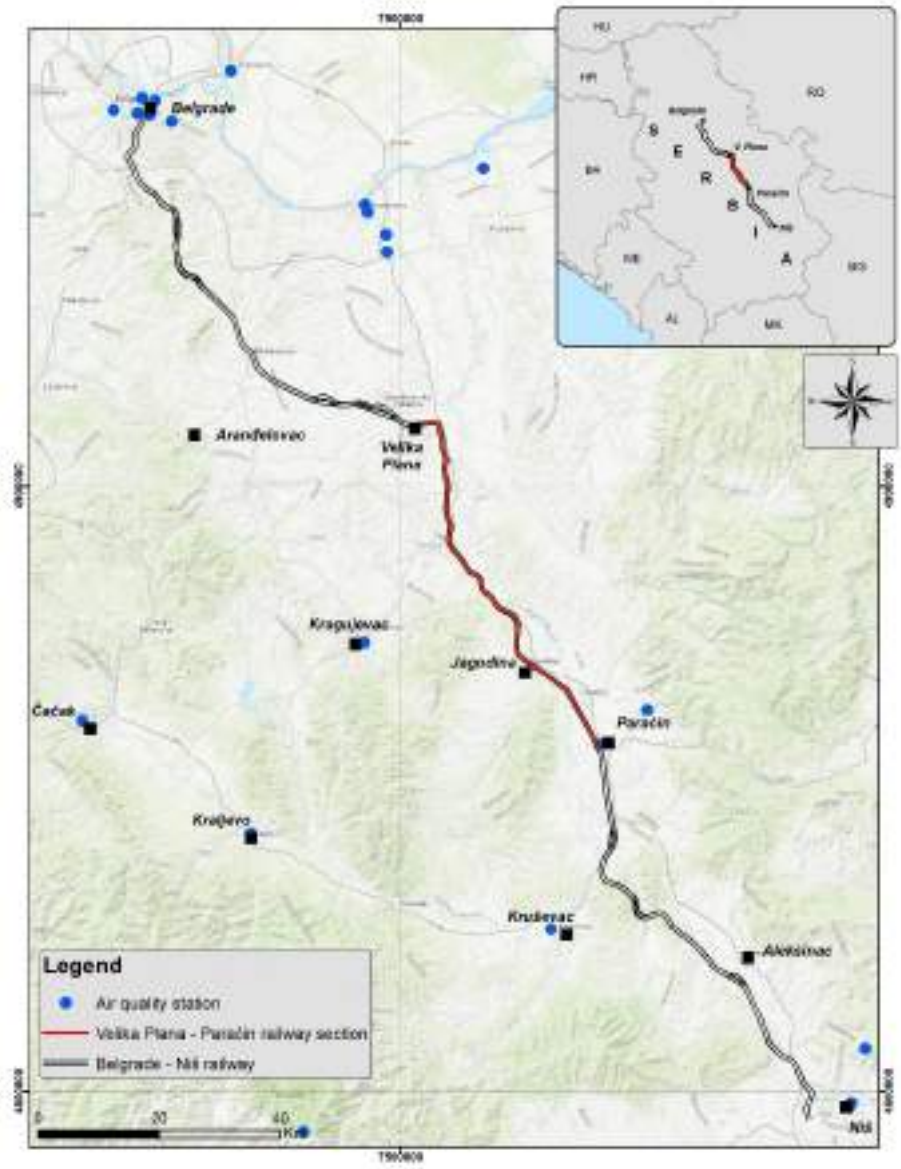


Figure 46. Network of air quality stations of the Environmental Protection Agency, City Institute for Public Health of Belgrade[67]

The following table shows the CAQI index (Common Air Quality Index) of the basic parameters that are measured, as well as their maximum allowed concentrations.

Table 36. Air Quality Index CAQI [68]

Averaging period	Polluting matter	Limit µg/m³	Excellent	Good	Acceptable	Contaminated	Very polluted
1h	SO_2	350	0–50	50.1–100	100.01–350	350.01–500	> 500.01
1h	NO_2	150	0–50	50.01–100	100.01–150	150.01–400	>400.01
1h	PM_{10}	90	0–25	25.01–50	50-.01–90	90.01–180.0	>180.01
1h	$PM_{2.5}$	55	0–15	15.01–30	30.01–55	55.01–110	>110.01
1h	CO	25000	0–5	5.00001–10	10.00001–25	25.00001–50	>50.00001
1h	O_3	180	0–60	60.1–120	120.1–180	180–240	>240.1

The display in colors is usually used so that citizens can easily find out in which of several categories the air quality is at the moment: whether it is excellent, good, acceptable, polluted or highly polluted, i.e. dangerous. The concentration of several pollutants is measured, and they have specific thresholds and colour ranges that determine the pollution category.

As part of air quality monitoring and in accordance with the criteria prescribed by the Air Protection Act, SEPA evaluates KV in zones and agglomerations. This represents the official evaluation of air quality in Serbia that applies the standards present in practice in the EU (Table 37), which is possible thanks to the fact that the EU Air Quality Directive has been transposed and integrated into the national legislation.

Table 37. Air quality standards for health protection, as presented in the Air Quality Directives and applied by SEPA in the evaluation of KV in the Republic of Serbia [69]

Polluting matter	Averaging period	Legal nature and concentration	Comments
SO_2	1h	Limit 350 µg/m³	No more than 24 hours per year
		Alarm threshold 500 µg/m³	It is measured during three consecutive hours in an area of 100 km² or in the entire zone

[67] *Environmental Impact Assessment Study, Reconstruction and Modernization of the Velika Plana - Niš Railway, Environmental Protection Agency, Annual report on the state of air quality in the Republic of Serbia*

[68] *https://balkangreenenergynews.com/*

[69] *http://www.sepa.gov.rs/index.php?menu=319&id=14&akcija=showXlinked_filters&tema=Vazduh&godina=2020*

	1 day	Limit 125 μg/m^3	No more than 3 days per year
NO_2	1 h	Limit 200 μg/m^3	No more than 18 hours per year
		Alarm threshold 400 μg/m^3	It is measured during three consecutive hours in an area of 100 km^2 or in the entire zone
PM_{10}	1 day	Limit 50 μg/m^3	No more than 35 days a year
	Calendar year	Limit 40 μg/m^3	
$PM_{2.5}$	Calendar year	Limit 25 μg/m^3	
CO	Max. daily 8-hour mean value	Limit 10 μg/m^3	
O_3	Max. daily 8-hour mean value	Target value 120 μg/m^3	No more than 25 days per year arranged for three years
		Information threshold 180 μg/m^3	
	1 hour	Information threshold 240 μg/m^3	

The air quality assessment for 2019 was made based on the annual concentrations of pollutants obtained from the monitoring of air quality in state and local networks by the Environmental Protection Agency from the annual reports.

In the next phase, air quality measurements along the railway corridor will be carried out by an authorized laboratory.

Identified sensitive zones and receptors:

The Belgrade - Niš railway line is electrified and therefore has a minimal impact on air quality. Further research of air quality will be carried out in the area of sensitive zones in Velika Plana, Markovac, Lapovo, Novo Lanište, Jagodina and Ćuprija settlements.

Identified and reviewed existing baseline information relevant for the project:

Environmental Protection Agency.

Annual report on the state of air quality in the Republic of Serbia 2021, Environmental Protection Agency.

Identified significant gaps in existing baseline data relevant for the project:

Lack of automatic measuring stations along the railway route.

Lack of air quality data for both Jagodina and Ćuprija stations on $O_{3,\ CO}$ and $PM_{2.5}$ and data on PM10 for Jagodina station.

Method of further ESIA baseline data collection and assessment:

Further assessment should include more detailed results on the available measurement data of the concentration of define parameters, as well as details on the environmental impact assessment. Further research of air quality will be done on following locations: Velika Plana, Markovac, Lapovo, Novo Lanište, Jagodina and Ćuprija settlements.

6.3.2. Waste administration

As a part of the negotiations for accession to the EU, the Republic of Serbia (RoS) has begun the process of establishing a waste management system and adapting it to the EU goals[70]. Progress has been made in harmonising waste management regulations with the EU requirements, in institutional strengthening and reaching regional agreements for the establishment of joint waste management, as well as in the construction of a number of sanitary landfills. The *Law on Waste Management* [71] defines the waste types, waste management planning, obligations and responsibilities regarding waste management, management of special waste streams, permission requirements and procedures, reporting, supervision and other relevant aspects of waste management. The implementation of the newly adopted waste management program in RoS, in addition to reducing the harmful impact on the environment and climate change, should enable the realization of the prerequisites for the use of waste in the circular economy.

The RoS planned to build 29 regional sanitary landfills by 2020 with the application of modern and environmentally safe waste management technologies, but only 12 have been built so far.

Existing municipal waste collection system

Waste collection services in the RoS are mainly under the jurisdiction of PUC established by the municipalities. In some municipalities there are agreements with strategic partners on waste collection or disposal. Collection is organised in urban areas, while rural areas are less covered. Certain problems in rural areas arise due to inadequate infrastructure, accessibility and organisation. Most local governments have mechanisation and vehicles for waste collection. However, there is a lack of adequate equipment for separate waste collection.

In the Project area, regional sanitary landfills are used for the disposal of non-hazardous waste, and they are sanitary-technically arranged locations where waste generated in public areas, in households, in production and service activities, in turnover or use, which does not have the properties of hazardous substances and cannot be processed or rationally used as an industrial raw material or energy fuel, is being disposed. There is no waste Belgrade-Niš

[70] *Waste management program in the RoS for the period 2022 - 2031 ("Official Gazette of RS", No. 30/18)*

[71] *Law on waste management ("Official Gazette of RS", no. 36/09, 88/10, 14/16 and 95/2018 - other laws and 35/2023-68)*

High Speed Railway Corridor Level E&S Assessment treatment before landfilling. In addition to these landfills, a large number of unsanitary, municipal landfills and dumps are in use.

Table 38. Regions for waste management near the project area (Source: Specific plan for the implementation of EU directive 1999/31/EC on landfills)

Region	Municipalities
Jagodina	Ćuprija, Jagodina, Paraćin, Smederevska Palanka, Velika Plana.
Lapovo	Despotovac, Lapovo, Rača, Svilajnac.

By the end of 2021, a total of ten regional sanitary landfills and two more that are not of the regional type have been built in the RoS in accordance with the EU standards. Operational regional sanitary landfills in the Project area, with quantities of waste disposed in the period 2016-2020 are presented in Table 39.

Table 39. Quantities of disposed waste at sanitary landfills near the project area

Year / Sanitary landfill	Quantities of disposed waste [tons]				
	2016	2017	2018	2019	2020
"Gigoš" Jagodina	74,113	62,893	61,660	75,360	69,042
"Vrbak" Lapovo	49,749	41,266	35,264	68,166	57,396

Accordingly, waste generated during the reconstruction and modernization of the Paraćin - Niš (Međurovo) railway line will be disposed of exclusively at regional sanitary landfills located at the shortest distance from the route in question, namely the "Gigoš" Regional Landfill in Jagodina and the "Vrbak" in Lapovo. Table 40 shows the distances of regional sanitary landfills from the route. Although according to the division of RS into regions for waste management[72,73], the starting and ending points of the Velika Plan route - Paraćin belong to the "Gigoš" landfill in Jagodina, the "Vrbak" landfill in Lapovo is significantly closer.

Table 40. Distance of the route from the nearest regional sanitary landfills

Distances [km] / Sanitary landfill	Velika Plana	Paraćin
"Vrbak" Lapovo	22	56

[72] *Specific plan for the implementation of the EU Directive 1999/31/EC on landfills*

[73] *Waste management program in the Republic of Serbia for the period 2022 - 2031 ("Official Gazette of RS", number 30/18) p. 22*

"Gigoš" Jagodina	48.2	70.7

Landfills in the Republic of Serbia that have cassettes for the disposal of hazardous waste (these landfills have separate cells for receiving waste containing asbestos, as well as other hazardous waste from construction and demolition), and which are located closest to the project area: FCC eko doo regional landfill “Vrbak” Lapovo capacity 12,876 m^3 [74].

Construction and demolition waste (CDW)

The waste producer is solely responsible for the legal and safe disposal (treatment or final disposal) of the generated CDW. Mineral construction waste, as well as mixed construction waste, is mostly disposed of in inadequate local landfills. Only metal waste from CDW is collected on a larger scale.

Currently, the practice of separating hazardous and non-hazardous construction waste is not sufficiently applied. Although separation at the point of origin during demolition and reconstruction is essential for enabling the recycling of construction waste, this activity is carried out very little in the RoS. Even when separation of hazardous components (e.g. insulating material; asbestos-containing construction material; bituminous mixtures containing coal tar; tarred products) as well as recyclable parts (e.g. wood, glass, plastics and metals) from mineral construction waste during demolition and reconstruction activities, very small amounts of these fractions are separated.

The existing infrastructure for the treatment of construction and demolition waste on the territory of the RoS includes only a few crushing plants and recycling of less than 1,000 t of waste per year, although a large number of operators are licensed to treat different types of CDW. The treatment of CDW as a substitute for primary resources for construction activities is rather underdeveloped in the RoS. If generated in reconstruction or demolition activities, mineral waste from construction and demolition is used for levelling or other levelling of surfaces. Bituminous material is used to a certain extent for roads or is reused/used on the construction site itself for road maintenance. Since there has been an increase in construction in the last few years, the amount of construction waste has also increased. All attention is directed towards the recycling of non-hazardous materials from construction waste. The basic steps in the recycling process are sorting, crushing and sieving, and the final product is an aggregate that can be used in construction, for landscaping and as a substitute for gravel in concrete elements.

Identified sensitive zones and receptors:

[74] *Waste management program in the RoS for the period 2022 - 2031 ("Official Gazette of RS", No. 30/18)*

Watercourses along the construction site, soil used for agriculture - Soil and water pollution from waste

Identified and reviewed existing baseline information relevant for the project:

Waste management program in the RoS for the period 2022–2031 ("Official Gazette of RS", No. 30/18)

Report on the State of the Environment in RoS in 2021, Ministry of Environmental Protection, Belgrade, 2022

Report on the State of the Environment in RoS in 2020, Ministry of Environmental Protection, Belgrade, 2021

Report on waste management in the RoS for the period 2011–2021, Ministry of Environmental Protection, Belgrade, 2022.

Identified significant gaps in existing baseline data relevant for the project:

No significant gaps.

Method of further ESIA baseline data collection and assessment:

A detailed analysis of the available data will be made in order to assess the necessary capacities for the proper and safe management of waste generated during the construction or operation phase, include valid planning documentation, characteristics of the facilities, requirements set by EU and domestic legislation, EBRD PR and best practice.

6.4. Socio-Economic Environment

6.4.1. Introduction

Section 2 of the Belgrade Niš railway line starts in the town of Velika Plana and ends in the town Paraćin. The railway passes through parts of the City of Jagodina, three larger towns, Ćuprija, Lapovo and Velika Plana, as well as a number of small villages, situated around the existing and planned railway. The City of Jagodina, the three towns and all the small villages territorially belong to five municipalities in three districts – Velika Plana (Podunavski district), Lapovo (Šumadijski district), Batočina, Jagodina and Ćuprija (Pomoravski district).

The new railway route will avoid and/or will be moved away from 4 settlements: Staro Selo in Velika Plana (partially) and Miloševo (partially), Novo Lanište and Ribnik, all three in Jagodina municipality. In addition, a part of section 2, from the Gilje stop in Mijatovac settlement (Ćuprija), to Paraćin station was modernised in the past by constructing a

new double-track railway for speeds up to 160 km/h. This section will not be the subject of new reconstruction, however, small-scale additional construction works are possible to enable reaching a speed of 200 km/h.

Data in the following section is presented mostly at the municipal level, as well as village level where available. Detailed data collected in the 2022 census has not been published at the time of developing this report and the final results will not be available before the end of 2023, which is why the 2011 data has been presented where no updates are available.

The newly planned high-speed railway to a large extent follows the existing railway footprint, however there are several locations where some changes are being made in the Preliminary design. Compared to section 3, this part of the railway passes through larger towns and to a much lesser extent through small villages, which are somewhat larger (in the number of inhabitants) than those that can be found along section 3.

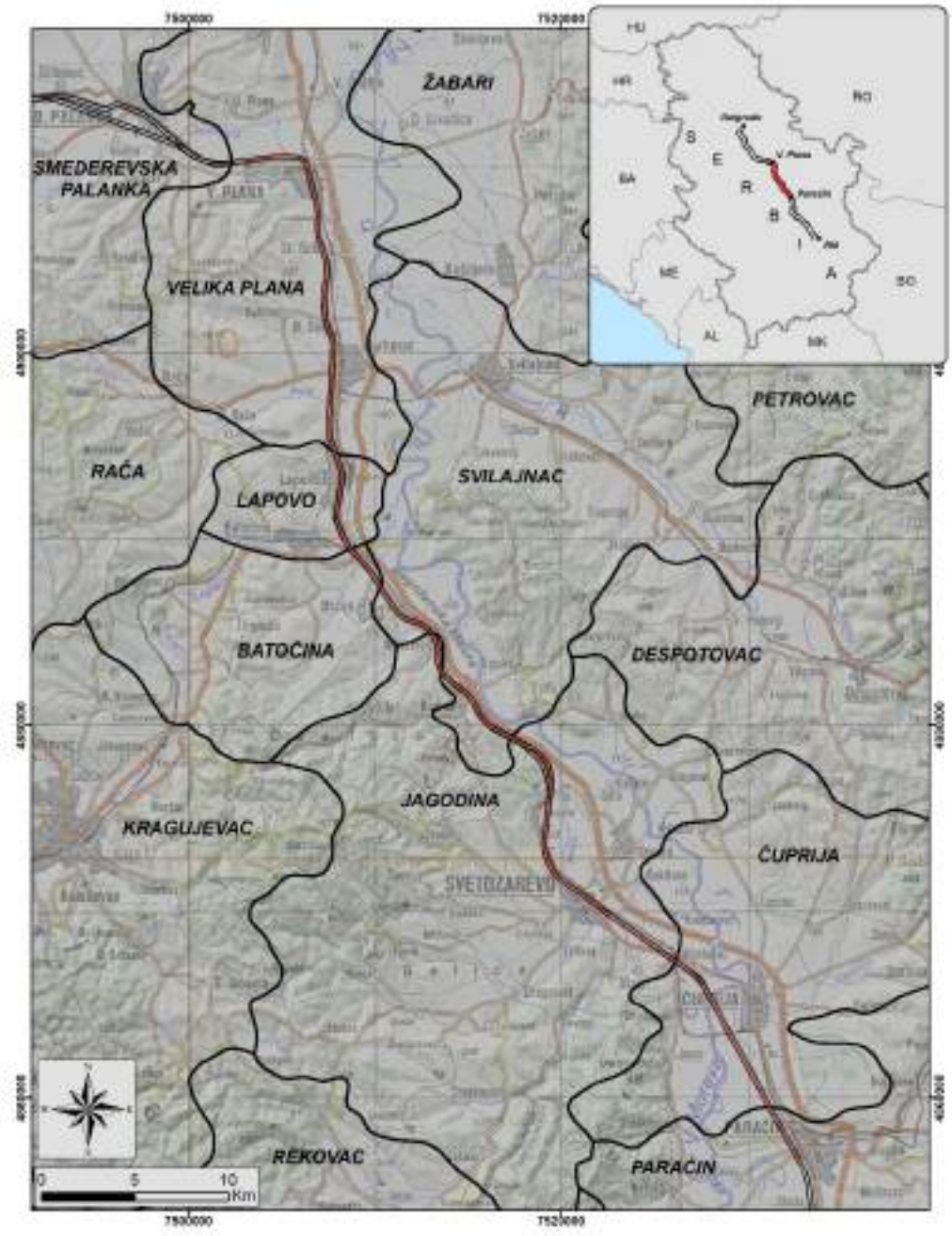


Figure 47. Municipalities that the railway passes through

6.4.2. Population and Demogaphics[75]

The proposed project footprint in section 2, passes through a number of urban locations, including through the towns of Velika Plana, Lapovo, Jagodina and Ćuprija and ten smaller, rural villages in between. The actual section 2 starts in Velika Plana station and ends in Paraćin station (which belongs to section 3 and is addressed in the ESIA Scoping Study for section 3). Between Ćuprija station and Paraćin station (where reconstruction of the railway has already been completed), there are no smaller villages.

The total population of these inhabited areas is over 90 thousand, however that includes the total population of three larger towns and the City of Jagodina, as there is no information on the number of inhabitants in the exact neighbourhoods through which the railway passes.

Table 41. Population by inhabited area (town, village)

District	Municipality	Town / village	Population (2011 census)
Podunavski	Velika Plana	Velika Plana town	16,088
		Staro selo	2,733
		Novo selo	1,229
		Markovac	2,915
Šumadijski	Lapovo	Lapovo town	7,143
Pomoravski	Batočina	Brzan	1,754
	Jagodina	Miloševo	1,043
		Bagrdan	809
		Staro Lanište	460
		Novo Lanište	618
		Ribnik	287
		Bukovče	844
		Jagodina city	36,092
	Ćuprija	Mijatovac	1,656
		Ćuprija town	19,471
TOTAL	5	14	93,142

Serbia as a whole, including the municipalities affected by the Project, is characterised by a significant decrease of the population in recent decades. The population per municipality in 2022 according to preliminary census results and how it compares to data from the population census in 2011 is provided in the table below. The rate at which the population is decreasing in smaller towns, like Ćuprija (17.6%) is almost double to the decrease in Jagodina (10%),

[75] *Source for all population data: Statistical Office of the RS*

which has a status of a city. It is expected that the population in inhabited areas presented in the previous table has also decreased, however this will be confirmed when the results of the 2022 census at village level become available.

Table 42. Population by municipality

Municipality	Population in 2011	Population in 2022 (preliminary census results)	% decrease
Velika Plana	40,906	35,451	- 13.3%
Lapovo	7,842	6,582	- 16.1%
Batočina	11,750	10,162	- 13.5%
Jagodina	71,849	64,644	- 10.0%
Ćuprija	30,735	25,325	-17.6%

The average age of inhabitants in 2021 in all municipalities is higher than at the national level. The aging index of the population, which represents the ratio of the number of older inhabitants (60 and older) and younger inhabitants (0-19 years of age), in 2021, ranges between 153.9 in Jagodina and 196.7 in Ćuprija, which is alarmingly high. This means that in Ćuprija there are almost two elderly people (1.97) for every young person in the population. As expected, in Jagodina, which is the largest urban settlement (city), the aging index is lowest, although still higher than the national average.

Table 43. Average age by municipality

Municipality	Total	Men	Women	Aging index
Republic of Serbia	43.5	42	44.9	144.5
Velika Plana	44.7	43.1	46.3	166.7
Lapovo	45.5	44	47	188.3
Batočina	44.7	43.4	46	171
Jagodina	44	42.5	45.4	153.9
Ćuprija	45.9	44.3	47.4	196.7

Ethnic Serbs make up the majority of the population in all affected areas and the second most present ethnic group are Roma in most municipalities (although their presence is still extremely low). The exception is Ćuprija, where the second most present ethnic group are Vlachs (1.5%), while Roma are present with approx. 1%. No other minorities are present in a significant percentage in any of the municipalities, which is different than at the national level where Serbs make up only 81% of the population while the remaining 19% are various ethnic groups. Complementary to ethnicity, the majority of the population in all areas belong to the Serbian Orthodox faith.

Table 44. Ethnicity by municipality

Municipality	Serbs	Roma
Republic of Serbia	81%	2%
Velika Plana	93%	<1%

Lapovo	95%	<1%
Batočina	96%	<1%
Jagodina	93%	1%
Ćuprija	91%	1%

6.4.3. Level of development, economic activity and employment

The Ministry of Public Administration and Local Self-Government of the RS determines the level of development for each municipality, based on different criteria, such as GDP per capita, population trends, unemployment trends, education trends, etc. According to those criteria, the affected municipalities all belong to different categories of development.

Velika Plana, Batočina and Ćuprija are all characterised as belonging to the third category municipalities, with a level of development between 60% and 80% of the republic level average. Jagodina and Batočina are better placed, as being second category municipalities, with a level of development between 80% and 100% of the republic level average.

The latest publicly available budgets of the municipalities in 2023 are provided in the table below.

Table 45. Municipality budgets

Municipality	Budget (2023) in RSD	Budget (2023) in EUR[76]
Velika Plana	1,660,825,000	14.1 million
Lapovo	413,891,377	3.5 million
Batočina	589,262,453	5.0 million
Jagodina	4,146,451,291	35.3 million
Ćuprija	2,068,387,000	17.6 million

Jagodina is the largest city in the region and as such, an important economic centre with three major factories for the production of cables, beer and meat processing. The local self government has been investing significant efforts in the past two decades to attract foreign investments and there are a number of additional factories operating in this city, mainly producing automobile accessories, furniture and cardboard packaging. In Ćuprija, the main development areas are oriented towards food, metal and wood processing. The situation with Velika Plana is similar, with an additional focus on the construction industry. Agriculture is also an important source of local development, although

[76] *Exchange rate of 117.5 RSD per 1 EUR was used.*

nowhere near the actual potential that the municipality possesses. Agriculture is also the backbone of the economy in Batočina. In Lapovo, the most significant employers are the public railway companies, including Serbian Railways infrastructure. The municipality is small and its rural population compared to the only urban centre (Lapovo varoš) is also small, however agriculture is a significant part of the local economy. The construction sector is also among important employers in the municipality.

As can be seen in the table below, since 2019, the number of registered businesses has been falling in Batočina and Jagodina, and particularly in Ćuprija, while in the remaining two municipalities, these numbers have slightly grown. With regards to numbers of registered entrepreneurs, they have been steadily rising in all municipalities in the last four years. Most of the regional development incentives in the past few years in all municipalities were directed towards increasing production, employment and to fostering the development of agriculture. Investments are also being made into energy and transportation infrastructure, but also in scientific research and educational development. Most incentives were directed to micro, small and medium sized enterprises and agricultural holdings, followed by entrepreneurs.

Table 46. Registered legal business entities by municipality

Municipality	Number of registered businesses		Number of registered entrepreneurs	
	2019	2022	2019	2022
Velika Plana	384	392	1,368	1,542
Lapovo	54	55	225	245
Batočina	91	86	315	390
Jagodina	844	839	2,207	2,377
Ćuprija	399	379	1,011	1,088

When analysing the sectors of employment in the municipalities, it is evident that most people are working in the processing industry and the values in all municipalities are above the national average (22%). Other important employment sectors are trade, transport and storage, as well as education, health and social services. Transport and storage are particularly important in Lapovo (22.6%) where the majority of the population is employed in public railway companies, significantly above the national average (5.5%). Agriculture is not a major sector of employment, and it is most important in the municipality Velika Plana (1.9%), while construction is quite significant in Ćuprija (9.5%) and to a lesser degree in Velika Plana (6.1%), but still above the national average. Ćuprija has an unusually high percentage of people working in the health and social services sector, significantly above the national average.

Table 47. Municipality by sector of employment in 2022 (part 1)

Municipality	Agriculture, forestry and fishing	Mining	Processing industry	Electricity, gas supply	Water supply, sewage, waste	Construction	Trade, whole sale,	Transport and storage	Accommodation and

					management		vehicle repairs		food services
Republic of Serbia	1.3%	1.2%	21.7%	1.1%	1.1%	5.3%	15.8%	5.5%	3.8%
Velika Plana	1.9%	0.6%	28.9%	0.7%	2.0%	6.1%	22.3%	5.0%	4.6%
Lapovo	0.5%	0.1%	33.9%	0.6%	5.3%	2.1%	12.6%	22.6%	2.5%
Batočina	0.4%	2.6%	41.7%	0.8%	6.6%	3.4%	15.8%	2.9%	1.6%
Jagodina	1.1%	0.2%	28.5%	1.2%	2.3%	3.5%	17.0%	3.9%	3.1%
Ćuprija	0.8%	0.1%	23.0%	0.8%	3.0%	9.5%	14.2%	2.8%	3.3%

Table 48. Municipality by sector of employment in 2022 (part 2)

Municipality	Provision of information and communication	Financial activities and insurance	Real estate	Expert, scientific and technical services	Administrative and support services	Local administration, defence and social insurance	Education	Health and social services	Art, leisure, and recreation	Other services
Republic of Serbia	3.6%	1.9%	0.3%	5.1%	4.7%	6.9%	6.8%	7.0%	1.7%	1.9%
Velika Plana	0.5%	0.8%	0.1%	2.7%	1.2%	4.7%	7.6%	3.7%	1.2%	1.7%
Lapovo	0.5%	0.3%	0.0%	2.4%	0.7%	3.5%	4.2%	5.0%	0.6%	1.0%
Batočina	0.5%	0.3%	0.0%	1.2%	1.9%	4.7%	6.3%	4.0%	1.1%	1.2%
Jagodina	1.5%	1.9%	0.5%	3.5%	2.1%	6.4%	7.1%	9.2%	2.5%	2.2%
Ćuprija	0.7%	1.0%	0.0%	3.5%	0.7%	6.1%	6.7%	17.0%	1.0%	1.8%

The number of persons registered as unemployed with the National Employment Agency of Serbia, in September 2023, in each affected municipality is presented in the table below. The percentage of women among unemployed persons is higher than men in all municipalities. The percentage of registered unemployed persons among the estimated working age population (19 to 64) is highest in Batočina, at 20%. It is important to note that the percentages provided in the last column do not represent official unemployment data for the municipalities and they have been presented only for comparison purposes.

Table 49. Registered unemployed persons by municipality

Municipality	Number of registered unemployed persons (September 2023)		Estimated % of the working age population
	Total	% women	
Velika Plana	1,866	55%	8%
Lapovo	677	54%	15%
Batočina	1,388	54%	20%
Jagodina	6,168	56%	14%
Ćuprija	1,959	55%	12%

The average net salaries in all municipalities are significantly below the republic level average (713 EUR in July 2023), as can be seen in the table below. Salaries are lowest in the municipality Batočina (534 EUR) and highest in Velika Plana (580 EUR), however the gap is not very large between all of them. Salaries have grown in the past year in all municipalities, between 6 and 12%.

Table 50. Average net salaries by municipality

Municipality	Average net salary (August 2022)		Average net salary (July 2023)		% increase
	RSD	EUR[77]	RSD	EUR[78]	
Republic of Serbia	75,282	641	83,781	713	11%
Velika Plana	60,606	516	68,114	580	12%
Lapovo	61,587	524	65,521	558	6%
Batočina	58,114	495	62,791	534	8%
Jagodina	60,557	515	67,859	578	12%
Ćuprija	60,691	517	66,924	570	10%

6.4.4. Education and Health

According to data from the 2011 population census, as can be seen in the table below, the percentage of people with no education or incomplete primary education is between 15 and 19% in the affected municipalities, which is above the national average of 14%. The percentage of women who fall into this category is higher, ranging between 19 and 25%. The percentage of men and women who completed elementary education ranges from 21 to 27% (24 to 29% for women) also the same as or higher than the national average, in all municipalities. The rate of completion of secondary school is the same as or lower than the national average, except in Lapovo where it is higher. The percentage of women who have complered secondary education is lower in all municipalities than the national level. The rate of completion of higher education (college or university degree) is significantly lower than the national average, in all municipalities, and especially in Velika Plana, Lapovo and Batočina where it is half the national average. The percentage of men and women who have completed higher education is almost equal.

[77] *Exchange rate of 117.5 RSD per 1 EUR was used*

[78] *Exchange rate of 117.5 RSD per 1 EUR was used*

The share of illiterate people over the age of 10 in the total population is between 1.44% in Lapovo and 2.82% in Ćuprija (among women, from 2.28% to 4.75% in Ćuprija). Lapovo and Batočina are below the national average (1.96%, among women 3.12%).

Table 51. Level of education of the population by municipality

Municipality	None or incomplete elementary		Elementary		Secondary		Higher education	
	Total	women	Total	women	Total	women	Total	women
Republic of Serbia	14%	18%	21%	21%	49%	44%	16%	16%
Velika Plana	19%	25%	27%	29%	46%	39%	8%	8%
Lapovo	18%	23%	21%	25%	52%	43%	8%	7%
Batočina	19%	24%	24%	26%	49%	42%	8%	7%
Jagodina	15%	19%	22%	24%	49%	43%	13%	13%
Ćuprija	19%	24%	24%	25%	44%	39%	12%	11%

Life expectancy at birth in 2021 is between 72.89 years of age in Ćuprija and 74.29 in Lapovo, and it is higher than the national average in all the municipalities. For women, life expectancy at birth is higher in all municipalities. It is highest also in Lapovo (77.85 years of age) and lowest in Ćuprija (76.07 years of age), still higher than the national average.

Table 52. Life expectancy at birth of the population by municipality

Municipality	Life expectancy at birth (2021)	
	Total	women
Republic of Serbia	72.72	75.64
Velika Plana	73.1	76.3
Lapovo	74.29	77.85
Batočina	74.25	77.73
Jagodina	73.56	76.3
Ćuprija	72.89	76.07

The most significant causes of death in 2021 in all municipalities were cardiovascular diseases (between 36% in Jagodina and as high as 52% in Batočina). However, a second highest cause of death in all municipalities is formally classified as ‘codes for special purposes’ which is where cases associated with Covid 19 were recorded (between 19% in Batočina and 28% in Jagodina). Apart from these two causes, tumours are also a significant cause of death in all municipalities (between 6% in Batočina and 14% in Lapovo).

Ćuprija and Jagodina each have a general hospital, while the remaining three municipalities do not. All municipalities also have at least one primary health care centre in the centre of the municipality with branch offices in smaller towns and villages.

6.4.5. Infrastructure

The main road in the vicinity of section 2 of the railway Beograd Niš is the E-75 highway which is the most important road in Serbia, running centrally from the north to the south of the country. This road runs in parallel to the railway in most locations between Velika Plana and Paraćin and from it, smaller roads will have to be used to access project locations. Another state road which runs parallel to most of section 2 of the railway and will probably be used to access project locations is the State Road 158. In some areas, smaller, local roads will also need to be used. These roads are used to access local communities adjacent to the project area, and although they are paved roads, their quality varies.

The electricity and telecommunications networks are developed in all local communities. Outskirts of larger towns and cities have a public sewage system, while in the smaller villages sewage water is mainly discharged into septic tanks. The quality of water in local water networks is in line with acceptable standards. Solid waste disposal is organised in the local communities, often on a weekly basis, but unfortunately there is still a habit among the local population to dispose of waste in unregulated waste dumps. The villages have street lighting, at least in central locations, and most have bus connections to the centres of the municipalities or other parts of the country.

6.4.6. Land use and property

Jagodina is territorially the largest municipality, while Lapovo is the smallest among the five, but also one of the smallest municipalities in Serbia. Agricultural land dominates over forest land in all municipalities, and it is higher everywhere than the national average of 70%. Agriculture is also the dominant land use along the railway corridor, as it passes through rural areas with small villages and agricultural fields. The number of inhabited, more urban environments along the railway corridor is however higher than on section 3 of the railway, as it passes through parts of three towns Velika Plana, Lapovo and Ćuprija, as well as the city of Jagodina.

Table 53. Land use by municipality

Municipality	Total area	Agricultural land	Forest land
Velika Plana	345 km^2	78%	9%
Lapovo	55 km^2	83%	7%
Batočina	136 km^2	77%	20%
Jagodina	470 km^2	71%	21%
Ćuprija	287 km^2	76%	31%

At the time of developing this report, there are no details regarding the ownership of affected land, i.e. what percentage is public land and privately owned land. All privately owned land needed for the construction and reconstruction of the railway line, as well as all associated facilities, will be acquired through expropriation, i.e. an involuntary land acquisition process. Most of the land will be permanently acquired, while some small areas along the railway line may be temporarily acquired during construction, for construction camps, equipment laydown areas, storage, etc. The project will aim to use public land for these purposes, however if appropriate locations cannot be found, the needed land is likely to be acquired by contractors through voluntary rent agreements with owners of the land.

A more detailed description of all planned land acquisition and how it will be carried out, will be prepared during the ESIA development phase, while detailed land acquisition and resettlement planning will be done through the development of Resettlement Action Plans, which will address both physical and economic displacement caused by the Project.

6.4.7. Existing and planned railway stations, stops and crossings

There are currently 14 train stations and stops which are in use on section 2 of the Belgrade to Niš railway. According to plans at the time of developing this report, it is expected that 7 of the existing stops will be closed and 7 stations will be reconstructed and remain operational, as presented in the table below.

Table 54. Existing and planned stations and stops

Municipality	Existing Railway Stations and Stops	Status After Project	Distance to Planned Stations
Velika Plana	Velika Plana station	Remaining	
	Staro Selo stop	Closed	Approx. 3.5 km to the Velika Plana station
	Novo selo stop	Closed	Approx. 2.7 km to the Markovac station
	Markovac station	Remaining	
Lapovo	Lapovo varoš stop	Remaining	
	Lapovo station	Remaining	
Batočina	Brzan stop	Closed	Approx. 4.5 km to the Lapovo station
Jagodina	Miloševo stop	Closed	Approx. 4 km to the Bagrdan station
	Bagrdan station	Remaining	
	Lanište stop	Closed	Approx. 6 km to the Bagrdan station
	Bukovče stop	Closed	Approx. 3.9 km to the Jagodina station
	Jagodina station	Remaining	
Ćuprija	Gilje stop	Closed	Approx 3 km both from Jagodina and Ćuprija stations
	Ćuprija junction	Remaining	

The current railway is not fenced and there are many at grade vehicle crossings, where measures to stop traffic (ramps, warning signalisation) are not always abided by, all contributing to numerous accidents. The number of accidents is luckily still fewer than it could be, due to the infrequent and slow operation of trains, particularly in some locations. However, the new railway, which will have higher speed trains and more frequent rail traffic, will be fenced and most of the at grade crossings will be closed. At present there are 25 at grade crossings on this section and only 2 will remain (between Gilje and Paraćin station, where section 3 begins). Provisions are being made to replace these crossings for both pedestrians and vehicles with additional underpasses and overpasses, some of which also have to take into account the size of agricultural machinery used by the local population which must also be able to pass through/over. The table below provides an overview of the existing and planned crossings and areas where communication between two sides of the railway will be possible.

Table 55. Existing and planned crossings and ancillary structures

Crossings and Ancillary structures	Number of Existing	Number of Planned
Level crossings	25	2
Bridges	33	17
Viaducts	0	0
Galleries	0	0
Overpasses	1	24
Underpasses	36	14

6.4.8. Vulnerability and gender aspects

From previous assessments done for the project corridor, as well as experience from other projects in the region, it is possible to define some preliminary vulnerable categories of the population, present in the project areas, who may be more adversely affected during the construction and/or operation phase and will require the implementation of targeted mitigation measures. Such categories include:

- elderly households without family or other support, and particularly among them single elderly people living alone, in the villages along the railway line (a significant portion of the population in the small villages near the railway comprises elderly people)
- low income households living in substandard houses in villages along the railway line, including particularly Roma families who often live in extremely poor conditions (a significant portion of houses in the small villages near the railway line are in poor condition or substandard state)
- persons who may have difficulties accessing information about the Project that may be important for their everyday functioning (due to illiteracy, low educational status, etc.)
- children attending schools or other facilities near the railway, who have to cross the railway regularly
- persons who have mobility difficulties (e.g. users of wheelchairs, strollers), who are using railway transport

Experience has shown that within the above listed groups, women can be even more vulnerable than men. For example, women, particularly elderly women, living alone in small villages along the railway, women who are dependent on railway travel (or even just crossing the railway) to access services or economic opportunities outside of their villages, women, who are at risk from GBVH, either in connection to the increased presence of workers in the area during construction or while accessing and using railway transport, etc.

Some individuals or groups are considered more vulnerable specifically in relation to project land acquisition impacts (physical and economic displacement), as follows:

- persons residing informally in structures affected by the Project, with no other property or place of residence
- informal users of affected land who have no sources of income or assets of their own

persons who depend on the affected land for incomes/livelihoods and it is the only land they own or use

- elderly single headed households, single parent households, households with multiple members, etc. who have to be physically re-located
- persons who will be affected by physical and/or economic displacement, whose socio economic status is low, for example beneficiaries of social welfare

A vulnerability assessment will be carried out as part of the ESIA development, where more detailed baseline data will be presented, as well as specific impacts on vulnerable groups and how they will be managed.

6.4.9. Cultural heritage

According to the Institute for the Protection of Cultural Heritage of the Republic of Serbia, the following table lists the protected immovable cultural assets (cultural monuments and archaeological sites) located in the immediate and immediate vicinity of the observed railway route.

One cultural heritage is under previous protection - the Railway Station in Lapovo, which is considered a valuable object of industrial architecture. A management plan has been commissioned for this site and is in preparation.

Table 56. Preliminary list of registered objects of cultural heritage of cultural heritage/immpovable property on the route Velika Plana–Paraćin[79]

No.	Category	Type/Name	Location	Municipality	Distance from the railway [m]
1.	Immovable cultural property	Ilija Nikolić's house	Veliko Orašje	Velika Plana	3500

[79] *Institute for the Protection of Cultural Monuments of the City of Belgrade, https://beogradskonasledje.rs/*

2.	Immovable cultural property	Church Sveta Petka	Veliko Orašje	Velika Plana	3200
3.	Immovable cultural property	The building of the old slaughterhouse	Velika Plana	Velika Plana	450
4.	Immovable cultural property	The building at 79 Miloš Veliki Street	Velika Plana	Velika Plana	200
5.	Immovable cultural property	Pokajnica Monastery	Staro Selo	Velika Plana	2300
6.	Immovable cultural property	Church Sveto Vaznesenje	Staro Selo	Velika Plana	100
7.	Immovable cultural property	Church Svetog Đorđa	Novo Selo	Velika Plana	500
8.	Immovable cultural property	Church Svetog Arhangela	Rakinac	Velika Plana	2800
9.	Immovable cultural property	Brvnara Church	Brzan	Batočina	750
10.	Immovable cultural property (archeological site)	Jerina's town	Gradac	Batočina	5000
11.	Immovable cultural property	Cave in Gradac	Gradac	Batočina	5000
12.	Immovable cultural property	Villa Klefiš in Jagodina	Jagodina	Jagodina	90
13.	Immovable cultural property	Church Svetog Petra i Pavla	Jagodina	Jagodina	340
14.	Immovable cultural property	Square in the center of Jagodina	Jagodina	Jagodina	375
15.	Immovable cultural property	Building at 37 Marsala Tita Street	Jagodina	Jagodina	430
16.	Immovable cultural property (archeological site)	Part of the Ancient Fortification (Horeum Margi)	Ćuprija	Ćuprija	1500
17.	Immovable cultural property	Monument to fallen soldiers from World War I	Ćuprija	Ćuprija	1900
18.	Immovable cultural property	Building at 47 Branka Krsmanovića Street	Paraćin	Paraćin	460
19.	Immovable cultural property	Building at 45 Branka Krsmanovića Street	Paraćin	Paraćin	400
20.	Immovable cultural property	The building at 17 Maksima Gorkog Street	Paraćin	Paraćin	670
21.	Immovable cultural property	Buildings in Kralja Petra Street No. 2 and 4 in Paraćin	Paraćin	Paraćin	600
22.	Immovable cultural property	Monument to the fallen warriors in St. I. war	Paraćin	Paraćin	630
23.	Immovable cultural property	The medieval town of Petrus	Paraćin	Paraćin	1300

Identified sensitive zones and receptors:

All inhabited areas along the railway route are considered sensitive zones where the impacts during construction and/or operation will be greatest. Smaller villages, as opposed to the suburbs of larger cities and towns, are considered even more sensitive, as the socio-economic status of the population is generally lower and because local residents generally have less public transport options available than people in cities (in case their railway stops will

be closed). In addition, smaller villages are highly dependent on crossing the railway to communicate with other parts of the village (everyday movement to work, school, public services, friends and family members, etc.) and the number of railway crossings and their location are among the most significant issues of concern for them. All listed impacts can be more severe for various vulnerable groups and some may also be gender specific.

Households who will be required to move, and among them particularly people who are not owners of affected structures but are users of municipal and/or railway apartments, are considered most sensitive. This also applies to any businesses who will be required to relocate.

As sensitive zones regarding cultural heritage stand out locations in immediate vicinity of railway line, such as Church of St. Vaznesenje, The building at 79 Miloš Veliki Street and Villa Klefiš in Jagodina.

Identified and reviewed existing baseline information relevant for the project:

Official census population data, from 2011 and 2022

DevInfo data on municipalities (key indicators)

Municipal local development plans, as well as studies and reports (e.g. budgets for 2023)

Data at municipal level available from the Serbian Business Registers Agency

Institute for the Protection of Cultural Monuments of the City of Belgrade, https://beogradskonasledje.rs/

Identified significant gaps in existing baseline data relevant for the project:

No up to date data at the level of villages (or neighbourhoods in the case of cities and larger towns) is available from the most recent 2022 official population census. According to announcements from the Statistical Office of Serbia, detailed population data (age of inhabitants, education and skills, economic activity, sources of livelihoods, etc.) at the level of municipalities is expected to be publicly disclosed by the end of 2023. It is not certain whether this data will also be available at village (local community) level. If not, it will be collected from local self-governments and village councils, as well as other local sources.

No identified gaps regarding the cultural heritage.

Method of further ESIA baseline data collection and assessment:

The above data will be collected during site visits and meetings with relevant local authorities, village councils and other relevant stakeholders such as active civil society organisations. Further data on specific topics of interest may be collected through focus group meetings in local communities, for example, with women users of railway transport, parents of children attending a school in the vicinity of the railway, residents of Roma settlements in the vicinity of the railway, etc. Depending on when the RAP socio economic surveys will be carried out, the data from these surveys may also be used to supplement the ESIA baseline.

Information obtained from the Institute for the Protection of Cultural Monuments of Serbia and location conditions will be used for further assessment of cultural heritage.

7. IDENTIFICATION OF THE POSSIBLE IMPACTS OF THE PROJECT

7.1. Impacts to the physical environment

7.1.1. Climate change

Impact of climate change on the project

As presented in Climate characteristics- baseline, the temperature in Serbia will continue to rise while the precipitation levels will decrease (end of the century, RCP8.5). The projected changes can have a negative impact on the project during construction periods during potential weather sensitive construction, but the overall impact is expected to be minimal or negligible.

During railway operation the impact of climate change is expected to be low to negligible. This assumption is made considering that thermal expansion of railway construction due to the increasing temperatures, that peak precipitation from the perspective of drainage systems and bridges, is taken into account in the design stage and that soil moisture percent will not decrease significantly, as expected. Circumstances outside of direct railway maintenance, as is regular clearings of river debris (mostly tree trunks and branches) that can lead to river level rising at the foot of the bridge pillars due to the piling up and therefore cause rail closing, are not taken into account. Furter detailed climate resilience assessment will be performed as the part of the ESIA and any potential mitigation measures stemming from obtained results should be implemented.

Impact of the project on the climate change

Construction phase

Fossil fuel powered construction machinery and transport vehicles will be used, along with electricity powered equipment (emission factor depends on Serbia's electricity production mix). Some vegetation removal along the new railway sections shall be necessary, therefore lowering carbon sink potential and probably releasing biogenic carbon stored in biomass. Both factors are relatively small and localized so that the overall impact of the project on climate change during construction can be considered negligible. During the construction phase of the project some negative impacts of the project on climate change are expected due to emissions from fossil fuel powered machinery and transport vehicles.

Operation phase

Detected emissions sources during operation are indirect emissions from electricity production (electricity powered trains) and emissions related to commuting of railway workers. Other emission sources during the operation phase are not expected.

Comparing the railroad transport to the fossil fuel powered road transport, rail transport is more efficient. Combining the higher efficiency with the electrified railroad, the overall impact of the project on climate change will be significantly positive.

The total impact of the project on climate change will be assessed in more detail in ESIA. The overall impact of the project is estimated to be negligible to low adverse.

7.1.2. Geohazards

Construction phase

The main impacts on land in the construction phase may be occurrence of landslides on the route in terms of terrain type and slope stability. Slope stability can be sensitive due to the creation of cuts or embankments, especially during viaduct works. The removal of topsoil can lead to the risk of erosion of exposed soil and increased water runoff and siltation of occasional streams. The use of heavy machinery and equipment, especially on steep slopes to clear construction corridors, can also lead to serious compaction or erosion problems. For example, the presence of quarries and borrow pits (sources of road construction materials) if not properly rehabilitated, can cause erosion.

A negative impact during the construction phase may be:

- Soil erosion from construction activities (deforestation, site clearance and preparation)
- Soil stability and risk of landslides.
- Seismic activity.
- Floods.

Operation phase

During its operational phase, the Project will not directly discharge pollutants to the land. The only eventual potential effects related to geology and soil features are the soil liquefaction and subsidence, as well as erosion and sedimentation.

The operational Project may result in minor potential impacts on the land, especially due to maintenance activities and the control of the infrastructure and equipment.

- Risk of pollution from fuel/oil
- Local effects on soils from compaction

Effects and mitigation measures are similar to construction stage. The overall potential effects might be evaluated of local extent, and of low probability and significance.

The subject section of the railway line Velika Plana–Paraćin is located in the area of seismic intensity of the VII and VIII degrees according to the MCS scale.

Possible earthquake of the mentioned intensity cannot cause serious consequences along the railway line and on the station facilities, both for the lives of employees and for the environment.

It is anticipated that these potential impacts will be of negligible to minor significance.

7.1.3. Soil

Construction phase

In the construction phase, soil pollution can primarily be caused by improper handling of oil and oil derivatives used for construction machinery and other devices during construction. Contamination can also occur if the cleaning of vehicles and work machines is performed inadequately outside the prescribed places, with inadequate arrangement of the construction site and other activities that are not carried out in accordance with the recommended technical measures during construction.

Soil pollution can be reduced to a minimum or completely eliminated if prescribed technical measures are followed. The construction process is characterized by extensive mechanical stabilization of the route and in places where temporary access roads are formed, and in certain sensitive parts they can have an impact on the entire system of soil parameters, primarily in terms of water permeability, air content, etc.

Construction equipment (vehicles and construction equipment) moving around the site can create soil compaction, which can harm soil productivity, disrupt drainage and increase the risk of flooding. This disturbance consists of localized changes in the soil profile in the immediate vicinity of the excavation.

A possible impact is expected in operation phase due to the movement of machinery and mechanization. The negative impact of structural damage and soil compaction caused by the use of heavy machinery (especially on wet ground) can be mitigated by protective measures using of existing access roads.

During the construction phase, impacts on soil characteristics may be:

- Loss of fertile topsoil (refers to the new part of the railway that will be built; where the project follows the corridor of the existing railway, there is no such influence).
- Occurrence of rockfall along the route regarding terrain type and slope stability. Slope stability may be sensitive by the creation of road cuts or embankments, especially during the works on the viaducts.
- Soil dewatering due to increase in surface runoff (10-20% water loss) and evaporation (60-70% water loss) as a result of removal of vegetation and changes in land slopes.
- Increased risk of localised pollution due to the maintenance of construction vehicles at the site, e.g. lubricants and oil changes, washing of vehicles, etc.
- Soil compaction
- Localised reduction in soil quality resulting from potential release of wastewater into soil.
- Changes in land use from agricultural and forest to construction land.
- Deforestation, in terms of cutting, clearing, and removal of forest or stand of trees where land is converted to a non-forest use.

Operation phase

During operation phase there will be a negative impact on the soil due to its permanent loss. Permanent soil loss refers to the area of infrastructure belt (25 m on both sides of the railway line from the centre lines of the end tracks), save in the zone of the belt in the inhabited place (6 m on both sides of the railway line from the centre lines of the end tracks).

In the operation phase, soil pollution will mainly be the result of the following processes: pollution from storm water; disposal of organic and inorganic waste; cargo spillage; deposition of atmospheric particles from the wind and dispersion due to vehicle movement.

Due to possible excess pollution, during various accidents, leaks from tanks, fuel spills, or leaks due to the failure of construction machinery are possible, which can lead to soil contamination. In the case of soil pollution with oil and its derivatives, the revitalization of such soil is a complex and long-term process. If the soil is made of fine-grained clayey material, infiltration and the possibility of contamination of the soil, and therefore the goundwaters, are reduced. On the other hand, if the soil layer is of significant thickness, then the processes of filtration, biodegradation, sorption and volatilization become significant, which results in faster contamination of groundwaters.

- Permanent loss of soil in the part of the new railway line
- Impact on topsoil quality and soil erosion
- Direct discharge of surface run-off
- Accidental fuel and oil spills
- Reduction in soil quality resulting from use of de-icing agents.

7.1.4. Agricultural land

Construction phase

During construction works negative impact on agricultural land is expected from excavation works. Topsoil with cover vegetation or agricultural crops will be removed from agricultural land, in width of working corridor, during construction of railway, stations and possible construction of temporary access roads.

Considering the nature of the Project, negative impacts on the agricultural land can also be expected due to:

- Temporary disruption of local land due to confiscation of land for construction activities (transportation and access roads, landfills, areas for workers), as well as negative impact of dust on crops near the construction site,
- Negative impacts on agricultural land during construction may result from spilled oils and liquids into the agricultural land (diesel fuel, motor oil, etc.) from temporary storage at the construction site or during machinery and vehicle maintenance (including fuel pumping). This negative impact can be avoided whit adequate organization of the construction site and proper handling of oils and liquids.

The impact on agricultural land during construction phase is temporary, linear, and local because it relates to period of construction works and to working corridor.

Operation phase

The most significant impact on agricultural areas refers to the loss of agricultural land around the construction of the railway and railway stations.

The impact is most significant around intensive agricultural production and valuable agricultural land (agricultural land of Great Morava).

A negative impact on the agricultural land is possible in case of:

- accidental situations
- large-scale pollution can occur during the transport of dangerous materials (train collisions, overturning of containers or wagons with dangerous materials during transport or some other damage)
- spillage of harmful substances (acid, oil, etc.) in the affected area.
- use of herbicides to remove vegetation near the railway, the use of repellents and pesticides, and the use of lubricants and other dangerous substances for the maintenance of railway elements, the washing of which by rainwater can lead to smaller amounts entering the soil.

In accordance with the above, the impact of the use of the project in question on the mentioned areas of agricultural land will be of a permanent and local character.

7.1.5. Waters

Construction phase

The reconstruction and rehabilitation of infrastructural facilities is a prerequisite for a significant improvement of the environment, although during the preparation, execution of works and exploitation it is possible to have a limited and minor impacts to the environment. In the long term, the reconstruction of the railway should contribute to reducing the risk of surface and groundwater pollution, because the drainage conditions of the railway will be improved. Improving the technical condition of the railway will increase the safety of transport and significantly reduce the risk of accidents.

Negative impacts on the quality of surface water are most often and most easily manifested on bridges over certain water bodies, on parts of watercourses parallel to the railway route, as well as culverts for smaller, torrential, and occasional watercourses. And the parts of the route with a high level of the first aquifer.

Temporary impacts that occur during the execution of construction works such as drains can cause surface water pollution, as well as have effects on the coast. Works involving spills can cause soil pollution, while excavation and disposal of contaminated soil can lead to groundwater pollution, and clearing of vegetation can cause turbidity of water courses.

When it comes to the possible contamination of surface and groundwaters, temporary impacts can occur during the process of transporting materials, performing construction works, and temporarily depositing waste. Such impacts are mostly short-term, spatially limited, and caused by works carried out for the purpose of railway reconstruction. The transport of necessary materials and equipment for railway reconstruction can also have an impact on the environment. Among the more significant temporary, short-term, negative impacts on water (surface and groundwaters), we can point out the impact of sanitary wastewater from the labor camp, as well as the water used for washing and maintenance of machinery. However, their impact on water pollution is insignificant, of a local nature and will be minimized through the implementation of measures to prevent environmental impact.

Fuel for construction machinery and numerous freight vehicles will be delivered by tankers, which represents a potential danger of spillage of oil derivatives during overflow or breakdown, as well as leakage of smaller quantities of fuel and lubricants in the event of a breakdown. Sporadic leakage of small quantities of oil derivatives and oily substances can lead to limited, local contamination of soil and possibly groundwater, but the impact on groundwater quality will be small.

During construction works, a negative impact on surface waters and groundwaters may be:

- Increased pollution risks to surface water bodies from increased sedimentation and disposal or spillage of fuels or other harmful substances that may be discharged, spilled directly, or migrate to local surface water receptors.

- Increased risks to surface waters from discharge of foul effluent from construction compounds / construction workers accommodation and increased water demand associated with construction compounds / construction workers accommodation.
- Increased flood risk associated with temporary works within areas of fluvial flood risk and within watercourses and increased flood risk associated with surface water discharges during construction.
- Impacts to watercourse flow and connectivity.
- Earthworks required for installation of abutments and piers may initiate the bank erosion resulting in significant sediment run-off and deterioration of the surface water quality and even affect the streambed hydromorphology.
- Potential Impacts on Groundwater Quality from Leaks / Spills from HGVs, Machinery and Hazardous Material Storage
- Dewatering and changing the groundwater regime.

Operation phase

During the development of railway traffic and the maintenance of the infrastructure, soil, surface and groundwater pollution may occur due to the traffic of railway vehicles.

Due to vibrations, friction and wear, during the passage of both freight and passenger trains, small particles of rust, paint, protective coatings and metal will fall off the rails. Water will wash away these particles, which will slowly penetrate the track soil over time. More than a decade of leaching will lead to soil saturation and groundwater penetration, which will worsen its quality. This is of a strictly local character and will not affect the quality of groundwater.

Only in cases of accidents, during the transportation of oil and derivatives, oil and dangerous substances in liquid state, significant pollution of surface and/or underground water can be expected. The consequences are usually of limited duration and range, but in case of failure it is necessary to take adequate preventive, protective and remedial measures, and especially accidents can have serious long-term consequences.

Also, a negative impact on groundwater and surface water can be achieved by the maintenance procedures of the railway curtain (Regulation 309 for chemical control of weeds and bushes, Official Gazette of ZJZ, No. 8/90). According to this rulebook, chemical control of weeds and bushes on the tracks is carried out as needed in spring, summer or autumn, depending on the applicable herbicides-arboricides, which are given in this rulebook. Suppression of weeds on the railway route is carried out with total herbicides systematically, every year, for the purpose of protecting the railway body and traffic safety. These compounds belong to the group of dangerous substances that, in addition to weeds, have a toxic effect on hydrobionts, as well as on humans. Their decomposition time is slightly longer than that of classic herbicides, so the danger of penetrating into the groundwater and spreading to the surrounding area is greater. The application of total herbicides is strictly limited and regulated by a special regulation. The packaging of the used herbicide is hazardous waste and requires special, prescribed treatment.

During the operation phase, impacts on water characteristics may be:

- Polluted surface water runoff that may be discharged to surface water bodies.
- Increased wastewater discharge and increased water demand associated with railway stations.
- Increased flood risk associated with proposed drainage systems.
- Increased flood risk caused by displacement of flood water storage or crossing of watercourses that may impact flood flow conveyance.
- Impacts to hydrology, hydromorphology and flow dynamics associated with any crossing or realignment of watercourses.
- Potential effects on groundwater quality, flow and recharge.

7.1.6. Noise and vibrations

Construction phase

Noise levels during railway modernization depend primarily on the organization of work on the construction site, the number and types of construction machinery employed, as well as their location and distance from residential buildings in the zone.

In the construction phase, noise pollution can primarily be caused by construction works, transport and material handling, while the receptors are construction workers at the site, nearest settlements, flora and fauna along the railway line.

During the execution of the works, it is necessary to carry out periodic noise measurements in order to determine that the generated levels do not exceed legally permitted limits.During the construction phase, a negative impact of noise and vibration may be:

- Increased noise levels near residential buildings due to excavation works
- Negative impact on workers from increased levels of noise during construction activities and use/movement of construction equipment
- 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
- Construction works will produce noise and vibration that may temporarily affect local flora and fauna.
- Increased vibration levels near residential buildings due to ground-borne vibration, particularly from blasting and heavy vehicles movement when there are irregularities in the road surface
- Impact on workers, residents, and fauna from increased levels of noise and ground-borne vibration during construction works as a result of tunnelling, earthworks, pilling or potential blasting.
- Structural damage from vibration caused by equipment and operation methods employed including potential use of explosives.

Operation phase

In the operation phase, the main source of noise will be the operation of the railway itself, while potential receptors will be workers at maintenance, and nearest settlements, flora and fauna along the railway line.

During the operation phase, impacts of noise and vibration may be:

- Impact on residents and biological functions from increased levels of noise, vibration and micro-pressure effect from railway traffic.
- Impact on workers from increased level of noise and vibration from rolling stock and machinery during maintenance activities.
- Negative impact as a result of increased railway noise in the zone with residential receptors
- Negative impact as a result of ground-borne vibration in the zone with residential receptors
- Potential disturbance of specific biological functions by noise and vibration effects

7.1.7. Landscape

Construction phase

Any external construction works cause visual and structural degradation. The construction phase will result in a significant perceptual change to the landform within the affected area, and in some instances obstruct views of the wider countryside beyond. Beside of being a relatively short-termed, such impacts are common in linear projects and can be partially mitigated with the relevant measures.

During construction phase visual impact is significant, and it's caused by presence of work machinery and workers and, along the new railway sections, excavation, and filling works. Part of these impacts is temporary and disappears upon completion of works, and most of the project is visible during operation phase and later. It is imperative that after-construction activities are carried out in line with the relevant vegetation management document.

From the landscape perspective and having in mind mentioned minimal deviation of the new railway from the existing one (moving from semi-urban surroundings to agricultural ones), no sensitive areas are identified.

From the point of impact on the viewsheds and potential receptors, negative impact would be small to medium adverse because over 50% of the route is planned in urban and semi-urban areas.

Operation phase

Again, it must be emphasized that new route greatly coincides with the existing one, meaning that landscape character won't suffer any significant change. Visual amenity will also, to the great extent, remain unchanged ones the railway tracks are removed.

Initial analysis of the zone of theoretical visibility (ZVI) shows that train with wagons will be visible for the viewers situated within Velika Morava valley (up to 10km between Velika Plana and Lapovo, around 3km between Lapovo and Novo Lanište and around 10 km between Novo Lanište and Paraćin). Due to the terrain configuration, railway will be visible to the larger population in its northern section (Velika Plana to Lapovo).

7.2. Biodiversity, protected areas, and habitats

7.2.1. Construction phase

During the construction phase, possible identified negative impact on biodiversity and protected areas include:

- Habitat loss
- Habitat degradation
- Habitat fragmentation
- Severance of ecological biocorridors
- Loss of flora
- Use of pesticides
- Direct mortality
- Species disturbance including noise / vibration and visual disturbance
- Possible pollution incidents.
- Introduction of invasive species

The construction activities (excavation, transport, construction of railway facilities) will cause temporary and localized increase in the ambient noise. Levels of dust will be increased. It is expected that a dust cover on vegetation will form near all locations of construction works so the evapotranspiration and photosynthesis processes will be temporarily disrupted. Expected dust cover will be spatially limited, temporary (dependent on meteorological conditions) and therefore will not represent significant impact on plant viability.

The habitats on the riverbanks will be crossed by means of bridges. During the reconstruction/construction of the bridges mentioned habitats will be directly affected by the works. The impact will be stronger in those locations where the construction of new bridges is planned. However, this impact can be considered temporary (temporary severance of the corridor) because the impact on habitats will be limited to the time the construction works. The magnitude of the impact will not be the same in every locality. The magnitude of this impact will be evaluated during field investigation.

During construction works across water habitats, a localized dispersion of sediment in water column is expected, which would cause a localized sediment plume (increase of turbidity and changes in physio-chemical conditions). This will cause short-term, temporary, and localized disturbance on present aquatic fauna.

The project construction phase may cause disruption to the migration of great mammals. The fatalities of species of mammals are not expected due to their avoidance of the area of construction works and hiding in the surrounding shelters. It is expected that birds will avoid the area of construction works. Locally present individuals of herpetofauna are expected to be found along the habitats near the rivers. It is possible for individual fatalities to occur during the construction works. The area of construction works will become temporary barrier for possible migrations and a source of noise and vibration to which species of herpetofauna are very sensitive. Although most of them will avoid construction area, fatalities among some of slowly moving individuals (e.g. young animals) or migratory groups are possible.

During construction works, habitats within project area will be disturbed by machinery and human presence. Any disturbed habitat poses bigger risk for the spread and distribution of invasive species. There is a possibility of invasive species taking over respected habitats for native species, so mitigation measures will be proposed.

Performing the construction works in accordance with the regulations and professional rules, it is possible to prevent potentially negative impact on soil and vegetation due to uncontrolled spillage/leakage of hazardous materials (machine oils or fuels) from the equipment and machinery.

Critical habitat assessment will be done within ESIA study after finalizing biodiversity surveys and conclusion of baseline assessment when the finalization of EAAA will be defined.

7.2.2. Operation phase

During the operation phase, possible identified negative impact on biodiversity and protected areas include:

- Habitat degradation
- Habitat fragmentation
- Direct mortality - e.g. as a result of increased collision risk with the railway and electrocution on power lines. Bird collision with high-speed trains to be noted, particularly in proximity to IBA or migration routes if identified
- Species disturbance - disturbance – including noise/vibration and visual disturbance.
- “Barrier effect”
- Introduction of invasive species

During operation phase, increase in human presence which will disturb locally present faunal species, that will migrate to undisturbed habitats in vicinity. The full assessment will be prepared, based on conducted one-year surveys. The identified impacts will be possible to reduce by prescribing additional measures, when areas with greater fauna activity will be determined. Based on that the need to prescribe additional measures will be known.

During maintenance activities, intrusion of invasive plant species is possible. for which mitigation measures will be proposed.

7.3. Discharges into the environment

7.3.1. Air pollution

Construction phase

The observed section of the Velika Plana–Paraćin line is electrified, so it has a minimal impact on air quality, regardless of which variant it is. Air pollution is possibly caused by the evaporation of means used for the maintenance of turnouts. During the construction phase, the main causes of potential negative impact on air quality are the emissions from construction works and presence of construction machines at the site. The construction phase impact on air quality is due to emissions of construction dust associated with the soil management, loading activities, storage of material onsite, transport of materials within site, drilling and digging (including soil excavation), movement on unpaved roads and transport of material offsite, asphalt and concrete laying and air pollutant emissions from burning fossil fuels in the motors of construction machines and vehicles.

During the construction phase, a negative impact on air may be:

- Impacts from generation of dust and particulate matter from the construction works;
- Emissions from construction machines and vehicles exhaust;

Operation phase

The existing and modernized part of the railway is electrified, so that it does not fall under the group of air pollutant emission sources. It can be concluded that comparing to the current situation from the aspect of air pollution, the project has no significant negative impact on the environment. By modernizing the railway along with upgrading both tracks along its entire length, as well as increasing transport speeds, gas emissions will be indirectly reduced if the goal of increasing the transport of goods and passengers by rail compared to road transport is achieved.

During the operation phase, impacts on air pollution may be:

- Modal shift of passenger and freight movements from road-based travel (car or bus movements for passenger and freight respectively) to rail-based travel.

- Change in human exposure to dust generated by rail and brake wear as a result of railway alignment.
-

7.3.2. Resources and waste

Construction phase

During the construction phase, there are a number of impacts that can arise from poor waste management and inappropriate sources of materials. The potential negative impacts of the Project in the construction phase are inefficient handling of excavated material, storage and disposal that causes environmental contamination or sedimentation of water resources, contamination of environments (particularly watercourses, groundwater and the land) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements, fugitive emissions, such as dust, associated with the handling and storage of some waste streams. By far the most significant waste stream which will be generated because of the construction phase of the Project is the soil/stone from excavation activities. And, besides the excavated spoil, the most significant materials that are expected to be used as part of the construction phase are the various grades of concrete, shotcrete and cement/grout. The primary environmental impacts associated with the use of concrete are elevated dust levels during use of the concrete batching plant and CO_2 emissions and embedded CO_2 associated with concrete production. If not controlled and treated in a special way, the following causes a serious environmental contamination: hazardous waste, for example, asphalt binder or waste containing asbestos, asbestos insulation materials (from the demolition and reconstruction of buildings at railway stations), impregnated wooden sleepers (due to the possible content of benzene from creosote oil and heavy metals such as arsenic, cadmium, etc.), as well as paints, varnishes, solvents, oil wastes etc.

During the construction phase, a negative impact of waste may be:

- Release of greenhouse gas emissions (through transportation and during concrete production).
- Water consumption.
- Ecological impacts
- Visual, impacts in ecology, waters and air from demolition waste, excavated material, decommissioning of the existing railway line and construction work site waste.

Operation phase

In the operational phase, likely types of waste include many municipal types of waste generated by passengers and train personnel or train station staff. Waste will also be generated as a result of railway facilities maintenance and in case of any traffic accidents. These include metal waste, packaging waste, packaging contaminated with hazardous substances, greasy cloths, absorbents, wiping cloths, filter materials and protective clothing, etc. The amount of operational waste will be significantly less than that generated during the construction phase.

During the operation phase, impacts of waste may be:

- Waste that will be generated during the railway operation will be primarily food, paper and packaging waste, coming from passengers;
- Track maintenance waste and ancillary infrastructure waste can be expected along the route and their quantities will depend on the maintenance activity.

7.4. Socio-Economic Impacts

7.4.1. Pre-Construction and Construction phase

Sources of impacts

Land acquisition, construction works, transport and material handling, closure of railway stations (stops) during construction which will become permanent, railway crossing points, potential detachment of existing railway lines (last mile connections) used by businesses along the railway, as well as creation of new connections.

Potentially impacted sensitive zones and receptors

Owners and users of land and structures which will be acquired for the Project and who will be physically and /or economically displaced, particularly those more vulnerable among them (e.g. people using municipal or railway apartments)

Users of land and structures near construction areas who could suffer damages as a result of construction activities, including construction related transport, and particularly those more vulnerable among them (e.g. people living in old houses which could be further eroded and damaged as a result of intense construction activities, elderly people living alone, etc.).

Owners and employees of businesses who will need to be relocated as a result of land acquisition, including any informal economic activities often carried out by people who are of a low socio economic status and in that sense will be more severely impacted and in need of targeted assistance.

Businesses who may lose access to direct connections to the railway for freight transport

People residing or working in villages and neighbourhoods along the railway route. This includes particularly vulnerable groups which will be impacted to a greater degree than the general population, for example children attending schools near the railway, residents who cross the railway regularly to access services (church, health centre, market, football field, etc.). Previous assessments also mention that closure of

stations will possibly have a greater impact on women who live in rural areas and are more dependent on railway transport.

Local self-governments (municipalities) and local community councils

Construction workers at the site

Land use, Land Acquisition, Physical and Economic Displacement

From the information available to date, most of the Project footprint will follow the existing railway corridor, which will be expanded on both sides, requiring clearing of land. Only in a few locations in section 2, it is likely that the footprint will deviate away from settlements (4 settlements) and towards land that is currently used for agriculture and possibly some forest land.

The expansion and clearing of the existing corridor will cause significant physical displacement during the pre-construction phase, in areas where the railway passes through inhabited areas (particularly towns Velika Plana, Lapovo and Jagodina), where houses have been built in the close vicinity of the railway on both sides. Most of the inhabited structures are privately owned, however, there are also railway owned apartments and houses which are most often occupied by current or former railway workers and/or their family members. In some of the smaller villages, a significant percentage of the houses are in poor condition, suggesting they are inhabited by vulnerable individuals, of a low socio-economic status. Some of the houses are not in use. There are also non-residential structures which may be affected, such as barns, sheds, etc. In addition, there are areas where industrial and business structures, such as workshops, warehouses, shops, etc. will have to be acquired and demolished.

These issues will be further explored in the ESIA development phase, however detailed assessments and mitigation measures will be developed in the Project RAP(s).

In addition to land use and physical and economic displacement impacts, resulting from land acquisition carried out during the early stages of the project, some further impacts may occur during construction. Land not previously acquired may need to be acquired and used temporarily, during construction, for worker camps, material laydown areas, storing of equipment, machinery, etc. From experience on similar projects, contractors prefer to make arrangements to use public land for such purposes or, if such land is not available, to rent land from local landowners or companies, through voluntary rent agreements, which include a clause on returning the land to its previous condition upon the completion of the rental agreement. Construction activities can also cause damages to private properties near construction locations (e.g. workers drive across agricultural fields with machinery). With the implementation of appropriate management plans and procedures, as well as grievance management and provision of compensation for all damages and losses, at full replacement cost, they will be fully mitigated.

Community Severance and Loss of Access

The upgrading of the railway will mean that current, level crossings for pedestrians and vehicles, will no longer be available and that fences will have to be erected along the railway, both to protect the infrastructure and to prevent accidents. It will be necessary to create underpasses and overpasses to enable people to continue crossing to the other side of the railway track on a daily basis, to continue with their usual everyday activities, such as traveling to work or school, accessing shops and other services, visiting friends and relatives, but also reaching agricultural land on the other side of the railway, to cultivate it. This means that the selection of locations for underpasses and overpasses, as well as ensuring that these roads may be used by agricultural machinery (e.g. combines) where necessary, is a key concern for the local population. In addition, any areas where pedestrian movement is expected, particularly at night, must be adequately designed to take into account the safety of pedestrians, for example proper lighting. This is one of the key issues to be addressed during the Project design phase and will be a topic for discussion with numerous stakeholders, particularly local communities. The process and outcomes will be described in the Project ESIA.

These impacts will start as construction of the railway line begins and some of the impacts will become permanent as the railway moves into the operations phase. The timing and sequencing of impacts will have to be considered and presented to affected people, including mitigation measures that will be applied by the Project.

Another potential indirect impact associated with loss of access, which could lead to loss of business and livelihoods, is the detachment of any existing railway lines currently connected to the Belgrade Niš railway which are used by the private sector for freight transport. It is understood that the MCTI is in the process of assessing the overall feasibility of these so called 'last mile' railway connections and their potential to increase freight traffic on the national railway network. Details on the existing railway lines and their prospects in terms of remaining connected to the network are currently unknown, however they will be further explored in the ESIA phase and, if needed, appropriate consultation and mitigation measures will be developed. Similarly to the above, these impacts may start with construction and move on to the operational phase becoming permanent, which is why sequencing will also be further explored and presented in the ESIA.

Access to Infrastructure and Utilities

As mentioned in the baseline section, the upgrading of the railway will mean that some of the current train stations/stops will be closed, and people living in villages where this happens, will no longer have access to an important means of local transport. At the time of developing this report it is expected that 7 out of the existing 14 stations and stops will be closed. It may even happen in villages that have no bus transport or any other form of public transport available. In a few locations the nearest stations will be 4 to 5 km away from the current stop which people are using. This is another issue of concern for some local communities and must be considered as early as

possible in the planning stages of the Project. The issue is particularly important from the view of women from rural communities who are often more dependent on railway transport than other population groups.

Impacts on local roads which will be used during construction, further potentially causing traffic delays, accidents, inability to access fields for agricultural works, damages to vehicles or other assets, or creating costs for local governments if not repaired, will also be explored in the ESIA. Potential impacts on any other community infrastructure, such as water supply, electricity supply, etc. either through the installation of construction camps or by way of damages during construction, will also be considered and adequate mitigation measures defined, including any small community investments.

Employment and Procurement Opportunities

A significant benefit that can be expected from the project are employment and procurement opportunities. Information on local employment and procurement from other similar projects will be analysed to predict the scale of these impacts that can be expected on this project, including further impacts on local livelihoods, particularly in the local communities. A significant portion of the workforce will comprise low skilled workers, which offers opportunities for unemployed persons from the small local communities. Businesses offering accommodation as well as shops, restaurants and cafés/ bars, may see a considerable increase in customers when construction starts. Support services such as laundry, catering, etc. may provide more economic opportunities for women. Businesses that provide construction related services will also significantly benefit and that benefit will stretch beyond local communities to the regional level, but also Serbia as a whole.

Labour and Working Conditions

The size of construction workforce is unknown at present, however it can be expected that a considerable workforce will be present in some locations. Although it is expected that local workers will be used wherever possible, or workers from other parts of Serbia, it is possible that foreign workers will be used as well. Workers may be housed on site in construction camps or in other forms of accommodation, available in local communities and larger towns along the railway line. These issues will have to be explored during the ESIA development phase and appropriate risk management and mitigation measures, including those addressing worker accommodation and HR standards, will be included.

Community Health, Safety and Security

The social impact assessment will also consider community safety and security issues including risks for communities associated with presence of workers in the project area (and particularly GBVH risks) and accidents involving community members. The fact that the workforce housed on site may be considerable compared to the size of existing local communities carries a number of risks that will be explored and addressed in the ESIA.

7.4.2. Operation phase

Sources of impacts

Operation of the fast railway, new stations and access to stations, improved and safer transport, better access for business and tourism

Potentially impacted sensitive zones and receptors

Current providers of public transport services (local bus companies, taxis) who may lose access to customers and suffer livelihood losses once the railway is operational.

People residing or working in villages and neighbourhoods along the railway route, people owning businesses along the railway route

Local self-governments (municipalities) and local community councils.

Women accessing and using railway transport susceptible to GBVH risks

The operation of the railway is expected to have positive impacts on local communities in terms of improved and safer transport, but also opportunities for more economic development including tourism development. There are areas of significant cultural heritage along the railway line, as well as natural landscapes, which will be more accessible to tourists especially if the local infrastructure and tourism services are developed. This is very much an opportunity for women to develop various support services in the local communities.

The closure of railway stations is not expected to cause termination of employment for railway workers, as SRI plans to re-assign them to other jobs that will become available. This will be further explored and confirmed in the ESIA.

The development of the railway and improvements in the quality and speed of passenger transport, will attract more people to use this form of public transport. It is possible, that as a result, some of the current providers of public transport services (local bus companies, taxis) may lose access to customers and suffer livelihood losses. This issue will be explored in more detail in the ESIA and if needed, measures to prevent or mitigate such impacts will be defined.

Further plans for provision of direct support to the municipalities or any local initiatives or activities, will be explored in the ESIA and measures to enhance such support, in accordance with international best practice, will be proposed.

The ESIA will explore GBVH risks associated with access to and use of railway transport. The corridor assessment report also concludes that, positive gender impacts can be achieved, as the project will contribute to safer and more reliable public transport, the development of tourism and employment opportunities, which all have the potential to benefit women, particularly those living in rural areas. The ESIA will present such findings if they are confirmed in the ESIA development phase and offer mitigation and enhancement measures.

7.5. Cultural heritage impacts

7.5.1. Construction phase

The Project has the potential to impact previously unrecorded remains which may be affected by the disturbance during construction phase. There is high potential for encountering such chance finds, considering that Serbia is known for its ample archaeological and cultural heritage sites. None of the identified cultural heritage sites are on the route itself and will thus not be directly impacted.

During the construction phase, possible identified negative impact on cultural heritage includes:

- Noise, vibrations, and dust - during the construction phase some cultural heritage sites located near construction sites up to 100m could be affected by noise due to construction works,
- Access roads - some access roads leading to cultural heritage sites could potentially be affected, as it is assumed that these roads will be used for the passage of machinery during the construction works. It will be necessary to pay special attention to prevent the interruption of access to the existing road infrastructure leading to the sites.
- Possibility of chance finds - given that Serbia is known for its archaeological sites, there is a great potential for encountering previously unknown heritage (accidental finds) during construction works.

7.5.2. Operation phase

During the operation phase, possible identified negative impact on cultural heritage includes:

- Possibility of chance finds during maintenance works – Operation maintenance activities could lead to disturbances or damage to known cultural heritage or previously undiscovered buried heritage.

7.6. Community health and safety (OSHS) and security

Recognizing the role of public authorities in promoting the health, safety and security of the public, Performance Requirement (PR) 4 of the EBRD's Social and Environmental Policy addresses its client's responsibility to identify and avoid or minimize risks and negative impacts on health, safety and community security that may arise from project activities. This PR addresses the potential risks and impacts of project activities on the affected community. Occupational safety and health standards are found in PR 2 detailed requirements on the prevention of effects on human health. EIB's standards 9 on Health, safety and security will be used as well.

The main objectives of this chapter are to anticipate and avoid adverse impacts on the health and safety of project-affected communities during the life cycle of the project from both routine and non-routine circumstances; to promote quality and safety, as well as climate change considerations, in the design and construction of infrastructure; to avoid or minimize community exposure to risks related to traffic and road safety, diseases and hazardous materials, etc. It is necessary to determine the health, safety and security risks and impacts on the communities affected by the project and the corresponding responsibility of the Borrowers to avoid or minimize such risks and impacts, with special attention to vulnerable groups of people, due to their potentially pronounced vulnerability. The project is not expected to generate a significant volume of traffic, however, there will be rail and traffic disruptions caused by works on railway tracks and railroad crossings. Safety procedures will be required for work on (high voltage) electrified lines. In case the works are carried out near populated areas, traffic management plans will be developed and monitored accordingly. Management of construction waste and hazardous waste must be done in a way that would protect the environment and communities in which disposal is planned exclusively at sanitary landfills located at the shortest distance from the project route. All waste management activities must also include adequate practices of applying the principles of the 5 R's hierarchy: refuse, reduce, reuse, repurpose, and recycle, as appropriate.

7.6.1. Risk of Major Accidents and / or Disasters

Article 3 of Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (hereafter referred to as the Environmental Impact Assessment (EIA) Directive) requires assessment of expected effects of major accidents and/or disasters within environmental impact assessment (EIA). Article 3(2) of the Directive states that the:

“Effects referred to in paragraph 1 on the factors set out therein shall include the expected effects deriving from the vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned.”

In addition, Annex IV of the EIA Directive states that the EIAR shall contain:

“A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and / or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to Union legislation such as Directive 2012/18/EU of the European Parliament and of the Council or Council Directive 2009/71/Euratom or relevant assessments carried out pursuant to national legislation may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies”.

Methodology

Risk identification, control and management is an integral part of the design and assessment process during all phases of the project life cycle. For example, a Risk Assessment of earthwork slope collapse, landslides, extreme weather events such as prolonged flooding resulting in sediment runoff during construction, storm damage, snow storms and wildfires, was conducted to assess vulnerability. For this purpose, action schemes are proposed for these and similar phenomena in order to mitigate them, where necessary. Elements of the Proposed Scheme which include measures designed to eliminate, reduce, isolate, control or exploit the occurrence of major accidents are described in the Environmental Impact Assessment Report (EIAR) where appropriate.

Measures to control the risks associated with the Construction Phase activities are included in the Construction Environmental Management Plan (CEMP) in a separate volume of the EIAR.

The methodology for this risk assessment process is as follows:

- Identify major accidents and/or disasters (i.e. unplanned incidents) to which the Proposed Scheme can be applied and
- Assess the consequent impacts and significance of such incidents in relation to the ecological, social and economic receptors that may be affected.

The risk assessment process consists of the key stages:

- Systematic and structured identification and definition of scenarios leading to major accidents
- Assessment of the probability or frequency of the defined scenarios
- Assessment of human consequences associated with the defined scenarios
- Combining frequency and consequences to perform numerical assessments of risk levels
- Comparison of risk assessments with risk tolerability criteria.

Such risks may be present in the construction phase and/or operational phase of the proposed scheme.

Risk Evaluation

The evaluated major accidents and / or disasters risk events were compared to a risk matrix to determine the level of significance of each risk event. These have been grouped according to three categories:

- High Risk – events that have an evaluation score of 15 to 25, as indicated by the Red Zones
- Medium Risk – events that have an evaluation score of 8 to 12, as indicated by the Amber Zone
- Low Risk – events that have an evaluation score of 1 to 6, as indicated by the Green Zone in Table Levels of event's significance.

The likelihood of the events has been thoroughly explained in the following table.

Table 57. Interpretation of event's likelihood

Likelihood	What it means
Very likely	Expected to occur in most circumstances
Likely	Will probably occur in most circumstances
Unlikely	Might occur occasionally
Very unlikely	Could happen at some time
Extreamly unlikely	May happen only in exceptional circumstances

Table 58. Levels of event's significance

Likelihood	5 – Very Likely					
	4 – Likely					
	3 – Unlikely					
	2 – Very Unlikely					
	1 – Extreamly Unlikely					
		1 – Minor	2 – Limited	3 – Serious	4 – V. Serious	5 – Catastrophic
	Consequence of Impact					

Possible accidents during the construction phase

Measures to control the risks associated with the Construction Phase activities are included in the Construction Environmental Management Plan (CEMP) in a separate volume of the EIAR.

The following Table presents events as possible accidents during the construction of the project, with the frequency of occurrence, possible consequences, and measures to mitigate them.

Table 59. Rating of major accidents and disasters during construction phase

Event	Likelihood	Consequence	Mitigation Measures
Construction Phase			
Explosion due to the strike of a gas main during excavation works	Unlikely	Serious Potential fatalities and injuries Hazards associated with the explosion to neighbouring residents, businesses and activities. Potential to discharge deleterious material to adjacent watercourses	Only trained workers with certificates for handling explosive materials can work with explosives. All construction facilities and construction sites will have 24/7 security. Explosive materials will not be stored on site/compounds overnight. Transportation of explosives will be subject to prior agreement. When transportation of these materials is required, appropriate security measures will be implemented such as proper escort.
Release of untreated wastewater due to the strike of mains, sewers and	Very Unlikely	Limited Potential injury	During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water:

combined sewers during excavation		Hazards associated with exposure to untreated wastewater (diseases etc.) Potential for untreated wastewater to discharge to adjacent watercourses	Requirements for the protection of fisheries habitat during construction and development works at river sites. Compliance with Guidelines for crossing watercourses during construction.
Environmental degradation due to haphazard disposal of waste	Very Unlikely	Limited Potential injuries Hazards associated with exposure to waste (diseases, etc.) Potential contamination of soil, surface water and possibly due to leaching by precipitation, contamination of groundwater	Prevent the generation of hazardous waste: Where elimination is not possible apply means and techniques to reduce the quantity of hazardous waste generated; Minimize amount of waste for disposal by recycling, reuse and/or recovery. This includes the recovery of energy which may be available from the waste. Treat waste to stabilize, immobilize, contain or destroy hazardous properties. Dispose of residues with minimum environmental impact. Appropriately contain, isolate and store hazardous waste for which no acceptable treatment or disposal option is currently available. Other specific measures that will be implemented are: Inert construction materials shall be used for construction of embankments, acoustic barriers or as filling materials on rural roads non-hazardous waste Concrete waste will be disposed in similar manner as inert wastes Metal waste shall be disposed separately for reuse and recycling Hazardous wastes will be collected and transported to Lapovo for their final disposal in approved disposal sites (regional landfill "Vrbak" Lapovo) Uncontrolled incineration will not be allowed before removal of wastes from the site. The quantity (volume) and size of wastes, the name of waste collector/disposal agent and the name of the place of their final disposal/measure shall be specified. This issue shall be controlled by the site manager The technical personnel shall be trained and informed about the appropriate regulations for handling hazardous waste. After demolition, the site shall be restored to the pre-construction state.
Striking and damaging high voltage underground cables during excavation	Very Unlikely	Serious Potential fatalities and injuries	The risk of possible mechanical damage to the cables is eliminated by the correct selection of the route of laying the cables, the method of laying them in the trench (technical conditions), as well as by choosing

		Potential to lead to fire and associated effects Potential to disrupt electricity/telecoms supply	the type of conductors and cables depending on the terrain and working conditions. On the parts of the route where there is a possibility of accidental damage (crossing over the roadway, railroad tracks), installation of additional mechanical protection is planned.
Collapse of earthworks, slopes, landslides	Unlikely	Serious Potential fatalities and injuries Disruption to local road network infrastructure	Excavation work should be carried out with quality and in accordance with regulations, project documentation and provisions and requirements of technical conditions. All final excavation surfaces should be made according to the requirements in the project documentation. Incorporate recommendations of the seismic study for excavation at the platform foundation locations to a depth where stable soils are encountered. Continuous monitoring of groundwater levels and earthworks will be carried out. In the period 2022/2023 on the Belgrade Center - Niš railway, Section 2, occurrences of landslides were recorded from km: 121+950 to km: 122+150, which is why light driving on the right track was introduced.
Contamination event – Pollution event leading to environmental damage to watercourses or groundwater, particularly associated with the potential release of silt to the aquatic environment	Unlikely	Serious Potential to cause environmental damage to the aquatic environment and associated species and to ecologically designated areas	Continuous monitoring of groundwater levels and earthworks. Pump tests will be carried out prior to pumping of the groundwater.
Tree instability - trees with unstable roots falling during surface and excavation works / potential for contact with overhead lines, residents, properties, pedestrians and road users	Unlikely	Limited Potential fatality and injuries Localised effects for a short duration. Potential for some minor damage to local infrastructure	Select appropriate species that are not subject to uprooting due to wind or shedding of branches. Plant trees at a distance from the path equal to the height of the mature tree.
Traffic accidents – Loss of control during land transport operations; Leaks and accidental spills of fuel, lubricants, anticorrosive agents, and other hazardous substances from construction machinery	Unlikely	Limited Potential fatality and injuries Disruption to local road network infrastructure	Design basis of road infrastructure Vehicle land logistics/subcontractor/supplier/equipment selection and management Road/land logistics HSE management arrangements (e.g. driver training and competence, safety briefings, auditing) Emergency response Enforce speed limit for vehicles

and vehicles at construction site			The construction area shall be isolated with special fences from the settled areas; clear signs should be posted at the entrance to the construction area to ensure that community members will avoid entrance of this area and will be more cautious when passing the construction site; Public Health and Safety Plan shall be developed and implemented to mitigate the impacts of the movement of heavy equipment on existing local roads. Construction Traffic Management Plan shall be developed which will allow re-routing of the truck traffic from residential streets or using local roads with fewest homes for transportation of construction materials. Regular training of employees and control of readiness to react in case of accidents. Keeping a central registry and book of minutes (type of substance, amount, consequence, remediation measure, etc.)
Vandalism of structures/equipment, theft of materials and portable items	Unlikely	Serious Potential fatalities and injuries Disruption to local road network infrastructure	Strengthen patrol of project construction sites and routes Strengthen security on construction sites.
Explosion/fire occurring at adjacent facility containing flammable/hazardous substances	Very Unlikely	Limited Potential for injury Localised disruption to road network	Only trained workers with certificates for handling explosive materials can work with explosives. All construction facilities and construction sites will have 24/7 security. Explosive materials will not be stored on site/compounds overnight. Transportation of explosives will be subject to prior agreement. When transportation of these materials is required, appropriate security measures will be implemented such as proper escort.
Explosion/fire occurring at adjacent facility containing flammable/hazardous substances (Seveso sites)	Very Unlikely	Limited Potential fatalities and injuries Localised infrastructure disruption	Protocols for the management of major accidents on the Seveso sites will be followed in an event there is an incident at a nearby Seveso sites. On section 2, Velika Plana - Paraćin, there are 2 registered Seveso LPG storage facilities80, location:

[80] Register of seveso plants in the territory of the RoS, Ministry of Environmental Protection, Department for Environmental Management, Department for Protection against Major Chemical Accidents, July 2023, Belgrade

			Location: Bagrdan village, operator: Gile gas doo Ostrikovac/ Butangas International, activity:LPG storage, distance from the railway: 100m by air. Location: Kraljevica Marko bb Jagodina, operator: Miletic petrol doo Paracin, activity: storage of petroleum products, distance from the railway: 700m by air.
Earthquake	Very Unlikely	Serious Potential fatalities and injuries Disruption to local road network infrastructure	Operation is stopped immediately when the seismometers detect the primary wave of an earthquake. Prevention of a bridge collapse, reinforcement of viaducts and fortifying bridge girders.
Extreme weather events such as prolonged flooding resulting in sediment load runoff during construction, storm damage, snowstorm, wildfire	Unlikely	Serious Potential fatalities and injuries Disruption to local road network infrastructure	In the period 2022/2023 on the Belgrade Centar - Niš railway, Section 2, problematic places in relation to flooding are in km: 115+810,80 - Grabovik Stream, Lapovo, km: 117+087 - Miloševački Stream, km: 137+100 Lugomir River, km: 142+602 Majur Stream, km: 172+068 Ćićevački stream. Mitigation of natural vegetation clearance have been recommended; rerouting, planning/designing, mobilization/construction, operation and maintenance and decomissioning stages of the project. The workplace should be designed to prevent the start of fires through the implementation of fire codes applicable to industrial settings. Other essential measures in terms of fire precautions include: Equipping facilities with fire detectors, alarm systems, and fire fighting equipment. The equipment should be maintained in good working order and be readily accessible. It should be adequate for the dimensions and use of the premises, equipment installed, physical and chemical properties of substances present, and the maximum number of people present; Provision of manual fire fighting equipment that is easily accessible and simple to use and The frequency of monitoring shall increase in case of receipt of a complaint concerning worker accidents.

Uncontrolled events are extraordinary, and the probability of their occurrence is reduced by careful execution of works during construction as well as by the application of necessary safety measures during traffic.

In the event that an uncontrolled event does occur, negative impacts can be prevented or significantly reduced by applying prescribed procedures and timely intervention.

Possible accidents during the operation phase

Accidents and incidents (extraordinary events), a characteristic of the operational phase of railway traffic, are possible in various situations during railway traffic, such as: passing the no-driving signal, skidding and collision of vehicles during maneuvering, fire and explosion and collision of railway vehicles and other accidents.

In order to understand the current situation, Table 60 lists Accidents and incidents (extraordinary events) that occurred in the period of 2013-2022, on the Belgrade Center - state border (Tabanovce) railway.

Table 60. The total number of extraordinary events/ accidents [81] and mishaps[82, 83] that occurred in the period 2013–2022 on Railway 102 (Belggrade Center – Junction „G" – Rakovica – Mladenovac – Lapovo – Niš – Preševo – state border (Tabanovce)):

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total killed	8	10	11	9	4	9	5	4	5	2
Total seriously injured	8	10	11	9	4	9	5	4	5	2

The following table presents events as possible accidents during the operational phase of the project, with the frequency of occurrence, possible consequences and measures to mitigate them.

Table 61. Rating of major accidents and disasters during operational phase

Event	Likelihood	Consequence	Mitigation Measures
Operational Phase			
Release of oils and fuels in the aquatic environment	Unlikely	Serious Potential fatalities and injuries Disruption to railway infrastructure	Fuels and lubricants shall be stored only at designated areas. Storage of fuel and lubricants shall be kept at least 30m from the edge of the surface waters e.g. rivers Refuelling and lubrication of equipment shall be restricted to areas at least 30m away from the edge of the surface waters Perform all routine equipment maintenance at least 30 meter away from the edge of the rivers and recover and dispose of wastes in an appropriate manner.

[81] *Period 2012-2015. year, classification according to the Rulebook on the method of recording data on extraordinary events occurring in railway traffic and on other data of importance for the safety of railway traffic ("Official Gazette of SRJ", number 76/99)*

[82] *Period 2016-2020. year, classification according to the Rulebook on research, recording, statistical monitoring and publication of data on accidents and incidents ("Official Gazette of the RS", number 4/16)*

[83] *Period 2021 - 2022, classification according to the Rulebook on reporting, research, recording, statistical monitoring and publication of data on accidents and incidents ("Official Gazette of RS" no. 32/21)*

			Fixed fuel dispensing locations will be provided with secondary containment to capture fuel from leaks, drips, and overfills. A supply of sorbent and barrier materials sufficient to allow the rapid containment and recovery of spills shall be maintained at construction site Conduct regular maintenance and inspections of the locomotives to reduce the potential for spills or leaks. Keeping a central registry and book of minutes (type of substance, amount, consequence, remediation measure, etc.)
Train derailment	Very Unlikely	Serious Potential fatalities and injuries Disruption to railway infrastructure	Appropriate training will be provided to all relevant staff members for operation of the electrified train fleet. Operation and maintenance manuals will be made available to staff as early as possible. A dedicated Major Incident Response Plan has been developed to identify the appropriate emergency response plans in event of an incident. Appropriate back up procedures will be prepared and implemented in an event of an incident.
Falling off from moving train, collision with train at road crossing as a result of increased train frequencies.	Unlikely	Serious Potential fatalities and injuries	Use of bridges or tunnels is recommended. If level crossings are unavoidable, signals shall be installed and their regular inspection/maintenance provided. Increase the security at all railway stations Continuously provide awareness campaign to inform passengers on the dangers of boarding or disembarking train while the train is moving. Develop and implement a Safety Program in accordance with the international norms. Underpasses or level crossings should be developed based on the consultations with the public and representatives of local government. Post visible warning signs at potential points of entry to track areas. Fencing or other barriers should be installed at station ends and other locations to prevent access to tracks by unauthorized persons. Stations should be designed in such a way to ensure that the authorized route is safe, clearly indicated and easy to use. In addition awareness raising campaign should be conducted in the area for the local public to provide them relevant information and increase their awareness on the risks of trespassing.
Traffic accidents -	Unlikely	Limited	- "Positive Train Control" (technology that is capable of preventing train-to-train collisions,

Leaks and accidental spills of fuel, lubricants, anticorrosive agents, and other hazardous substances from trains and tanks		Potential fatality and injuries Disruption to railway infrastructure	overspeed derailments, and casualties or injuries to roadway workers (e.g., maintenance-of-way workers, bridge workers, signal maintainers) operating within their limits of authority). - Risk Reduction Program (RRP) - initiative to reduce accidents and injuries, and build strong safety cultures by developing innovative methods, processes, and technologies and correct individual and systemic contributing factors using "upstream" predictive data. RRP will incorporate developing knowledge of precursors to actual accidents, confidential reporting, effective problem analysis, and corrective actions. - Training of employees and control of readiness to react in case of accidents (regular and comprehensive training to the railway staff on the latest technologies, equipment, systems, safety rules and procedures). - Keeping a central registry and book of minutes (type of substance, amount, consequence, remediation measure, etc.)
Traffic accidents - (obstruction on the tracks, mechanical failures, negligence, human error etc.)	Unlikely	Limited Potential fatality and injuries Damage to railway property, or disruptions in rail traffic exceeding established threshold levels and values	- "Positive Train Control" (technology that is capable of preventing train-to-train collisions, overspeed derailments, and casualties or injuries to roadway workers (e.g., maintenance-of-way workers, bridge workers, signal maintainers) operating within their limits of authority). - Risk Reduction Program (RRP) - initiative to reduce accidents and injuries, and build strong safety cultures by developing innovative methods, processes, and technologies and correct individual and systemic contributing factors using "upstream" predictive data. RRP will incorporate developing knowledge of precursors to actual accidents, confidential reporting, effective problem analysis, and corrective actions. - Mandatory technical training based on organizational needs (regular and comprehensive training to the railway staff on the latest technologies, equipment, systems, safety rules and procedures). Various types of analyses are performed to determine the organizational needs, including feedback from headquarters, the regions, and the inspectors. - Promote and enhance public safety by reducing rail-related deaths and injuries due to trespassing on railroad rights-of-way and

			other property, using increased public outreach and education programs.
Vandalism of structures/equipment, theft of materials and portable items	Unlikely	Serious Potential fatalities and injuries Disruption to railway infrastructure	Strengthen patrol of the railway infrastructure Work with local leadership to get their cooperation to guard the infrastructure Strengthen community outreach and Corporate Socio Responsibility programmes.
Collapse of earthworks, slopes, landslides	Very Unlikely	Serious Potential fatalities and injuries Disruption to railway infrastructure	Continuous monitoring of underground water levels and earthworks will be carried out, especially in places where such accidents have been recorded in the past period. In the period 2022/2023 on the Belgrade Centar - Niš railway, Section 2, occurrences of landslides were recorded from km: 121+950 to km: 122+150, which is why light driving on the right track was introduced.
Earthquake	Very Unlikely	Serious Potential fatalities and injuries Disruption to railway infrastructure	Anti-derailment devices are required to be installed, which guide the wheels along the rails after derailment, thus preventing derailment and complete derailment of the rails even after the train derails and the rail fasteners are broken. "Soft measures" - daily confirmation of procedures related to the initial response in case of emergencies, evacuation of passengers and measures for those who have difficulty returning to their homes due to the state of emergency.
Extreme weather events such as prolonged flooding resulting in sediment load runoff, storm damage, snowstorm, wildfire	Very Unlikely	Serious Potential fatalities and injuries Disruption to railway infrastructure	In the period 2022/2023 on the Belgrade Centar - Niš railway, Section 2, problematic places in relation to flooding are in km: 115+810,80 - Grabovik Stream, Lapovo, km: 117+087 - Miloševački Stream, km: 137+100 Lugomir River, km: 142+602 Majur Stream, km: 172+068 Ćićevački stream. Improve the management and coordination activities for the reduction of disaster risk and increase the resilience of sites of critical infrastructure; Establishment of an early warning system and notification of disasters; Improving the quality of management, organization and technical provision of the single rescue system; Development of systems for seismic surveys and monitoring of water basins and rivers; Improving the system for training of managerial staff for disaster response; Public education using modern technologies and media to form a culture of safe life activity.

In case that an uncontrolled event does occur, negative impacts can be prevented or significantly reduced by applying prescribed procedures and timely intervention.

It is not possible to place the safety of rail transportation of dangerous goods in a time-space context because it largely depends on the condition and quality of the vehicles that transport dangerous goods, as well as on the human factor.

By applying prescribed protection measures such as compliance with European agreements (RID) and national legislation and its by-laws, and by hiring authorized companies to eliminate the consequences of sudden water pollution in the event of serious or very serious pollution, possible negative impacts are reduced to an acceptable level.

Identified sensitive zones and receptors:

Seveso sites near LPG storage, Bagrdan, Jagodina

Oil derivatives storage, Kraljevića Marka bb, Jagodina

Identified and reviewed existing baseline information relevant for the project:

Law on Environmental Protection ("Official Gazette of RS" no. 135/2004, 36/2009, 36/2009 - other law, 72/2009 - other law, 43/2011 - US decision, 14/2016, 76 /2018, 95/2018-second law and 95/2018-second law)

Rulebook on the content of the Accident Prevention Policy and the content and methodology of the preparation of the Safety Report and Accident Protection Plan ("Official Gazette of RS", no. 41/2010, 51/2015 and 50/2018)

Register of Seveso Plants in the Territory of the RoS, Ministry Of Environmental Protection, Sector for Environmental Management, Department for Protection against Major Chemical Accidents, Belgrade, 2023.

Identified significant gaps in existing baseline data relevant for the project:

No significant gaps.

Method of further ESIA baseline data collection and assessment:

A detailed analysis of available data will be carried out in order to identify and assess sensitive zones and receptors, including all available documentation, requirements set by EU and domestic legislation, EBRD PR and best practice.

8. MITIGATION MEASURES FOR THE IDENTIFIED IMPACTS

The following text outline the proposed mitigation measures during both the construction and operation phase of the project (by topic). This list of mitigation measures identified during the Scoping phase will be further developed and finalised within the ESIA phase of the project.

8.1. Climate change

8.1.1. Construction phase

Mitigation measures during the construction phase are presented below:

- Design optimisation to reflect the carbon reduction hierarchy
- Reduce the requirement for construction materials and excavation;
- Specify materials and products with reduced embodied GHG emissions including through material substitution, recycled or secondary content and from renewable sources;
- Designing, specifying and constructing the Project with a perspective to maximise the potential for reuse and recycling of materials/elements at the end-of-life stage; and
- Specifying high efficiency mechanical and electrical equipment.
- Planting specifications and maintenance regimes for the public realm will be important in reducing the impact of long periods of drought and waterlogging on ground conditions.
- River crossings, beds and banks will be restored to their original state, and banks and adjacent upland areas will be stabilised immediately after final grading; the watercourse crossings will be designed to avoid affecting the stability and long-term performance of riverbanks and flood defences.
- Not carry out landscaping or excavation work near watercourses during high water periods or during heavy rains.
- Drainage from higher areas will be diverted around stockpile areas to prevent erosion. As required, sediment controls will be installed downstream of stockpile areas to collect any run-off.
- Restore ditches damaged by machinery (damage to the gradient, shoulder construction of the embankments, etc.).
- The Contractor will ensure all dirt and debris are cleaned on sites without delay (approved by the Construction Supervision Officer).

8.1.2. Operation phase

Mitigation measures during the operation phase are presented below:

- Implement energy efficient lighting throughout the Project;
- Use energy meters to monitor energy requirements;
- Implement efficient water fittings.

- Rail tracks will be designed and materials will be selected to withstand temperature increases
- Technical buildings will have air conditioning systems to eliminate the effect of condensation due to temperature differences or very cold/hot air.
- Consideration of design foundation and ground movements in regard to their resilience to flooding or heavy rainfall events.
- Drainage ditches will be the best quality without any casting defects and beads and showing no cracks or other faults and be in firm and homogenous condition
- Drainage infrastructure will include an allowance for climate change.
- The design of drainage will minimise the need for drain cleaning, the possibility of clogging and the consequent flooding of the track work subgrade.

8.2. Geohazards

8.2.1. Construction phase

Mitigation measures during the construction phase are presented below:

- Careful construction and thorough quality control processes
- Program to ensure good driver behaviour / maintenance of vehicles
- An Emergency Response Plan will be produced prior to construction (including a Spill Management Plan),
- Slope stabilisation – including mulching (straw mulching), brushwood mulching, erosion control blankets, soil binders (e.g. polyacrylamide) and gravelling;
- Retaining walls – to retain loose materials on slopes where it would not naturally be held, for example on near vertical or vertical slopes;
- Sediment traps and basins – which will intercept and retain sediment-laden runoff.

8.2.2. Operation phase

Mitigation measures during the operation phase are presented below:

- Maintain sediment traps and basins, drainage channels and treatment systems; and
- Maintain slope (cuttings and embankment).
- Revegetation and/or maintenance of vegetation to increase the stability of potentially loose materials and surfaces which may develop during the operational phase of the Project.

8.3. Soil

8.3.1. Construction phase

Mitigation measures during the construction phase are presented below:

- Properly and temporary store the removed topsoil and subsoils.
- Preserve the topsoil and reuse it for rehabilitation works
- All excess material should be removed from the construction site and used elsewhere for other construction or remediation activities.
- Limit the movement of heavy machinery and machines and define places for parking and turning of construction machinery during the construction and extension of tracks in order to avoid additional degradation of soil, i.e. to the greatest extent possible use the existing network of roads.
- Provision of spill kits to contain leaks / spills;
- Drainage channels – which will divert run-off water;
- Treatment systems – to remove material contained within the run-off water.

8.3.2. Operation phase

Mitigation measures during the operation phase are presented below:

- Revegetation and/or maintenance of vegetation to increase the stability of potentially loose materials and surfaces which may develop during the operational phase of the Project
- Maintenance and thorough quality control processes including inspections for maintenance depots;
- Leak/spill management.

8.4. Agricultural land

8.4.1. Construction phase

Earthworks and project activities can cause negative impacts in terms of soil erosion, and as prevention measures - the contractor will have the obligation to implement erosion control measures, such as grassing disturbed areas and installing linings. Also, the contractor will stabilize the cleared areas that have not been used by planting vegetation, or by adequate treatment of the terrain, as soon as possible after the completion of the works.

- Limit the movement of heavy machinery and machines and define places for parking and turning of construction machinery during the construction and extension of tracks in order to avoid additional degradation of soil and agricultural land by increased passage of heavy machinery, i.e. to the greatest extent possible use the existing network of roads.
- During the construction phase of the railway, avoid agricultural land of the highest class
- Any work with oil and its derivatives during the construction process, filling of machines, must be carried out in specially determined places with the observance of the greatest precautions in order to avoid any spillage. All packaging for oil and oil derivatives must be collected and deposited at landfill sites.Operation phase
- Measures for soil also apply.

8.4.2. Operation phase

Measures relevant to agricultural land protection are the following:

- Controlled application of herbicides in order to reduce unnecessary excessive use and reduce the risk of leaching into the soil and groundwater, regular maintenance of sediment traps and basins, drainage channels and purification systems, regular maintenance of slope stability (cutting and embankment), edge vegetation will be planted along affected waterways to minimize soil erosion and reduce suspended matter in surface runoff.
- In the case of dismantling the existing railway (at locations where the new route deviates from the existing one) and reusing the land for agricultural or sports-recreational purposes, it is necessary to first examine the quality of the soil to determine the possible degree of contamination, and then carry out soil decontamination activities, if necessary.

8.5. Waters

8.5.1. Construction phase

Mitigation measures during the construction phase are presented below:

- Provide sediment barriers between earthworks and the watercourse to prevent sediment from washing into the river.
- Use of silt fences, silt traps, filter bunds, settlement basins and/or proprietary units such as a 'siltbuster' to treat sediment laden water generated on site before discharge should also be implemented.
- Fuels and potentially hazardous construction materials should be stored in bunded areas with external cut-off drainage and fuel.
- Fuelling and maintenance of construction vehicles and plant (including washdown) should be done on hard standing or on haul roads, with appropriate cut-off drainage and located away from watercourses.
- No surface water runoff from construction working areas or sites that may contain fuels or other harmful substances should be discharged to surface water receptors unless first subject to robust pre-treatment.
- Limit the clearance of vegetation on the channel banks.
- Until the beginning of the in-water works, preserve at least 20m depth of bankside vegetation from the channel bank to protect bank stability.
- Avoid works to watercourses during high flow events and during heavy rainfall to reduce the risk of fine sediment release, watercourse erosion and increased flood risk.
- Hydraulic connectivity must be maintained
- If watercourse diversion is required, maintain a temporary channel to maintain flow and connectivity whilst the permanent channel is prepared.
- Avoid undertaking works within or adjacent to the watercourses as far as practicable.
- Minimise the required construction zone adjacent to and within watercourses to reduce the impacts of flow constriction and loss of fluvial floodplain storage and conveyance.
- Implement a construction-stage drainage strategy for construction compounds, construction workers accommodation and other large areas of impermeable surface to capture and attenuate runoff prior to discharge.
- Long term and seasonal groundwater monitoring should ideally be undertaken prior to construction to allow for baseline conditions to be understood and monitor changes (such as those to turbidity and groundwater levels)

- Action would be needed to address the degradation of groundwater quality during construction such as adjustments to drilling duration or speed.

8.5.2. Operation phase

Mitigation measures during the operation phase are presented below:

- Provision of a new drainage system that will drain the track corridor (embedded in Project design).
- Maintain existing drainage and treatment at high-risk areas
- Collect waste products such as oil from maintenance stations and dispose off site in agreement with the necessary requirements
- Regular inspection and maintenance of drainage systems to remove blockages (embedded in Project operation).
- Consider climate change effects on capacity of drainage system.
- Detailed assessment and, if required, provision of attenuation to reduce rate and volume of increased runoff from impermeable surfaces.
- Design of watercourse crossings to have sufficient capacity
- Consider climate change effects.
- Further consideration to potential impacts to fluvial floodplain storage and conveyance in high-risk areas, and provision of appropriate mitigation such as flood relief culverts beneath embankments or reprofiling of low-vulnerability land to provide compensation,
- Further consideration of the potential effects of climate change to flood flows and the extent/depth of the floodplain.
- Maintain the stability, profile, hydraulic connectivity and hydraulic capacity of all watercourses crossed by the Project and in particular those with bridge piers within the watercourse.
- Provision of erosion control upstream and downstream of all watercourse crossings to prevent scour and impact to watercourse hydromorphology and geomorphology (e.g. rock armour, concrete bagwork and concrete scour mattress).
- Set back bridge piers from within watercourse to remove any impacts on flow conveyance
- Provision of low flow channels through proposed culverts to maintain constant baseflow.
- Operational Maintenance Plan will be produced and will include maintenance and repair plans.
- The implementation of the mitigation measures defined above for soils and surface water will serve to protect groundwater during the operational phase.

8.6. Noise and vibrations

8.6.1. Construction phase

- Preparation of Construction Noise and Vibration Management Plan
- Site inspection in order to ascertain information on the condition of the Site and the surrounding area, with regards to the construction works and their impact on the environment and the local population, with special regards to sensitive objects.

- The Contractor must determine the noise and vibration baseline levels of the Site and the surrounding area, by measurements which must be conducted by the accredited organizations. A publicly available database with noise and vibration baseline collected data needs to be established.
- Periodical measurement of noise and vibration shall be performed to determine whether the generated level exceeds permitted limit values, and by comparing the measurement results with the baseline data, the degree of impact of works.
- Construction working hours will be limited in line with national legislation on working hours/days and holidays.
- Trainings of the engaged staff will be prepared and held, with aim of raising awareness of environmental protection, potential problems, solutions and good practices in order to avoid problems occurring;
- Local residents will be informed of the planned works and the potential periods of disruption;
- All construction equipment will comply with the requirements of EU Directive 2000/14/EC (must have CE marking);
- All construction equipment and vehicles will be maintained in good working order;
- Noisy construction equipment and equipment generating a lot of vibration will be located as far as possible from sensitive receptors;
- Noisy construction equipment must be fitted with noise muffling devices that will reduce sound levels;
- Internal construction access roads will be kept well maintained;
- External construction access road should avoid passing near residential and other sensitive buildings, where is possible;
- Restriction of the maximum speed on the internal and external construction access roads;
- Transport and construction management will be used to avoid the cumulative effects of noise and/or vibration along construction roads and/or construction site;
- Avoid simultaneous use of equipment that generate a lot of noise and/or vibration;
- Noisy construction works and/or the work that makes a lot of vibration near sensitive receptors will be organized in such a way that the exposure time is as short as possible (schedule and resource planning);
- In case where noisy works need to be performed at night or during a longer period than one day in the vicinity of the sensitive objects, a temporary noise barrier shall be used around the working area;
- Reversing alarms that do not have a tonal component (i.e. broadband) will be used, if applicable;
- Low or non-vibratory piling equipment such as rotary or bored piling will be used;
- The requirement for vibratory compaction and using static force compaction, such as smooth-wheeled or sheepsfoot rollers, will be reduced;
- Managing of the explosive type and weight, delay-timing variations, size and number of holes, distance between holes and rows, method and direction of blast initiation will be reduced blasting vibration;
- Selection of demolition methods not involving vibration impact, where is possible.

8.6.2. Operation phase

- Preparation of Operational Noise and Vibration Management Plan
- The noise monitoring shall be performed in the zones of residential and other sensitive buildings located in the immediate vicinity of the railway. In selecting the measuring points, following shall be included in the monitoring:

structures that were not considered affected during calculations, structures protected with noise barriers and structures protected by applying passive protection measures. Measuring points representative for the analysed area shall be selected, but in case of justified complaints of local population, the number of measuring points can be increased. Parameters of environmental noise levels that are to be monitored are as follows: Equivalent noise level LAeq,T [dB], Referent noise level LRaeq,T [dB] and Residual noise level [dB]. The noise monitoring should be conducted at least once every year;

- The noise barriers characteristics shall be controlled at least once in five years. Control shall be performed in accordance with: ISO 10847, EN 16272-4, SRPS CEN/TS 16272-5, SRPS EN 16272-6 and SRPS CEN/TS 16272-7;
- Visual control of noise barriers shall be carried out at least once a calendar year. Control may be performed on a selected sample but the sample has to be always different. If the control shows particularly bad spots, they shall be controlled at the annual basis, regardless of the selected sample;
- Vibration monitoring should be performed in the switching area of stations. The monitoring locations will be established at selected residential and other sensitive buildings up to 35 m from nearest station switch (out of the railway infrastructure belt). The vibration levels should be monitored at the most affected façade and/or room (closest to the railway vibration source). The vibration measurements can be done following the principles outlined in ISO 14837-1. Vibration monitoring should be conducted once during year 1 of operation.
- At the vehicle level, vibration and ground-borne noise emission can be lowered by improving roundness of the wheels, stiffness of the vehicle suspension systems, reducing of the unsprung mass, reducing of speed and using resilient wheels. The SRI, as infrastructure manager, has direct control only over speed, while other measures can only be controlled indirectly by the network access fee. At the track level, vibration emission can be lowered by rail enhancements (e.g. control of the railhead roughness, using of the rail pads), reduction of breaks in the running surface of a rail (rail joints, continuous welded rails, switches and crossings), fasteners enhancements (e.g. using of the elastic elements to prevent direct contact between the rail foot and sleeper), sleepers and ballast enhancements (e.g. using of the elastomeric pads between the sleepers and the ballast). As an alternative to ballasted tracks in tunnels other technologies can be used, such as the floating slab tracks.
- Once the new rails are laid, preventive grinding shall be required to remove initial roughness on rail surface together with a layer with non-uniform content of carbon as well as irregularities due to superimposed tolerance in the course of track laying (including adjustment of both, direction and reference level).
- In the course of railway operation, running surface of a rail shall be flat and smooth. During the repair of rails all upsweeps and downsweeps at welding points shall be removed. Maintenance plans shall include regular rail grinding.
- On transmission path, barriers can be used with materials or without materials (e.g. open trench), which are able to attenuate propagation of vibration waves. In urban areas it can be realized as underground barriers near the rail track. It is also possible to mitigate the ground vibration intervening in the geotechnical characteristics of the soil proprieties (stiffening to improve the soil absorption capacity) under the track, around the track, or between the source and the receiver. Regarding potential micro-pressure effects in tunnel, the protection methods that can be applied are:
- The installation of a tunnel hood at the tunnel entrance.
- The use of side branches in the tunnel.
- The installation of a shelter with slits between two adjacent tunnels.
- Reduce speed train.
- The reduction of the cross-sectional area of the train (not applicable in the project).
- The optimizing of the train noise (not applicable in the project).

Cuttings: The Project benefits from cuttings at some sensitive locations.

At the source:

- Using wheel and track absorbers with potential of reduction noise
- Between source and receptor:
- Installing noise barriers (protective walls)
- Insulation of house windows and facade.
- Selecting vehicle characteristics for reduced vibration generation and improved maintenance of wheels.
- Using maintenance strategies for track and rolling stock with the aim of low vibration emission.
- Considering the use of track support systems such as Resilient track fasteners, Ballast mats, resiliently supported ties, Floating slabs, construction of trenches.

8.7. Landscape

8.7.1. Construction phase

Mitigation measures during the construction phase are presented below:

- Upon completion, areas used as construction compounds will be returned to their original use and state
- Replacement tree planting / woodland planting will be carried out within those areas noted as being subject to significant loss
- All planting will be of local provenance and in keeping with the local character; and
- Where topsoil is to be stripped and stored on site temporarily for reuse, the stockpile mounds will be stored at a maximum height of 2m, in order to preserve the structural integrity of the soil.
- Mitigation screen vegetation planting, subject to land take, and availability of suitable land area.
- Implementation of a 5-year Landscape Management Plan
- Restricted hours of working will be proposed within built up areas.

8.7.2. Operation phase

Mitigation measures during the operation phase are presented below:

- Regular maintenance of vegetation.
- The appropriate design and colours for the fencing.
- Using as much as possible low and/or transparent noise barriers

8.8. Biodiversity, protected areas, and habitats

8.8.1. Construction phase

- Preparation of the Biodiversity Management Plan by the Contractor

- Pre-construction surveys for Nesting bird habitat/features, presence of specific sensitive receptors, bat roosts, suitable reptile/amphibian hibernacula; And invasive plants.
- Delimitation of areas to be cleared before the beginning of the construction activities
- Construction/rehabilitation of facilities to be sited on unused land of no particular ecological value
- Maximum use of existing access roads in order to avoid construction of new temporary access roads for bringing material and vehicles, which will minimize loss and fragmentation of vegetation and natural semi-natural habitats
- Restoration of sites after completion of construction rehabilitation (retaining as much of the original vegetation as possible for reinstatement)
- Minimized or avoided clearing in riparian areas
- The construction of drainage pipes and bridges in water courses will be carried out during the dry season
- Abutments of the proposed bridges will be designed to retain habitats along the waterways and the associated movement of species
- The extension of the construction area next to the water courses will be only that strictly necessary to adequately
- Drainage of swampy areas in the South Morava River alluvial plain will be avoided or minimized
- Gradual vegetation clearance to retain passage for species as long as possible
- Avoid dawn-dusk and night-time works, during the activity of nocturnal animals such as carnivore species and bats
- Vegetation clearance works should start if possible before the breeding season (spring)
- Construction of fauna crossing points (i.e. culverts) along the railway.
- Develop and implement a Biodiversity Management Plan (BMP), if necessary to protect ecological values of high biodiversity importance areas (which will be further elaborated after the detailed investigation) – prior to any construction operations
- The clearance of vegetation will be limited to the strip of land needed for the occupation of the permanent way and the right of way of the future railway corridor and the adjacent working width for buildings
- Avoid the cutting of trees: if cutting will be necessary, it will only be done with the required permits in compliance with the regulations
- Preparation of integrated vegetation control and management program, regarding the use and application of pesticides, or use of alternative control measures and methods to avoid the use of chemicals
- In forested areas, and especially those where the value of vegetation is high or very high, each tree lying on the border of the construction site will be protected by covering its trunk with wooden planks avoiding any damage to the tree
- Railways will be designed and maintained to discourage plant growth in the track area
- Works in the watercourses will be timed with due regard to mitigating potential impacts on migratory fish, mammals, birds, amphibians, and invertebrates
- In case winter snake refuges (hibernaculums) are discovered during the earthworks, the works will be ceased and the relevant authority (the Institute for Nature Conservation) contacted to relocate them.
- The workers camps will be constructed in areas of vegetation with negligible sensitivity vegetation, or low sensitivity
- Construction materials should be stored and maintained away from watercourses.
- Surface water runoff from the construction sites into the watercourses should be avoided and a system of cut-off ditches, silt fencing, and/or bunds should be installed if required.

- Noise and vibration should be controlled and kept to the minimum necessary to prevent potential negative effects on fish.
- Lighting used for construction should be switched off when not in use and, where possible, positioned so as not to spill onto watercourses.

8.8.2. Operation phase

- Preparation of Vegetation Restoration Plan in order to achieve pre-construction conditions as much as possible (e.g. re-vegetation of the working strip)
- Maintenance clearing in riparian areas will be avoided or minimized
- The implementation of the mitigation measures identified for flora, fauna, and habitats, will serve to ensure the integrity and conservation objectives of all the ecologically important and designated areas in the railway corridor area.
- Control of vegetation along the track; use of an integrated vegetation control and management program, regarding pesticides/herbicide uses
- Alien and invasive species are not used for the maintenance of the corridor; native species will be planted and invasive plant species removed
- Development of natural vegetation along the railway corridor which assists in the screening of the Railway
- Maintain the multifunctional passages for small and large animals clear of vegetation and debris, in a functional status
- Registration where animals are killed; propose appropriate measures (e.g. fencing)
- Regular removal of food and organic waste from the railway
- Fenced areas to be vegetated with native plant species that attract local fauna and with plantation patterns designed to lead the animals towards the wildlife crossings.
- Regular maintenance activities including protective fence maintenance, removal of food, waste, animal carcasses, etc. around the railway, in order to reduce the attraction of scavengers.
- Monitoring of the status of these areas, including activities with stakeholders; Monitoring Plan will define further status and condition of these habitats, with the proposal of specific measures for the preservation of these areas.

8.9. Environmental quality

8.9.1. Air pollution

Construction phase

Mitigation measures during the construction phase are presented below:

- A Dust Management Plan (DMP), including measures to control other emissions, in addition to the dust and PM10 mitigation measures given in this report, will be developed;
- A Construction Traffic Management Plan will be produced to manage the sustainable delivery of goods and materials;
- Construction compounds are required to be located away from sensitive receptors;

- Where practicable, erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site;
- Ensure all vehicle operators switch off engines when stationary - no idling vehicles;
- Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable;
- Ensure an adequate water supply on the site for enabling effective dust or particulate matter suppression.

8.9.2. Resources and waste

Construction phase

Mitigation measures during the construction phase are presented below:

- Mandatory to include waste minimization techniques in each segment, taken from the 4R concept (reduction, reuse, recycling and recovery techniques) in waste minimization in construction waste management.
- Ensure that the specification of recycled and secondary content in imported materials (such as earthwork, stone and aggregate, cement and asphalt), is set out during detailed design.
- Maximise the use of off-site construction and pre-fabrication methods to encourage a process of assembly rather than construction.
- The Contractor will be required to develop and implement a Waste Management Plan, to drive performance in the highest tiers of Waste Hierarchy, thereby maximise reuse and recycling
- Where on-site reuse (or other forms of recovery) cannot be achieved, the arisings should be sent to licenced off-site reuse, recycling or recovery facilities.
- A Decommissioning Waste Management Plan (DWMP) for the existing railway line will be prepared and maintained by the lead contractors.
- Waste generated from the decommissioning of the existing railway line will be re-used, where appropriate, treated or safely disposed in accordance with the Serbian regulatory requirements;

Operation phase

Mitigation measures during the operation phase are presented below:

- Implementation by the SRI of the waste management hierarchy
- Public waste bins in passenger trains and 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;

Hazardous waste from the track maintenance will be segregated and temporarily stored inside a properly equipped space, and then handed over to an authorized operator and finally disposed of in special cassettes for hazardous waste at sanitary landfills.

8.10. Mitigation of Socio-Economic Impacts

8.10.1. Pre-Construction and construction phase

Land use, Land Acquisition, Physical and Economic Displacement

As mentioned earlier, the detailed mitigation measures to be applied in addressing impacts associated with land use and land acquisition, including particularly physical and economic displacement, will be presented the Project Resettlement Action Plans. In brief, the key measures to fulfil international standards and requirements include:

- Compensation for all affected people at full replacement cost, both for formal and informal assets registered before the cut off date and any damages caused by the project;
- Provision of assistance measures for physically and economically displaced persons, with specific measures for any vulnerable individuals and/or households;
- Implementation of livelihood restoration measures for all categories of economically displaced persons;
- Implementation of a Project Grievance Mechanism.

Community Severance and Loss of Access

- Construction of overpasses and underpasses as appropriate, to prevent community severance and livelihood impacts (use of land on the other side of the railway);
- Presentation of project design and consultations with local stakeholders including local communities particularly on the location of underpasses and overpasses;
- Securing the provision of assistance measures for any businesses loosing direct access to the railway via connected private railways for freight transport in cooperation with the responsible authorities.

Access to Infrastructure and Utilities

- Presentation of project design and consultations with local stakeholders including local communities particularly on the planned closure of stations/stops;
- Securing integrated public transport options for affected local communities (e.g. minibuses to drive passengers to nearest operational train stations/stops, synchronised with train schedules) in cooperation with responsible authorities i.e. local self governments (municipalities);
- Timely processing of grievances in relation to roads or any other infrastructure damaged during construction and implementation of measures for ensuring prompt repairs of these roads and infrastructure including restoration to at least pre-construction quality. Regular communication with affected local communities and feedback on the expected timing of repairs, duration, scale, etc;
- Implementation of small community investments to off-set construction related nuisances and/or permanent damages.

Employment and Procurement Opportunities

The project will seek to enhance local employment and procurement through the implementation of the following measures:

- Organisation of training for potential workers from local communities;

- Announcement of employment opportunities locally and encouragement of women to apply;
- Implementation of transparent and fair recruitment procedures;
- Ensuring that all non-employee workers are engaged in line with both national legislation and applicable international (ILO) standards and recommendations;
- Providing a grievance mechanism for workers;
- Announcing procurement opportunities locally and procuring goods and services locally whenever possible, including accommodation of workers, provision of food and other services, etc.

If the above measures are implemented, more local people will be employed and more goods procured locally, enhancing the positive impact, including fostering more opportunities for women. In addition, all of the above will lead to more local households benefitting and having increased livelihoods and standards of living.

Labour and Working Conditions

In addition to mitigation measures listed in the previous section, it will be important to ensure that any provided accommodation of workers is in line with good industry practice and that policies governing the quality and management of the accommodation and provision of services are available and implemented.

Community Health, Safety and Security

Good industry practice measures will be implemented as detailed in relevant management plans and they will include commonly used measures such as restricted access to unauthorised areas, implementation of local safety awareness campaigns, measures for managing potential influx of workers, etc. The proposed measures will also include those specifically aimed at addressing identified GBVH risks. As with other impacts one of the key measures is regular communication with local communities and management of grievances.

8.10.2. Operation phase

No major negative impacts are foreseen in the operations phase of the Project and it is expected that impacts will be largely positive. Any enhancement opportunities will be explored in the ESIA development stage and presented in adequate management plans.

Specific measures to address potential impacts on livelihoods of the current providers of public transport services (local bus companies, taxis), as impacts that do not stem directly from land acquisition (PR 5), will be defined and presented as part of the ESIA.

Gender related impacts during the operations phase will be managed through the development of a Gender Plan, to address impacts confirmed through the ESIA development stage, particularly aimed at preventing GBVH in trains or near and at train stations and enhancing potential positive gender impacts.

8.11. Mitigation of Cultural Heritage Impacts

8.11.1. Construction phase

- SRI will ensure that relevant institutes for cultural heritage protection are consulted during the issuing of Location Conditions for each subsection.
- The Contractor will develop a Cultural Heritage Management Plan which will cover the following: consultations with local authorities; supervision of all earthworks by an archaeologist; specific actions and measures to manage risks and impacts to cultural heritage sites as well as local cultural events in the Project area; and development of a Chance Find Procedure detailing necessary steps to be taken should any culturally significant assets be found.

8.11.2. Operation phase

- SRI will develop an Operational Cultural Heritage Management Plan to ensure that any maintenance activities with the potential to impact known cultural heritage assets are planned carefully and in liaison with relevant institutes for cultural heritage protection, and that those undertaking maintenance activities are aware of the potential for previously undiscovered buried heritage remains to exist when undertaking any intrusive below ground activity.

9. STAKEHOLDER ENGAGEMENT

A Corridor Level Stakeholder Engagement Plan (Belgrade to Niš) was developed in the project prefeasibility stage and it provides general guidance for future stakeholder engagement planning and implementation in relation to the project. An Annex to this Corridor Level SEP focuses of the Stalać–Đunis section of the railway (within section 2), which is in a more advanced stage of implementation.

For each of the three sections for which ESIAs will be developed, including the section Velika Plana–Paraćin, as the subject of this Scoping Report, a SEP Annex will be prepared to present stakeholder engagement carried out during the ESIA phase, the main outcomes of the engagement and how they were incorporated in project planning, as well as engagement planned during the construction and operation phase by SRI, with support from other relevant institutions such as municipalities. To preserve consistency in the approach for all these sections the three SEP Annexes will be developed on the basis of the Stalać–Đunis SEP Annex.

As the ESIA development stage already started for the section Velika Plana–Paraćin, a stakeholder register has been shared with all PPF9 project teams who have a responsibility for recording all engagement activities and the main outcomes of engagement carried out by them in the ESIA development process. The filled in register will be annexed to the ESIA.

The overall responsibility for project related stakeholder engagement activities lies with SRI, as coordinated by the Project Implementation Unit (PIU). The PIU is being assisted by a team of TA experts, whose role will be to support the PIU and SRI in designing and implementing these activities. In the ESIA preparation stage, the PPF9 consultants developing the Project ESIA will help guide the process and will participate in engagement activities with local authorities, local communities and any other relevant stakeholders in connection to the collection of needed ESIA baseline data and in connection to identifying potential impacts and mitigation measures.

One of the obligations of SRI from previous project planning documents is the engagement of Community Liaison Officers, who will be the main focal points for the organisation of stakeholder engagement activities and grievance management at the local level, during the ESIA development phase but also beyond this, during construction and operation. SRI is in the process of identifying suitable positions within the organisation for fulfilling these tasks and once determined, an introductory training on the expected responsibilities in this process, will be organised by the PIU with assistance from the TA experts. The Community Liaison Officers will also be participating in the ESIA development phase engagement activities as soon as their engagement becomes operational.

The following Table presents the key identified stakeholder groups, the proposed methodology and type of communication with each, as well as the key issues of concern / topics of interest which will be the subject of provision of information and engagement on the Paraćin–Niš section of the railway in the ESIA development phase.

Table 62. Identified stakeholder groups for the Paraćin–Niš section

Stakeholder group	Type of communication and proposed method	Issue of interest / concern
Residents of 14 communities (total estimated population of around 90,000) located along the Project footprint, belonging to 5 municipalities, as follows: ▪ Velika Plana ▪ Lapovo ▪ Batočina ▪ JagodinaĆuprija The names of 14 communities are provided in Table 52 of the Scoping Report Special attention will be placed on identifying and consulting vulnerable groups regarding impacts and mitigation measures.	Description of Project E&S impacts and mitigation measures Stakeholder Engagement Plan Community notice boards (and information from local community council presidents) Public hearings and / or consultation meetings Project website and/or other relevant websites (MCTI, SRI, municipal) Media Grievance mechanism Focus group meetings and key informant interviews to carry out a vulnerability assessment	Project benefits and opportunities Solutions for public transport in villages where the train will no longer be operating / stopping (during construction and operation) Access to land on the other side of the railway, during construction and operation (overpasses and underpasses) Environmental and social impacts, particularly: ▪ Transport and traffic impacts during construction (traffic on local roads, potential other nuisances such as utility interruptions) ▪ Employment / procurement opportunities ▪ Noise during operation (near any residential facilities) ▪ Land acquisition related impacts ▪ Community compensation measures ▪ Submission of grievances (to SRI and the Contractor) and grievance management ▪ Specific impacts on vulnerable groups
Women residing or working along the railway corridor	As above, and Specific focus group meetings Meetings with representatives of women organisations	▪ Gender specific impacts, including but not limited to:GBVH risks during construction and operation of trains, safety risks at or near stations ▪ Impacts on women from rural areas in case of closure of stations or stops ▪ Opportunities to enhance employment of women, directly on the Project and indirectly (e.g. development of rural tourism)

Stakeholder group	Type of communication and proposed method	Issue of interest / concern
Presidents of local community councils	Description of Project E&S impacts and mitigation measures Stakeholder Engagement Plan Official correspondence and meetings	As above.
Owners and users of land and assets which will be acquired for the Project, who may be physically and/or economically displaced, including businesses (and their employees) and vulnerable individuals or households affected by land acquisition.	Resettlement Action Plan Stakeholder Engagement Plan Expropriation hearings Individual meetings Grievance mechanism	Expropriation process, compensation amounts, appeals, etc. Assistance for persons whose livelihoods are severely affected or vulnerable individuals/households SRI grievance contact details and management
Owners of businesses (and their employees) who may suffer loss of business and loss of livelihood, as a result of the detachment of any existing railway lines currently connected to the Belgrade Niš railway which are used by the private sector for freight transport.	Provision of information about potential impacts Targeted meetings to discuss potential impacts and mitigation measures Grievance mechanism	Information about potential detachment of used railway lines and/or options to continue using these or new connections. Grievance contact details and management
Local providers of public transport services (bus operators, taxis)	As above	Information about potential loss of business when the railway becomes operational and how that can be prevented and/or mitigated. Grievance contact details and management
Property administrations (Velika Plana, Lapovo, Batočina, Jagodina, Ćuprija)	Resettlement Action Plan Regular coordination meetings to follow progress of expropriation, identify and assist person's whose livelihoods may be affected and any vulnerable individuals / households Individual assistance action plans (action plan to assist affected people)	Progress of expropriation in each municipality Identification of formal or informal land users, identification of persons whose livelihoods are affected or who may be disproportionally affected by land acquisition (vulnerable persons) Proposed measures to assist them

Stakeholder group	Type of communication and proposed method	Issue of interest / concern
Interested NGOs, citizens' associations and other organisations, including those addressing issues in relation to environmental issues or any vulnerable groups.	Description of Project E&S impacts and mitigation measures Stakeholder Engagement Plan Public hearings and / or consultation meetings Project website and/or other relevant websites (MCTI, SRI, municipal) Media Grievance mechanism	Environmental and social impacts of the Project and mitigation measures Submission of grievances (to SRI and the Contractor) and grievance management
Municipalities (Velika Plana, Lapovo, Batočina, Jagodina, Ćuprija), including all relevant departments and service providers (NES, social welfare centres and others)	Resettlement Action Plan Description of Project E&S impacts and mitigation measures Stakeholder Engagement Plan Official correspondence and meetings	Environmental and social impacts of the Project and mitigation measures Acquisition of municipal properties (land and structures) Submission of grievances (to SRI and the Contractor) and grievance management Service providers – actions to be undertaken to assist people affected by land acquisition, as specified in the RAP.
Other statutory stakeholders, i.e. relevant Ministries, institutes, utility companies, directorates, etc.	Official correspondence and meetings when necessary	Conditions, applications for permits Project progress and specific topics of interest

10. TERMS OF REFERENCE FOR ESIA

10.1. Introduction

A key outcome of the scoping process is the definition of the Terms of Reference (or ToR) of the ESIA study. The findings of the ESIA study will be presented in the ESIA report, which will be prepared in compliance with Serbian national laws and regulations and in accordance with IFIs Policy Requirements and Good International Standards. The Consultant has selected the more stringent IFIs standards as the international standards benchmark for the ESIA report.

This chapter provides the proposed Terms of Reference for the ESIA and is structured as follows:

- Next steps required to complete the ESIA process,
- Proposed baseline studies,
- Proposed structure of the ESIA Report.

10.2. ESIA objectives

The Consultant recognizes that comprehensive planning and management of environmental and socio-economic issues are essential to the execution of any successful project and, therefore, intends to fully integrate environmental and socio-economic considerations into the life cycle of the proposed Project.

The purpose of the ESIA is to assess the potential impacts of the Project and Project related activities on the environment (including biophysical and socio-economic resources) and, where applicable, to design mitigation or enhancement measures to avoid, remove or reduce negative impacts to the environment and to enhance positive and mitigate negative environmental and socio-economic impacts.

10.3. ESIA Steps

Following on from the scoping phase of the Project, the ESIA will:

- Conduct additional consultation and further refine the scope of the ESIA as necessary;
- Collect additional baseline data through desktop research and field studies, as well as stakeholder meetings, to complete a comprehensive description of the environmental, social and cultural heritage conditions;
- Identify and assess environmental, socio-economic and cultural heritage impacts;
- Develop mitigation and enhancement measures and elaborate an Environmental and Management Plan (ESMP) including an approach for monitoring;

- Develop a SEP Annex for the relevant ESIA section, presenting the stakeholder engagement activities undertaken during the ESIA development process, as well as next steps in disclosing the ESIA and relevant management plans and receiving comments, and further planned engagement during construction and operation.Report findings in a comprehensive ESIA report. A Final draft ESIA Report will be submitted addressing IFI's and Beneficiary's comments.

10.4. Methodology and Key Aspects Included

10.4.1. Project Description

A Project Description will be provided as early as possible that describes all Project activities that could impact on environmental and social components within the Project area of influence. The Project Description will be prepared by the Project engineering team in association with the ESIA team. The Project Description will be as detailed as possible to identify the environmental and social aspects resulting from Project's activities.

10.4.2. Analysis of Alternatives

Chosen variant from PFS is used as a basis for Preliminary Design. E&S team will be included in process of project documentation preparation. Alignment optimisation will be done with the aim to improve project implementation by avoiding potential adverse environmental and social impacts.

EBRD mitigation hierarchy will be applied to avoid and if not possible to minimize and mitigate identified impacts.

Key criterias to be followed are:

- noise and vibration,
- biodiversity,
- physical and economic displacement
- technical requirements,
- occupation of agricultural soil.

An Analysis of Alternatives to the Project will include consideration of alternatives within Project design. This should also include the 'no-action' or 'no-go' alternative for the Project.

10.4.3. Baseline Conditions

A comprehensive understanding of existing environmental and societal baseline conditions in the Project region is essential prerequisite for sound identification and assessment of potential impacts from the proposed developments. Understanding the baseline allows the measurement of changes that would be caused by the Project. The process

for collecting the baseline environmental and social data is based on desk studies, stakeholder meetings and field survey.

Desk studies (i.e. legally defined quality standards for environmental media and emission limit values; existing literature, strategic / planning documents, statistics, databases and reports from various relevant organizations; as well as available internet sources and other similar projects). Stakeholder meetings include meetings with key stakeholders to collect baseline data from the field and they can take on the form of interviews of local community or local government representatives, meetings with representatives of civil society, focus group meetings with people of a specific profile to provide their views and opinions on a certain topic, etc.

The table below represent the desk activities and stakeholder meetings.

Table 63. Methodology for baseline analysis

Environmental component or pressure/Social issue	Methodology for baseline analysis
Climate	A desktop literature review will be performed and a brief description of climate in the wider project area will be done. Meteorological data should be collected from the available data on the official web sites for the meteorological stations and parameters which are relevant for the project area. Data about historical trends of meteorological parameters and projections of climate change will be prepared and analysed based on the available literature. Digital climate atlas will be used to better assess climate indices in different climate scenarios and time horizons. Impacts of the project on climate change and impacts of climate change on the project will be assessed using European Commission guidelines (Technical guidance on the climate proofing of infrastructure in the period 2021-2027 (2021/C 373/01)). Impact of the project on climate change will be assessed through GHG emission calculation. The impact of climate change on the project will be made using risk and vulnerability analysis.
Geology and geohazards	A desktop literature will be performed. Associated maps using existing geological and hydrogeological maps, satellite imagery, topographic maps and technical documentation will be prepared. Types of the deposits/bedrock in the project wider area will be identified and their characteristics described as well as their spatial distribution. For the description of the geological conditions in the project area, geological maps with map scale 1:100 000, analysis of digital model of terrain (DMT), available satellite imagery as well as available reports in the study area. The seismicity of a wider area will be analysed based according to available data, e.g. seismological maps, historical data, data on active faults and other available sources. Detailed data on the geotechnical characteristics of the terrain is in progress. Further data collection will include data acquired from the field visit.
Groundwater and surface waters	A desktop literature review will be performed. The field survey will include site visit of river/stream crossings. The analysis of existing hydrological data will be performed.

Environmental component or pressure/Social issue	Methodology for baseline analysis
	Determination of the physical and chemical parameters of the surface water as well as the assessment of the ecological status of the investigated localities will be carried out by taking 3 samples at each suggested location: River Rača near Markovac, River Lepenica near Batočina, River Great Morava near Bagrdan, River Osaonica near Bagrdan, River Belica near Jagodina, River Lugomir near Jagodina, River Great Morava near Ćuprija. Further baseline assessment during the ESIA will include assessment of seasonal discharge rates to a level of detail that will inform construction phase of project regarding high flow regimes low flow regimes, and time of year when flooding is likely for the gauged watercourses, while on ungauged watercourses professional estimation will be carried out.
Seismicity	Further assessment should include statistical data on earthquakes that occurred in a wider area of the route as well as data on the impact of earthquakes on the terrain in general, data from Seismic Hazard Harmonization in Europe (SHARE) project, data received from the Republic Seismological Institute of Serbia and other available published data.
Soil and agricultural land	Description of the basic soil characteristics and soil loss on the project area is specified using the available literature. Soil erosion risk map shown in the initial state description are taken as backgrounds from Republic Geodetic Institute of Serbia. Further assessment should include the results of the soil measurement of the soil quality in Velika Plana, Lapovo, Miloševo, Bagrdan, Lanište, Jagodina and in area beetwen Jagodina and Gilje, data provided by Republic Institute of Statistics. Detailed analysis of the orthophoto map of the Republic of Serbia as data from the site visit/field survey will be performed to determine potential sites of soil erosion. More detailed data on agricultural land and production and data on soil quality will be requested from local municipal administrations. Detailed analysis of the orthophoto map and available satellite images of the subject project area will be performed to determine location of agricultural land and existing types of agricultural crops. Data on the suitability of agricultural land for cultivation will be used to determine the area of valuable arable agricultural land. ESRI Satellite Imagery, CORINE land cover classification will be used for agricultural land determination on the observed area and site visit.
Landscape	The landscape analysis will be based on the following sources of information: Further assessment should include results of the desk-based review, video recording taken from the current railway and planning policy context (where possible), review of landscape character, including the existing site and features on the site, Detailed inventarisation of landscape characteristics and visual exposure – desktop analysis (DOF, DMR, TK25, literature, spatial plans) and field survey. Assess the significance and strength of the impact of the planned intervention on landscape – landscape structure, visual exposure, and landscape character LVIA methodology has been adopted from the Guidelines for Landscape and Visual Impacts Assessment (The Landscape Institute and the Institute of Environmental Management & Assessment, 2013) and will also be used in the future work.
Biodiversity and habitats	For the ESIA baseline preparation a set of documentation is available that include national (laws and sub laws, strategies) and international (EU Directives, Conventions, etc.) legislation, various reports on state of environment and on biological biodiversity

Environmental component or pressure/Social issue	Methodology for baseline analysis
	prepared by international and national institutions etc. Additionally, due to the project's characteristics (long linear infrastructure project) and sensitivity of the area, a biodiversity survey throughout one year period (habitats, flora and fauna) will be done. Baseline study and surveys shall include Desktop review of project area and species and habitats potentially distributed within area of project influence, particularly those that are recognized as priority biodiversity features (PBF) and/or critical habitat (CH) according to EBRD PR6 and Baseline survey of species and habitats identified through desktop review, within the appropriate area of assessment. The scope of all foreseen activities within biodiversity surveys include Research on natural habitats, flora and fauna species; Mapping of natural habitats within the Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance. An important source of data and information for baseline description is envisaged to be given from NGOs dealing with environmental protection, national authorities (Institute for Nature Conservation of Serbia) with whom consultations will be held. Results of the biodiversity surveys will be used for ESIA baseline description.
Protected areas	To perceive position of protected areas, a detail map of protected areas and areas designated for protection, will be made. Protected areas within following categories will be analysed: national protected areas, Ramsar areas, Important Bird Areas, Important Plant Areas, Key Biodiversity Areas and Emerald Network candidate sites/ potential NATURA 2000 sites. Detail desktop study will be performed to grasp the main values of these areas, identify potential conflicts in this area and future drivers of spatial and temporal changes. Additionally, due to the project's characteristics (long linear infrastructure project) and sensitivity of the area, a biodiversity survey throughout one year period (habitats, flora and fauna) will be done. Baseline study and surveys shall include Desktop review of project area and species and habitats potentially distributed within area of project influence, particularly those that are recognized as priority biodiversity features (PBF) and/or critical habitat (CH) according to EBRD PR6 and Baseline survey of species and habitats identified through desktop review, within the appropriate area of assessment. The scope of all foreseen activities within biodiversity surveys includes research on natural habitats, flora and fauna species; Mapping of natural habitats within the Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance. An important source of data and information for baseline description is envisaged to be given from NGOs dealing with environmental protection, national authorities (Institute for Nature Conservation of Serbia) with whom consultations will be held. Results of the biodiversity surveys will be used for ESIA baseline description.
Priority biodiversity features and Critical habitats	A biodiversity survey throughout one year period (habitats, flora and fauna) will be done. Baseline study and surveys shall include Desktop review of project area and species and habitats potentially distributed within area of project influence, particularly those that are recognized as priority biodiversity features (PBF) and/or critical habitat (CH) according to EBRD PR6 and Baseline survey of species and habitats identified through desktop review, within the appropriate area of assessment. The scope of all foreseen activities within biodiversity surveys includes research on natural habitats, flora and fauna species; Mapping of natural habitats within the

Environmental component or pressure/Social issue	Methodology for baseline analysis
	Project Area and Species and habitats within the project area that are a priority for conservation, for the purpose of confirming their presence and abundance. An important source of data and information for baseline description is envisaged to be given from NGOs dealing with environmental protection, national authorities (Institute for Nature Conservation of Serbia) with whom consultations will be held. Results of the biodiversity surveys will be used for ESIA baseline description.
Air quality	A detailed desktop literature review will be performed. Measured concentrations of air pollutants will be analysed and compared to the limit values defined by the national regulations. Further assessment should include more detailed results on the available measurement data of the concentration of define parameters, as well as details on the environmental impact assessment. Further research of air quality will be done on following locations: Velika Plana, Markovac, Lapovo, Novo Lanište, Jagodina, Ćuprija settlements.
Noise and vibration	A desktop literature review will be performed. Noise levels data will be described using legislation (national noise standards compared to EU/international standards), spatial plans, maps and other documentation (relevant studies, reports, plans etc.). Noise levels will be shown in the vicinity of the project. Data collection in the determination of the baseline noise and vibration levels in the observed area (site and surrounding area) by field noise and vibration measurements. Assessment of the impact of noise and vibration using appropriate software for modelling. Due to lack of national legislation related to vibration, German standard DIN 4150-2 and DIN 4150-3, will be used as the criteria for assessment. The vibrations and low frequency noise generated by railway traffic will be calculated using VIBRA-1 (Ziegler Consultants and Swiss Rail) software package. Field measurements will be exectued at sample locations where the houses are closest to the railway.
Waste management	Review of national waste management legislative framework and waste management practice will be conducted with aim to present the overview of implemented policies, to define available existing waste management infrastructure in nearby areas and estimate position/distance from to nearest landfills/disposal facilities. Further baseline assessment during the ESIA should identify disposal or treatment facilities which should be used for the project waste disposal. These facilities should be in complience with the requirements set by EU and domestic legislation, EBRD PR and best practice.
Vulnerable groups and gender aspects	The identification and analysis of vulnerable groups will be based on the demographic and socioeconomic statistical data, cross referenced with data collected in the field from key stakeholders including representatives of local communities as well as local civil society organisations and other key informants. Previous project studies identified potentially affected vulnerable groups, as follows: • elderly households without family or other support, and particularly among them single elderly people living alone • low income households living in substandard houses in villages along the railway line, including particularly Roma families who often live in extremely poor conditions • persons who may have difficulties accessing information about the Project that may be important for their everyday functioning (due to illiteracy, low educational status, etc.)

Environmental component or pressure/Social issue	Methodology for baseline analysis
	• children attending schools or other facilities near the railway, who have to cross the railway regularly • persons who have mobility difficulties (e.g. users of wheelchairs, strollers), who are using railway transport Experience has shown that within the above listed groups, women can be more vulnerable than men. For example, women, particularly elderly women, living alone in small villages along the railway, women who are dependent on railway travel (or even just crossing the railway) to access services or economic opportunities outside of their villages, women, who are at risk from GBVH, either in connection to the increased presence of workers in the area during construction or while accessing and using railway transport, etc. An assessment of potential specific impacts (or the severity of impacts) on vulnerable groups, present in the project area, as well as proposed mitigation measures will be presented in the ESIA.
Socio-economic environment	Desktop literature review and review of official statistical data will be conducted. A population census was carried out in 2022 and the results are being released by the Statistical Office of the Republic of Serbia during 2023. It is expected that the majority of this, up to date information, will be available by the end of 2023. In addition, there are indications that data from the 2022 census will also be available at the lowest, village / local community level, which would provide an excellent source of baseline data to be used for the assessment of project impacts on the local population, as well as for later monitoring and evaluation. Additionally, the needed baseline data will be collected directly from representatives of local authorities and local communities, as well as from other key informants (e.g. local civil society organisations) and from residents of local communities. Depending on when the RAP socio economic surveys will be carried out, the data from these surveys may also be used to supplement the ESIA baseline.

In order to determine relevant baseline environmental and social conditions within the study areas detailed surveys outlined in the Table below needs to be undertaken. The scope of these surveys was determined through desk study and an initial walkover survey undertaken by PPF9 team of experts. The field surveys will be undertaken from the authorised laboratories and findings obtained from these surveys for each relevant topic will be reported in respective sections within the ESIA report.

Table 64. Indicative methodology, goal and scope

Baseline survey	Indicative methodology, goal and scope
Air Quality	Key sources of air emission within 200 m of the centreline of the alignments of the railway route and 200 m around the proposed locations will be observed to gain indicative air quality baseline situation. There are no measurements of the ambient air quality within the study area and the data on the existing air quality are scarce and inadequate, it is necessary to carry out a target

Baseline survey	Indicative methodology, goal and scope
	measurement of the air quality in Velika Plana, Markovac, Lapovo, Novo Lanište, Jagodina, Ćuprija settlements. Key air pollution source in the environment are the air emissions during heating season and from agricultural activities. No significant industrial facilities are present in the area. The measurement should be continuous for at least 24 hours in a 5 day interval before and during heating season. Test parameters: Carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), ozone (O3), benzene (C6H6), benzo (a) pyrene, suspended particles of the PM10 fraction, suspended particles of the PM2.5 fraction, metals from of suspended particles of the PM10 fraction (As, Cd, Cu, Zn, Fe, Pb, Mn, Ni).
Soils	Key sources of soil quality within 500 m of the centreline of the alignments of the railway route and 500 m around the proposed locations will be observed to gain indicative soil quality baseline situation. Key source of soil pollution is leaking due to the use of the railway and in wider area due to agriculture. Existing data on soil quality is not adequate and it is necessary to carry out a target measurement of the soil quality in Velika Plana, Lapovo, Miloševo, Bagrdan, Lanište, Jagodina and in area beetwen Jagodina and Gilje. Also, it is necessary to carry out a target measurement in the area of sanitary protection zones of Paraćin and Ćićevac which are crossed by railway line. In order to analyze the impact of existing railway traffic on soil quality, it is necessary to analyze the following parameters in soil samples: mineral oils, pH value, moisture percentage, metal content (arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), zinc (Zn), cobalt (Co), molybdenum (Mo), antimony (Cb), polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), volatile organic substances, content of organic matter, granulometric composition.
Surface waters	Existing data on surface water quality are not sufficient to define baseline conditions. For this reason, the measurement of surface water quality should be carried out in places where the railway crosses watercourses, as well as in places where the railway runs directly alongside watercourses. The key polluters of surface water are wastewater that does not undergo any treatment but is directly discharged into the rivers from the settlements along the railway. Determination of the physical and chemical parameters of the water as well as the assessment of the ecological status of the investigated localities will be carried out by taking 3 samples at each suggested location: River Rača near Markovac, River Lepenica near Batočina, River Great Morava near Bagrdan, River Osaonica near Bagrdan, River Belica near Jagodina, River Lugomir near Jagodina, River Great

Baseline survey	Indicative methodology, goal and scope
	Morava near Ćuprija. Key parameters for research: Water temperature, Visible waste matter, pH value, Electrical conductivity, Ammonium ion (NH4-N), Total nitrogen, Total organic carbon (TOC), Suspended matter, Nitrites, Nitrates, Sulfates, Chlorides, Total mineralization, Surfactants, Phenols (phenolic index), Chemical oxygen consumption (COD), Biochem. oxygen consumption (BOD5), Arsenic, Boron, Manganese (total), Copper, Chromium (total), Zinc, Iron (total), Total phosphorus, Orthophosphates, Dissolved oxygen, Total coliforms in 100 ml, Faecal coliforms in 100 ml, Intestinal enterococci in 100 ml, Number of aerobic heterotrophs in 100 ml.
Groundwater	Existing data will be used.
Biodiversity	Ongoing. Methodology is presented as separate document.
Noise and vibration	Key sources of noise emission within 200 m of the centreline of the alignments of the railway route and 200 m around the proposed locations will be observed to gain indicative noise baseline situation. There is no existing information within the study area it is necessary to carry out a target measurement of the noise and vibrations in settlements alnog the corridor which are defined as sensitive zones. Sensitive zones are 15 settlements betwen Paraćin station and Trupale station, along the corridor. Specific tasks for noise measurements: In all locations, the dominant source of noise should be railway traffic. Measurements should be carried out during regular traffic. Each of the measurements should be continuous for 24 hours, at least 5 days at each location. The weather conditions must be suitable for measuring noise in the environment (periods when the wind speed was higher than 5 m/s and/or when the amount of precipitation was higher than 6 mm/h should be excluded from the measurement). Measurements should be carried out in an open space in areas of objects sensitive to noise. Specific tasks for vibration measurements: Analysis of vibration and low frequency noise will be done for mentioned distance (In the operational phase, 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 if necessary for the wider area where there are residential and other sensitive buildings. Based on analysis of vibration and low frequency noise caused by forecasted traffic volume at railway station Belgrade-Nis, mitigation measures will be defined in order to reduce the impact on the environment.

It is hoped that data from the 2022 country wide Population Census will be available at the time of developing the ESIA and especially that it is available at the level of local communities. If so, updated information will be presented

in the ESIA. Gaps in data will be bridged by collecting the relevant baseline data from local stakeholders, through meetings and other engagement activities. Depending on the timing of socio-economic surveys of people affected by land acquisition which will be carried out for the development of Resettlement Action Plans, the results of these surveys may also be used to supplement the ESIA baseline.

10.4.4. Environmental standards

Water quality

Law on Water ("Official Gazette of RS", No. 30/210, 95/18, and 95/2018-other law) regulates the legal status of water, integrated water management, water management facilities and water land, sources and method of financing water activities, supervision over implementation of this law, as well as other issues relevant to water management. The bullets below present Decrees adopted by the Republic of Serbia that is related within the Project's scope as:

- Surface water quality, groundwater and sediment standards are regulated by the Order on limit values of polluting substances discharged into surface water, groundwater and sediment and deadlines for complying setting the limit values of polluting substances and defining five classes of the ecological status: high, good, moderate, poor and bad ("Official Gazette of RS", No. 50/12).
- Limit values of parameters related to general water conditions, oxygen regime, nutrients, salinity, metals, organic matter, and microbiology are defined by the Regulation on parameters of the ecological and chemical status of surface water and parameters of the chemical and quantitative status of groundwater ("Official Gazette of RS", No. 74/11).
- Limit values for priority and priority hazardous substances are set by the Order on limit values of priority and priority hazardous substances polluting surface waters and deadlines for complying ("Official Gazette of RS" No. 24/14).

Regulation on limit values of polluting substances in surface and underground waters and sediment and deadlines for reaching them (Official Gazette of the RS", No. 50/2012) determines the limit values of polluting substances in surface and groundwaters and sediment, as well as the deadlines for reaching them.

Table 65. Limit values of pollutants in surface waters

Parameter	Unit of measure	Thresholds(1)				
		Class I(2)	Class II(3)	Class III(4)	Class IV(5)	Class V(6)
General						
pH(12)		6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	<6.5 or <8.5
Suspended matter(9) (12)	mg/l	25	25	-	-	-
Oxygen mode						
Dissolved oxygen	[mg O2/l]	-(8) (or PN)	-(8)	5	4	< 4
Oxygen saturation	%					
-epilimnion (stratified water)		90-110	70-90	50-70	30-50	<30

Parameter	Unit of measure	Thresholds(1)				
		Class I(2)	Class II(3)	Class III(4)	Class IV(5)	Class V(6)
- hypolimnion (stratified water)		70-90	70-50	30-50	10-30	<10
-unstratified water		70-90	50-70	30-50	10-30	<10
BOD5	[mg O2/l]	-(8) (or PN)	-(8)	7	25	>25
HPK (bichromatic method)	[mg O2/l]	10 (or PN)	15	30	125	>125
HPK (permanganate method)	[mg O2/l]	5 (or PN)	10	20	50	>50
Total Organic Carbon (TOC)	[mg/l]	-(8) (or PN)	-(8)	15	50	>50
Nutrients						
Total nitrogen	[mg N/l]	1 (or PN)	2	8	15	>15
Nitrates	[mg N/l]	-(8) (or PN)	-(8)	6	15	>15
Nitrites	[mg N/l]	0.01 (or PN)	0.03	0.12	0.3	>0.3
Ammonium ion	[mg N/l]	-(8) (or PN)	-(8)	0.6	1.5	>1.5
Non-Ionized Ammonia(9)	[mg/l NH3]	0.005	0.025	-	-	-
Total Phosphorus(7)	[mg P/l]	-(8) (or PN)	-(8)	0.4	1	>1
Orthophosphates	[mg P/l]	-(8) (or PN)	-(8)	0.2	0.5	>0.5
Salinity						
Chlorides	[mg/l]	50 (or PN)	-(8)	150	250	>250
Total Residual Chlorine(9)	[mg/l HOCl]	0.005	0.005	-	-	-
Sulfates	[mg/l]	50 (or PN)	100	200	300	>300
Total mineralization	[mg/l]	<1000 (or PN)	1000	1300	1500	>1500
Electrical conductivity at 200S	[mS/cm]	<1000 (or PN)	1000	1500	3000	>3000
Metals						
Arsenic	[µg/l]	<5 (or PN)	10	50	100	>100
Pine tree	[µg/l]	300 (or PN)	1000	1000	2500	>2500
Copper	[µg/l]	5 (T=10)22 (T=50)40 (T=100)112 (T=300)	5 (T=10)22 (T=50)40 (T=100)112 (T=300)	500	1000	>1000
Zinc	[µg/l]	30 (T=10)200 (T=50)300 (T=100)500 (T=500)	300 (T=10)700 (T=50) 1000 (T=100)2000 (T=500)	2000	5000	>5000
Chromium (Total)	[µg/l]	25 (or PN)	50	100	250	>250
Iron (Total)	[µg/l]	200	500	1000	2000	>2000
Manganese (Total)	[µg/l]	50	100	300	1000	>1000

Parameter	Unit of measure	Thresholds(1)				
		Class I(2)	Class II(3)	Class III(4)	Class IV(5)	Class V(6)
Organic substances						
Phenolic compounds (such as C2H5OH)	[µg/l]	<1	1	20	50	>50
Petroleum hydrocarbons(9)		(10)	(10)	-	-	-
Surfactants (such as lauryl sulfate)	[µg/l]	100	200	300	500	>500
AOH (adsorbing organic halogen)	[µg/l]	10	50	100	250	>250
Microbiological parameters						
Faecal coliforms	cfu/100ml	100	1000	10000	100000	>100000
Total coliforms	cfu/100ml	500(11)	10000	100000	1000000	>1000000
Intestinal enterococci	cfu/100ml	200	400	4000	40000	>40000
Number of aerobic heterotrophs (Kohl method)	cfu/100ml	500	10000	100000	750000	>750000

T - water hardness (mg/l CaCO3)
PN - natural level
(1)Unless otherwise stated, values are expressed as total concentrations in the sample taken
(2)The description of the class corresponds to excellent ecological status according to the classification given in the rulebook that prescribes the parameters of ecological and chemical status for surface waters. Surface waters belonging to this class provide, based on the limit values of the quality elements, the conditions for the functioning of the ecosystem, the life and protection of fish (salmonids and cyprinids) and can be used for the following purposes: supply of drinking water with prior treatment by filtration and disinfection, bathing and recreation, irrigation, industrial use (process and cooling water).
(3)The description of the class corresponds to a good ecological status according to the classification given in the rulebook that prescribes the parameters of the ecological and chemical status for surface waters. Surface waters belonging to this class ensure, based on the limit values of quality elements, the conditions for ecosystem functioning, life and protection of fish (cyprinids) and can be used for the same purposes and under the same conditions as surface waters belonging to class I.
(4)The description of the class corresponds to a moderate ecological status according to the classification given in the rulebook that prescribes the parameters of the ecological and chemical status for surface waters. Surface waters belonging to this class ensure, based on the limit values of the quality elements, conditions for the life and protection of cyprinids and can be used for the following purposes: supply of drinking water with prior treatment by coagulation, flocculation, filtration and disinfection, bathing and recreation, irrigation, industrial use (process and cooling water).
(5)The description of the class corresponds to a weak ecological status according to the classification given in the rulebook that prescribes the parameters of the ecological and chemical status for surface waters. Surface waters that belong to this class based on the limit values of quality elements can be used for the following purposes: drinking water supply with the application of a combination of the aforementioned treatments and improved treatment methods, irrigation, industrial use (process and cooling water).
(6)The description of the class corresponds to poor ecological status according to the classification given in the rulebook that prescribes parameters of ecological and chemical status for surface waters. Surface waters belonging to this class cannot be used for any purpose.
(7)Total phosphorus is analyzed from the filtrate, i.e. from the dissolved phase obtained by filtration through a 0.45 mm filter.
(8)See Annex 1, Table 2 and Table 3, in which the limit values of polluting substances are given for I and II class of surface waters.
(9)The parameter is monitored only in surface waters designated as salmonid or cyprinid.
(10)Petroleum derivatives must not be present in water in such quantities that:
- form a visible film on the surface of the water or isthmus on the shores of watercourses and lakes,
- they give a recognizable "hydrocarbon" taste to fish,
- cause harmful effects in fish.
(11)Based on a 95% estimate
(12)Deviation from the limit values is allowed in case of specific geographical condition

Air quality

Air quality limit and target values are defined by the national legislation for pollutants: SO_2, NO_2, CO, PM_{10}, $PM_{2,5}$, O_3, benzene, PAHs and heavy metals in order to protect the human health (Table 66). The legislation also defines alert thresholds for SO_2, NO_2, PM_{10} and ozone concentration levels. The limit and target values are defined in the Official Gazette of RS No. 36/09 and 10/13. The national legislation was made in accordance with EU air quality standards and WHO guideline, so the limit values are harmonized.

Table 66. Limit target and alert values for air pollutants defined by the national legislation

Polluting matter	Averaging period	Legal nature and concentration	Comments
SO_2	1h	Limit 350 µg/m^3	No more than 24 hours per year
		Alarm threshold 500 µg/m^3	It is measured during three consecutive hours in an area of 100 km^2 or in the entire zone
	1 day	Limit 125 µg/m^3	No more than 3 days per year
NO_2	1 h	Limit 200 µg/m^3	No more than 18 hours per year
		Alarm threshold 400 µg/m^3	It is measured during three consecutive hours in an area of 100 km^2 or in the entire zone
PM_{10}	1 day	Limit 50 µg/m^3	No more than 35 days a year
	Calendar year	Limit 40 µg/m^3	
$PM_{2.5}$	Calendar year	Limit 25 µg/m^3	
CO	Max. daily 8-hour mean value	Limit 10 µg/m^3	
O_3	Max. daily 8-hour mean value	Target value 120 µg/m^3	No more than 25 days per year arranged for three years
		Information threshold 180 µg/m^3	
	1 hour	Information threshold 240 µg/m^3	

Noise level

Local valid regulations in the field of noise protection have been harmonized with the relevant EU directives and will be used for analysis of noise impact on environment.

As acoustic zoning does not exist for the subject area, therefore selection of the permissible noise levels was made in accordance with the Regulation on noise indicators, limit values, assessment methods for indicators of noise, disturbance, and harmful effects of noise in the environment (Official Gazette of RS, No. 75/2010).

Regulation on noise indicators, limit values, assessment methods for indicators of noise, disturbance, and harmful effects of noise in the environment defines the highest permissible levels of external noise (outdoor noise indicators), which noise indicators (allowable levels of noise during the day, the evening and the night), as well as the methods for measuring and evaluating noise levels in the environment. These values are presented in the following table with comparison to the values given in Environmental, Health, and Safety (EHS) Guidelines by the International Finance Corporation.

Table 67. National standard

Zone	Purpose	Day and evening	Night
1	Areas for rest and recreation, hospital zones and convalescent homes, cultural and historical sites, large parks	50	40
2	Tourist areas, small and rural settlements, camps and school zones	50	45
3	Purely residential areas	55	45
4	Business-residential areas, commercial-residential areas, children's playgrounds	60	50
5	City center, craft, trade, administrative zone with apartments, zones along highways and railways	65	55
6	Industrial, storage and service areas and transport terminals without housing	At this area borders, noise must not exceed the limit value of the neighbouring area	

Table 68. IFC – Noise level guidelines [84]

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00

[84] *Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.*

Residential; institutional; educational*	55	45
Industrial; commercial	70	70

*For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).

Vibration level

Due to lack of national legislation related to vibration, German standard DIN 4150-2 (Structural Vibration - Human Exposure to Vibration in Buildings) and DIN 4150-3 (Vibrations in buildings - Part 3: Effects on structures), will be used as the criteria for assessment.

Table 69. Reference values for the assessment of vibration in dwellings and similar buildings according to DIN 4150-2 (Structural Vibration - Human Exposure to Vibration in Buildings)

Use	Day			Night		
	(600-2200)			(2200-600)		
	Au	Ao	Ar	Au	Ao	Ar
Industrial area	0.4	6	0.2	0.3	0.6	0.15
Predominantly commercial area	0.3	6	0.15	0.2	0.4	0.1
Mixed commercial and residential area	0.2	5	0.1	0.15	0.3	0.07
Mainly residential area	0.15	3	0.07	0.1	0.2	0.05
Special areas (e.g. hospitals) or health resorts	0.1	3	0.05	0.1	0.15	0.05

The guideline values of short-term and long-term vibrations from the aspect of the impact on the buildings structure, according to the DIN 4150-3 standard are shown in Table 70. Vibration levels shall always be within the limits specified for the appropriate structure type and floor (e.g. 5mm/s in 1 to 10Hz range for foundations of residential dwellings, No. 2).

Table 70. Guideline values of short-term vibration for the assessment of the impact on building structures according to DIN 4150-3 [$v_{i,max}$ in mm/s]

No.	Type of structure	Short-term vibration, vi,max in mm/s				
		Foundation all directions, (i=x,y,z) at a frequency of			Topmost floor, horizontal direction i=x,y	Floor slabs vertical direction, i=z
		1 Hz – 10 Hz	10 Hz – 50 Hz	50 Hz – 100 Hz	all frequencies	all frequencies
1.	Building used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2.	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3.	Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value	3	3 to 8	8 to 10	8	20

Table 71. Guideline values of short-term and long-term (or continuous) vibrations for the assessment of the impact on building structures according to DIN 4150-3 [$v_{i,max}$ in mm/s]

No.	Type of structure	Long-term vibration, vi,max in mm/s	
		Topmost floor, horizontal direction, all frequencies	Floor slab vertical direction, all frequencies
1.	Building used for commercial purposes, industrial buildings and buildings of similar design	10	10
2.	Dwellings and buildings of similar design and/or occupancy	5	10
3.	Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value	2.5	10

10.4.5. Project Area of Influence

The Project area of influence (AoI) has been preliminary determined as part of this assignment as the surrounding buffer zone of the railway route in which most of the impacts are expected, including both Belgrade-Nis High Speed Railway Corridor Level E&S Assessment environmental and social impacts. The AoI has been set preliminary to include the buffer of 500 m from the rail centreline at each side of the railway route for most of the impacts. However, the following areas of influences were used for some E&S issues:

Table 72. Areas of influence

Parameter	Area of influence
Geology	The area of influence (study area) will encompass 500 m of the corridor on both sides of the railway.
Soil	A buffer of 500 m on each side of the planned railway was taken as an initial surveying area as project area of interest
Biodiversity	The area of influence (study area) will encompass 500 m of the corridor on both sides of the railway. In addition, the study area will be expanded to fully encompass the ecologically appropriate areas of analysis (EAAA) for features that require additional focused study. In accordance with existing data on the biodiversity of the project area, the study area will be expanded in the zone of ecosystems and habitats that are a priority for conservation and protected areas. The EAAAs will be defined further, once the fieldwork has been undertaken. For areas where PBFs and CHs are identified, an ecologically appropriate area of analysis (EAAA) will be taken into consideration within ESIA, and it will include entire related habitat area of each PBF/CH
Groundwaters	The area of influence will encompass 500 m of the corridor on both sides of the railway (1 km corridor).
Surface waters	The area of influece is defined in the area of bridges across the rivers, and 500 m upstream and downstream.
Landscape	The area of interest for assessing impacts on landscape is defined to be up to 2 km of each side of the railway route for purposes of wider impact analysis and 250 m (500 m corridor) for narrow analysis .
Noise and vibrations	The noise and vibration impact analysis will be analysed in a zone of 200 meters corridor on both side of the planned railway section.
Resources and waste	The area of interest is defined to be 300 m of each side of the railway route.
Air quality	For potential air quality impact, two zones of impact are defined. In the first buffer zone of 2 km from the edge of the project where some negative effects on air quality due to material handling, construction work and emissions from fossil fuel powered vehicles and machines

	are possible. Second zone of possible impact is along the access roads to the project used for transport of materials and machinery needed for construction works.
Social	Local communities along the railway corridor as well as the municipalities to which they territorially belong

10.4.6. Impact assessment methodology

This ESIA report will provide identification and characterization of:

- potential negative environmental and social impacts
- cumulative impacts
- potential positive impacts

The report will include relevant stages of the project's life; construction and operation.

The impacts will be analysed according to the following characteristics:

- Magnitude - a scale of the severity / benefit of the impact is used to assess to which extent the impact affects the ecosystem (for ecological impacts) or people, local communities and workers (for socio-economic impacts).
- Spatial (area of influence) and temporal size (duration) of the impact – the spatial scale defines the physical extent of the impact; the time scale defines the duration of this impact;
- Environmental sensitivity (sensitivity of the zone of the impact / receptor) - a sensitivity scale makes it possible to evaluate whether the receiving environment and social environment has features (scarcity, high stakes use of resource, vulnerability, etc.) potentially reinforcing the importance of an impact in a given intensity. This sensitivity includes the notion of reversibility of the impact;
- Likelihood - makes it possible to quantify whether the impact considered is certain (for example the loss of vegetation during earthly works), possible, or exceptional (for example for certain accidents). Although some impacts may have important effects, a very low probability of occurrence may diminish the overall significance of this impact. Similarly, a frequent impact must be assessed as more significant than the same impact with a rare frequency of occurrence.

For the assessment of the temporal size of the impact, the following categories will be used:

- During construction works
- Short term – less than 5 years
- Middle term – between 5 and 20 years
- Long term/Permanent – more than 20 years

For the assessment of the spatial size of the impact, the following categories will be used:

- Very localized – construction work corridor

- Wider project area – up to 2 km corridor on both sides (depending on environmental component). From the social perspective, this includes primarily the local communities in which people live and work, along the project corridor and the municipalities to which they territorially belong.
- Regional/National
- International

Grades for the impacts will be given according to the following table.

Table 73. Grades for the impacts

Magnitude				Grade
Low	Low impact			1
Moderate	Moderate impact			2
High	Severe or significant beneficial impact			3
Very high	Very severe or particularly beneficial impact			4
Spatiotemporal scale				
	Short term – less than 5 years	Middle term – between 5 and 20 years	Long term/Permanent – more than 20 years	
Very localized	1	2	3	
Wider project area	1	2	3	
Regional / National	2	3	4	
International	2	3	4	

Environment sensitivity		Grade
Low	The environment assessed / activity / population is common, has no particularity or important issues	1
Moderate	The environment assessed / activity / population subgroup is quite common and has some specific features or issues	2
High	The environment assessed / activity / population is rare and has significant and important features or issues	3
Very high	The environment assessed / activity / population is very rare and has unique features or issues	4

Social sensitivity		Grade
Low	A non-vulnerable social receptor with at least some capacity and means to absorb proposed changes and with at least some access to alternative similar sites or services.	1
Moderate	An already vulnerable social receptor with limited capacity and means to absorb proposed changes or with little	2

	access to alternative similar sites or services.	
High	An already vulnerable social receptor with very little capacity and means to absorb proposed changes or with very little access to alternative similar sites or services.	3
Likelihood		**Grade**
Very low	The impact considered has a very low probability of happening	1
Low	The impact considered is possible	2
High	The impact considered is likely	3
Certain	The impact considered will happen with certainty	4

Table 74. Change in noise levels and magnitude of impacts

Change in noise levels (dB)	Magnitude of the impact	Grade
Construction phase		
Less than 1	Very low	1
1–2.9	Low	2
3–4.9	High	3
Greater than or equal to 5	Very high	4
Operational, long term		
Less than 3	Very low	1
3–4.9	Low	2
5–9.9	High	3
Greater than or equal to 10	Very high	4

Table 75. Change in vibration levels and magnitude of impacts

Magnitude of Impact (defined in relation to the DIN 4150-2)	Vibration level		Grade
	[PPV mm/s]	Human disturbance	
Negligible	< 0,2	Threshold of perception, weakly noticeable	1
Low	0.2 to 0.8	Awakening threshold, noticeable	2
Medium	0.8 to 6.3	Awakening threshold, strongly noticeable	3
High	> 6.3	Very strongly noticeable	4

	Vibration level	Grade

Magnitude of Impact (defined in relation to the DIN 4150-3)	[PPV mm/s]	Building disturbance	
Negligible	< 5.0	Damage to building unlikely	1
Low	5.0 to 15.0	Damage to building possible at frequencies < 50 Hz	2
Medium	15 to 20	Damage to building possible at frequencies < 100 Hz	3
High	> 20	Damage to building possible at all frequencies	4

Table 76. Change in air quality and magnitude of impact

		NO_2 µg/m³	PM_{10} µg/m³	O_3 µg/m³	$PM_{2.5}$ (optional) µg/m³	Grade
Very low (negligible)	0–25	0–50	0–25	0–60	0–15	0
Low	25–50	50–100	25–50	60–120	15–30	1
Medium	50–75	100–200	50–90	120–180	30–55	2
High	75–100	200–400	90–180	180–240	55–110	3
Very high	>100	>400	>180	>240	>110	4

Sum of the grades gives the overall effect, according to the following table:

Table 77. Grades of overall effects

		Effect (sum of magnitude, spatial and temporal size of the impact, environmental sensitivity & impact likelihood)									
		3	4	5	6	7	8	9	10	11	12
Likelihood	1	4	5	6	7	8	9	10	11	12	13
	2	5	6	7	8	9	10	11	12	13	14
	3	6	7	8	9	10	11	12	13	14	15
	4	7	8	9	10	11	12	13	14	15	16

Based on the sum of magnitude, spatial and temporal size of the impact, environmental sensitivity in relation to impact likelihood, impact significance will be defined. The given number indicates the impact significance according to the following table.

Table 78. Impact significance

Significance	Description	Evaluation

Low	An acceptable impact, which can require measures of avoidance or reduction, without that being essential. This impact is insufficient by itself, or even in combination with other impacts of similar importance; to call into question the project.	4–7
Moderate	A significant impact which requires measures of avoidance and/or reduction. This impact is insufficient alone to call into question the project, but could, in conjunction with other impacts of comparable nature, being a brake with its realization.	8–10
High	A serious impact which; if no measures are taken (and if this impact is negative), can call into question the project. This impact is considered by the company a major change and usually of long run of the environment (natural and/or socio- economic) with important consequences.	11–13
Very high	A very serious impact which, so of measures are not taken (and if this impact is negative), can be enough in itself to call into question the project. This impact, doubtless permanent and irreversible; results for the sponsor in major consequences for the environment, the populations or the economic activity.	14–16

During the impact assessment, in the description manner, additional impact characteristics will be considered:

- Direction – positive, negative
- Reversibility – whether it is a direct (when a direct cause-and-effect relationship exists between a component of the project and an element of the environment - ecosystem or socio-economic components), indirect (which results from a direct impact or component of the project while continuing with a chain of consequence), or residual (impact remaining after the application of avoidance and / or reduction measures) impact.

Impact assessment methodology is designed to ensure that decisions on projects are made in full knowledge of their likely impacts on the environment and society. A vital step within the process is the identification of measures that will be taken to mitigate impacts. The ESIA process will identify where significant impacts could occur and then define mitigation measures to reduce those impacts to levels that will be deemed acceptable. These measures will then be integrated into the ESMP and ESAP as clear commitments.

Where a significant negative impact will be identified, a hierarchy of options for mitigation will be explored as follows:

- avoid - remove the source of the impact,
- reduce - reduce the source of the impact, reduce the impact between the source and the receptor, reduce the impact at the receptor,
- remedy - repair the damage,

- compensate - replace in kind or with a different resource of equal value.

Specific methodology will be used for impacts related to climate change.

Methodology used to assess climate change impacts (climate proofing) is given in the Technical guidance on the climate proofing of infrastructure in the period 2021–2027 (2021/C 373/01). There are two pillars of climate proofing, climate neutrality which is focused on the mitigation of greenhouse gases and climate resilience which is focused on adaptation to current and future climate change. Each pillar has two phases, screening, and detailed analysis. To determine which phase should be used, a following diagram can be used.

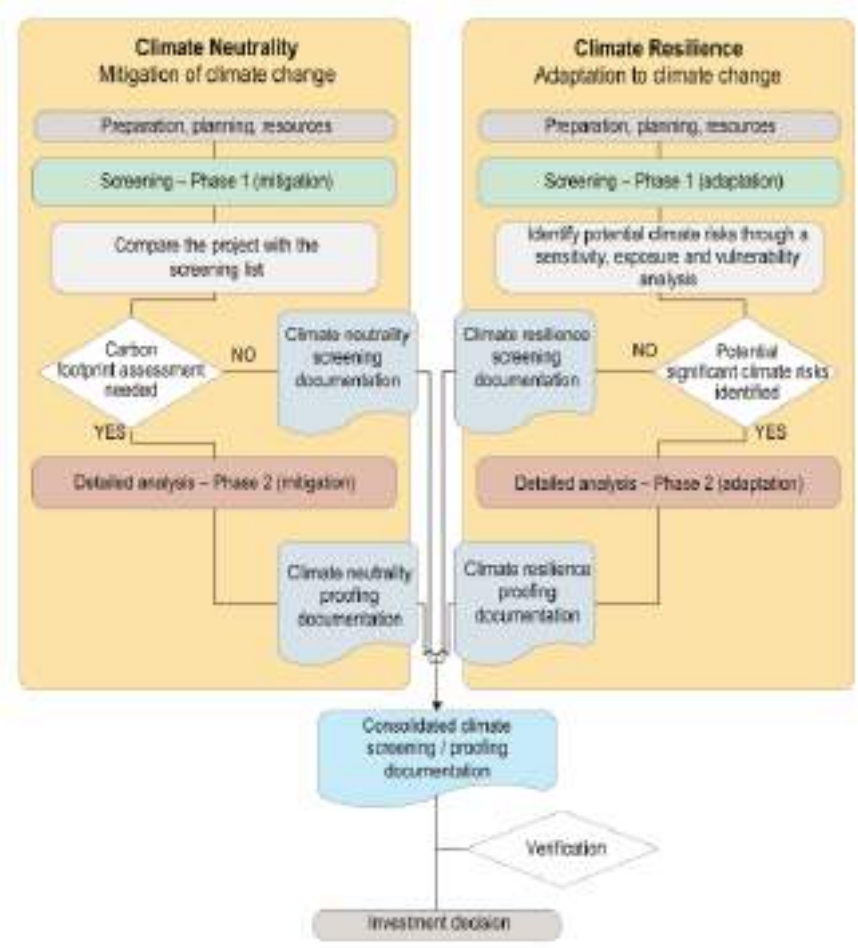


Figure 48. Impact of project on climate changes

Impact of the project on climate change is assessed through carbon footprint calculation. The calculation will be done using the methodology given in the *EIB Project Carbon Footprint Methodologies* (Version 11.3; January 2023).

In the calculation should at least include scope 1 (direct) and scope 2 (indirect) emissions of greenhouse gases while scope 3 (indirect) emissions are not required. For a railway project, emissions from fuel and electricity use of the trains should be included as well as emissions from the accompanying infrastructure required for a smooth operation of the railway.

The calculation should include emissions of at least carbon dioxide, methane, and nitrous oxide. The final results should be expressed as $CO_{2,eq}$ and compared to the limit values set in the *Technical guidance*.

Impact of climate change on the project is assessed in four stages. The first three stages are sensitivity, exposure, and vulnerability analysis. Sensitivity analysis determines the sensitivity of the project on specific climate change impacts while exposure analysis determines the exposure of the region to that climate change impact. The vulnerability analysis combines the results of sensitivity and exposure, determining the vulnerability of the project to a climate change impact.

If the vulnerability of the project is determined to be high with regard to a climate change impact, a detailed risk analysis should be done in acordance with the *technical guidelines.* If a high risk is determined, all measures should be taken to mitigate the potential negative impacts of the climate change on the project.

Waters

Construction phase

Receptors that can be affected by the Project construction works are watercourses and groundwater.

The potential impact on surface and ground waters can potentially arise from different construction activities that can cause water pollution.

The assessment of Project impacts on water resources will be based upon local characteristics of watercourses (e.g. type, seasonality) and on hydrogeological characteristics of the aquifers over which railway routes traverses. Construction activities that can cause adverse effect on waters are river crossings. The aquifers along the railway can be also affected in accidental situations (spills and leakages of fuel, oil, lubricants etc.) if topsoil of low permeability layer is missing or is very thin (alluvial aquifer with degraded silt/clay cover).

For the determination of possible impact on waters, spatial analysis (with GIS tool) will include watercourses, location of springs, and wells that are used for public water supply.

Operation phase

As opposed to impacts during the construction phase which will be temporary and will cease after the completion of the construction works, during operation phase no significant impacts are expected. Only in cases of accidents, during the transportation of oil and derivatives, oil and dangerous substances in liquid state, significant pollution of surface and/or underground water can be expected.

Geohazards

Construction phase

The study area affected by geological hazards like earthquakes, potential landslides and floods while local mass movement (potential landslides) will be determined in scope of site visit. In order to estimate how geohazards can affect the project, potentially hazardous areas will be identified by type in project area. Possible effects will be described for each geohazard type.

Flooding of the construction site can have adverse effect on water quality as well can cause damage to the construction equipment. The project railway routes crosses over area with potentially expressed liquefaction that can affect project safety. Construction activities in general include forming of a work strip, construction of access roads etc. which can trigger local mass movement (mostly diluvial unbound deposits on slopes with higher inclination values).

Operation phase

During operation phase earthquakes and related phenomena (liquefaction) can have adverse effect on the gas infrastructure. Potentially hazardous areas will be detected mainly according to the vicinity of the active faults, potential liquefaction areas and areas with higher PGA values.

Soil

Construction phase

Construction phase assumes the impact on soil within the working strip during construction of the railway and stations and possible construction of temporary access roads which will be used to access the working strip. Major direct impact on soil is excavation of soil material and removal of topsoil (humus). Since the impact on soil from excavation is inevitable, measures for proper and temporary humus disposal as well as returning humus to the original surface will be prescribed.

The impact of soil erosion is possible in some places at steep terrains. In general, erosion can occur on sloping and bare terrain, where the vegetation cover was removed during construction work. For impact assessment purposes

the potential soil erosion location in width of working corridor will be determined, as well as measures to mitigate and prevent soil erosion will be prescribed.

Operation phase

Negative impact on the soil due to its permanent loss is expected. Permanent soil loss refers to the area of infrastructure belt (25 m on both sides of the railway line from the centre lines of the end tracks), save in the zone of the belt in the inhabited place (6 m on both sides of the railway line from the centre lines of the end tracks).

Agricultural land

Construction phase

Major and the most exacerbated direct impact on agricultural land is from excavation works during which cover vegetation or agricultural crops will be removed from agricultural land, in width of working corridor, during construction of railway, stations and possible construction of temporary access roads. For impact assessment purposes the location and types of the crops in width of working corridor, on location of stations, and temporary access roads will be determined.

Operation phase

During operation phase there will be a negative impact on the agricultural land on the area of railway corridor and stations due to its permanent loss. According to the Law on Railways ("Official Gazette of the RS", No 45/13 and 91/15) it is forbidden to build any structures except for the railway functions in the zone of 8 m from the last track axis (6 m in the urban zone) on both sides. Regarding the wider zone of 25 m (railway protection zone) from the last track axis on the both sides, it is for forbidden to build any structures except for railway function. Additionally, it defines the fire safety zone for forest land with a width of 18m from outer track and fro agricultural land with a width of 13 m from the outer track.

Landscape

Impacts on landscape can be described as changes in landscape features as well as for the landscape as a whole. Landscape features are all natural and anthropogenic elements in the area and landscape is theirs complex visual and functional relation.

For impact assessment purposes will be necessary to define the critical elements of the planned operation and then assess the nature of the impact of construction technology on landscape features of the area. In addition to direct physical impacts, such as excavation or embankment, indirect ones, such as visual presence of machinery or excavated materials, will be also treated.

Construction phase

Impacts on landscape characteristics will be divided in two groups:

- The physical impact zone is limited to the area covered by the planned intervention construction works, and the movement area of construction machinery. In this zone, all activities that cause damage or removal of valuable elements of the landscape such as forests, hedges, etc. will be determined.
- Visual impact area is defined with zones of primary and secondary visibility specified in more detail in the impact methodology during operation phase.

Operation phase

During the operation phase impacts can be reduced to a visual and experience sphere and change of landscape character.

Primary and secondary zone of theoretical visibility, mostly for railway structures, will be defined for the purpose of impact assessment. The relief, dominant surface cover, dominant weather conditions and average observer view height (about 1.6 m) will be considered for the definition of the zone. In the case of landscape without visual obstacles (vegetation, terrain and objects) the estimated distance of primary visibility is 2,000 m. Up to this distance, and without any visual obstacles in between, it is possible to clearly detect project elements. At distances between 2,000 m and 4,000 m is zone of secondary visibility. In this zone objects are visible, but in cases of minor haze or lack of ideal daylight, they are poorly expressed.

Effect of light elements of the railway elements on the night image of the space will be assessed.

Impacts on landscape character can be manifested as an assessment of the degree of landscape character change due to the existence of a planned operation. The acceptability of the landscape character change is evaluated in relation to the value of the landscape, the physical, visual, social and historical features of the space.

Biodiversity

Construction phase

Impact assessment on biodiversity features includes assessment of potential impacts on habitats, flora and fauna species and the priority biodiversity features that have been identified. They were chosen based on requirements of EBRD Performance Requirement 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources, general guidelines presented in Hardner et al. 2015, Gullison 2015, extensive desktop study of the project area and data collected from the relevant stakeholders.

The focus of impact assessment will be on priority biodiversity features (PBF) and critical habitats (CH) and this include:

- quality of habitats before the project construction works and their ability to support PBF/CH,
- importance of location for PBF/CH,
- how will construction work affect the PBF/CH,
- the characteristics of these impacts (temporary/permanent/duration/low/high…),
- how many individuals will be impacted and how will that reflect the whole population of the species,
- the affected surfaces and areas,
- cumulative effect.

The impact assessment will also include other biodiversity features that have general importance for habitats, flora and fauna, even though the impacts on the priority biodiversity features will be specially emphasized and elaborated.

Operation phase

Impact assessment on biodiversity features will include assessment of potential impacts on habitats, flora and fauna species and the priority biodiversity features that have been identified. They will be chosen based on requirements of EBRD Performance Requirement 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources, general guidelines presented in Hardner et al. 2015, Gullison 2015, extensive desktop study of the project area, field survey and data collected from the relevant stakeholders.

The focus of impact assessment will be on priority biodiversity features (PBF) and critical habitats (CH) and will include:

- quality of habitats after the project construction works and their ability to support PBF/CH,
- importance of location for PBF/CH,
- how will maintenance work affect the PBF/CH,
- the characteristics of these impacts (temporary/permanent/duration/low/high…),
- how many individuals will be impacted and how will that reflect the whole population of the species,
- the affected surfaces and areas,
- cumulative effect.

The impact assessment will also include other biodiversity features that have general importance for habitats, flora and fauna, even though the impacts on the priority biodiversity features will be specially emphasized and elaborated.

Protected areas

Construction phase

For impact assessment purposes the location and types of protected areas in the nearby vicinity of project area will be determined. To determine the potential impact of the project structures construction, analysis of characteristics of each identified protected area will be done.

Operation phase

For impact assessment purposes the location and types of protected areas in the nearby vicinity of project area will be determined. To determine the potential impact of the project structures operation, analysis of characteristics of each identified protected area will be done.

Air quality

Construction phase

During the project construction typical emissions are expected. Therefore, typical measures for mitigation of impacts on air quality are to be implemented.

Operation phase

If the trains will operate only using electricity, there are no significant emissions of air pollutants expected. If some trains will still use diesel or any other fossil fuel as power source, then some emissions of air pollutants will be emitted from their engines. These emissions are not expected to have significant impact as the trains are constantly moving so the air pollutants are quickly dispersed and the impacts on air quality are expected to be minimal.

Noise

Construction phase

Potential impacts will arise from several different sources during operation phases. The Project contribution to the local acoustic environment will be estimated through qualitative and quantitative analysis, identifying all the potential noise sources involved during the project construction phases. To estimate the impacts due to the Construction Phase, a noise qualitative assessment will be performed, considering all the potential noise sources involved in this specific project's phase. Construction noise is generally characterized by a variable and short-term duration. The impact of noise will be determined based on the combination of several characteristics such as impact magnitude, spatial and temporal size of the impact, environmental sensitivity, likelihood, and impact importance. These will be based upon experience and professional judgement.

Operation phase

Potential impacts will arise from several different sources during operation phases. The potential noise impact due to the Project will be assessed in accordance with national regulations as well as relevant and recognized international standards (e.g. World Bank/IFC and World Health Organisation). The magnitude of the noise impact will be evaluated and compared with in force international noise quality standards (IFC and WHO). A noise quantitative assessment will be performed in order to estimate the impact during the operation phase. All the potential noise sources will be assessed. Noise emissions will likely to be deriving from the operation of the railway itself. Analysis of noise impact caused by forecasted traffic volume on the railway section Belgrade-Niš will be determined using a software package CadnaA.

Noise indicators for noise prediction will be calculated. The provisional method for the calculation of noise indicators for railway traffic in Republic of Serbia is the Dutch national method SRM II - 19961, which is also recommended by the EU Directive 2002/49/EC. Use of the Dutch national method is defined by the Regulation on noise indicators, limit values, methods for assessing noise indicators, disturbing and harmful effects of noise in the environment (Official Gazette of RS No. 75/2010).

The noise impact analysis will be done based on the forecasted traffic volume in the last year of traffic analysis and in a zone of 200 meters left and right of the planned railway section.

As input for the preparation of an acoustic model in software CadnaA different parts of the preliminary design will be used, which includes 3D model of the terrain, technical and technological characteristics of the railway and rolling stock, volume of railway traffic, speed etc.

Analysed railway section Belgrade-Nis is divided into sections with different characteristics (number of trains, type of railway, speed limits, etc.).

Based on noise level obtained by means of an acoustic calculation, using the CadnaA software, within the Design of technical measures for environmental protection noise barriers (location, height, and length) and other noise protection measures will be defined. The impact of noise will be determined based on the combination of a number of characteristics such as impact magnitude, spatial and temporal size of the impact, environmental sensitivity, likelihood and impact importance. These will be based upon experience and professional judgement.

Waste management

Construction phase

- According to the type of the project and since different types of waste will be arising as products of construction activities planned during construction of railway, expected produced types of waste (waste streams) will be considered and defined in compliance with the Law on waste management (No. 68/2004 and 71/2004, last amended in 2011) and European waste catalogue.

- The different types of waste will be fully defined by the six-digit codes for the waste and the respective two-digit and four-digit chapter headings.
- In line with legal framework, the following steps will be taken to identify expected waste streams from the waste list:
- the source generating the waste will be searched in Chapters 01 to 12 or 17 to 20 of waste list to identify the appropriate six-digit code of the waste;
- If no appropriate waste code could be found in Chapters 01 to 12 or 17 to 20, the Chapters 13, 14 and 15 will be examined to identify the waste in accordance to guidance.
- Amounts of waste during construction works will be estimated by Project designer and given as an input for impact assessment, these amounts will be based on experience gained from similar projects and the status of project design.

Operation phase

that will be generated during the railway operation will be primarily food, paper and packaging waste, coming from passengers. Due to the railway maintenance, track maintenance waste and ancillary infrastructure waste can be expected along the route and their quantities will depend on the maintenance activity. Expected waste streams will be defined in compliance with Law on waste management and European waste catalogue by the six-digit codes for the waste and the respective two-digit and four-digit chapter headings.

In line with legal framework, the following steps will be taken to identify expected waste streams from the waste list:

- The source generating the waste will be searched in Chapters 01 to 12 or 17 to 20 of waste list to identify the appropriate six-digit code of the waste;
- If no appropriate waste code could be found in Chapters 01 to 12 or 17 to 20, the Chapters 13, 14 and 15 will be examined to identify the waste in accordance to guidance.

Potential environmental major accidents and unplanned events

Construction phase

Possible accidents during the construction phase of the project include:

- Contamination event – Pollution event leading to environmental damage to watercourses or groundwater, particularly associated with the potential release of silt to the aquatic environment,
- Traffic accidents - Leaks and accidental spills of fuel and lubricants from construction machinery and vehicles at construction site,
- Explosion / fire occurring at adjacent facility containing flammable / hazardous substances,
- Earthquake,
- Extreme weather events such as prolonged flooding resulting in sediment load runoff during construction, storm damage, snowstorm, wildfire.

Extreme weather events such as prolonged flooding resulting in sediment load runoff during construction, storm damage, snowstorm, wildfire accidents and unplanned events could occur mainly because of inadequate

implementation of occupational safety measures, non-compliance with traffic rules, restrictions applied at working site and improper handling of hazardous and flammable materials. The impact of potential environmental major accidents and unplanned events will be determined based on the combination of a number of characteristics such as impact magnitude, spatial and temporal size of the impact, environmental sensitivity, likelihood and impact importance. These will be based upon experience and professional judgement. Uncontrolled events are extraordinary, and the probability of their occurrence is reduced by careful execution of works during construction as well as by the application of necessary safety measures during traffic. In the event that an uncontrolled event does occur, negative impacts can be prevented or significantly reduced by applying prescribed procedures and timely intervention.

Operation phase

Possible accidents during the operation phase of the project include:

- Traffic accidents - Leaks and accidental spills of fuel and lubricants from the train,
- Contamination event – Pollution event from transport of dangerous goods could lead to environmental damage to watercourses or groundwater, particularly associated with the potential release to the aquatic environment,
- Explosion / fire,
- Earthquake,
- Extreme weather events such as prolonged flooding resulting in sediment load runoff during construction, storm damage, snowstorm, wildfire.

In case of uncontrolled event does occur, negative impacts can be prevented or significantly reduced by applying prescribed procedures and timely intervention. It is not possible to place the safety of rail transportation of dangerous goods in a time-space context because it largely depends on the condition and quality of the vehicles that transport dangerous goods, as well as on the human factor. By applying prescribed protection measures such as compliance with European agreements (RID) and national legislation and its by-laws, and by hiring authorized companies to eliminate the consequences of sudden water pollution in the event of serious or very serious pollution, possible negative impacts are reduced to an acceptable level.

The impact of potential environmental major accidents and unplanned events will be determined based on the combination of a number of characteristics such as impact magnitude, spatial and temporal size of the impact, environmental sensitivity, likelihood and impact importance. These will be based upon experience and professional judgement.

10.4.7. Mitigation Measures and Recommendations

Mitigation measures are actions taken to avoid or minimise negative environmental or social impacts. Mitigation measures should be clearly identified and linked to the Environmental and Social Management Plan (ESMP).

Once evaluated, the potential impacts should be dealt with a mitigation strategy, which will aim at minimizing and reducing the likely adverse effects and, whenever possible, enhancing the positive environmental effects of the project.

The principles of mitigation, including their hierarchical setup, would follow four steps:

- Preference for avoidance and prevention,
- Cancellation,
- Mitigation,
- Remedial/Compensation.

Table below outlines the hierarchy of mitigation strategy.

Table 79. Hierarchy of mitigation strategy[85]

Hierarchy of mitigation strategy	
Avoidance measures	These are intended to stop or prevent effects from occurring, or to eliminate (completely remove or get rid of) the risk of them occurring, perhaps by relocating a project away from a sensitive area, or removing from a project the element that may cause an adverse effect. Successful avoidance measures mean there will be no adverse effect.
Cancellation measures	Are intended to completely neutralize or fully negate the adverse nature of effects. There will be an effect, but its negative outcomes will be cancelled out.
Mitigation/reduction measures	Mitigation measures aim to make effects smaller or less in amount, degree, size or likelihood, either by reducing the effect itself, or the likelihood of it occurring, or both. These measures may so reduce the adversity of the effect, or they become so unlikely, that they are no longer of concern. There will, nevertheless, be a residual effect, it may be necessary to check that the residual effects of one proposed change do not exacerbate the effects of

[85] *Adopted from "Environmental Impact Assessment Handbook". Scottish Natural Heritage. 2018*

Hierarchy of mitigation strategy	
	others, by way of cumulative, combined or synergistic processes.
Remedial/Compensation	In environmental assessment these measures are only taken into account after a decision has been made. They are intended to at least try to recompense, or otherwise make up for, or off-set, the adverse effects of a proposed change that could or would occur and would be of concern. Thus, an important negative effect is anticipated and environmental loss or harm is likely to occur. However, it has been decided that the project should nevertheless go ahead, and the compensatory measures try to make amends. The objective should be that the recompense is made in time to make good the environmental benefit or function that would be affected.

10.4.8. Monitoring and Follow-Up

Once the ESIA has been completed, monitoring and follow-up actions should be completed to:

- Continue the collection of baseline data throughout construction and operation;
- Evaluate the success of mitigation measures, or compliance with Project standards or requirements;
- Assess whether there are impacts occurring that were not previously predicted; and
- In some cases, it may be appropriate to involve local communities in monitoring efforts through participatory monitoring. In all cases, the collection of monitoring data and the dissemination of monitoring results should be transparent and made available to interested Project stakeholders.

Monitoring recommendations outlined in the ESIA will be carried through to the ESMP.

10.4.9. Residual Impacts

Those impacts that remain once mitigation has been put in place will be described as residual impacts.

10.4.10. Cumulative Impacts

Cumulative impacts are changes to the environment that are caused by an action in combination with other past, present and future human actions. The assessment of these effects is called a cumulative impact assessment (CIA).

The resulting significance determination is an illustration of how multiple effects can lead to an increased residual effect compared to looking at effects in isolation. Residential receptors in the vicinity during the construction phase

may see adverse effects from noise and vibration due to construction activities, moderate adverse effects from social due to interruption of access to utilities, less adverse effects on air quality from construction activities and minor adverse effects from landscape and visual due to views on construction objects. It can be determined that these effects, when combined and acting on the same receptor, can degrade the ability of the receptor to absorb further effects and increase the effect on said receptor, which would not be the case if the effects occurred in isolation. The determination of the interaction effect in this case can be concluded as moderate adverse. There is a notable enhanced effect, and in this case the cumulative effect would be significant, because it is an increase of significant effects on the same receptor.

Cumulative impacts assessments will be included in the ESIA and may include considerations of interactions between the associated facilities.

10.4.11. Environmental and Social Management Plan (ESMP)

An Environmental and Social Management Plan (ESMP) summarises the mitigation and monitoring measures that should be employed during construction and operation for the Project. The ESMP will summarise the Developer's commitments to address, mitigate and monitor risks and impacts identified as part of the ESIA, through avoidance, minimisation and compensation/offset.

The ESMP will also ensure that all relevant stages of the project are structured to meet applicable laws and regulatory requirements. Where relevant, the ESMP will also cover management of third party and supply chain issues. The ESMP will:

- Include a monitoring plan aimed at tracking actions specified in the ESMP,
- Performance indicators linked to significant environmental and social impacts,
- Any regulatory monitoring and reporting requirements,
- Specify the roles and responsibilities for implementation of the actions contained therein as well as for regular update of the ESMP,
- Specify any training or capacity-building required to ensure that personnel tasked with implementing the ESMP have the necessary awareness and skills to execute these functions effectively.

10.5. Proposed Structure of the ESIA Report

The ESIA will include the following:

- Review of relevant local, regional, and national environmental and social laws and regulatory requirements of the jurisdictions in which the Project will operate, including those laws implementing Serbia's obligations under international law. The ESIA will review the Project's compliance to relevant requirements, alongside the status of any material permits or authorisations needed.

- Project description, including alternatives considered and discussed with stakeholders (including potentially affected communities) and information on related operations and activities.
- Analysis of the physical, biological, and socio-economic environment likely to be affected by the Project for both the construction and operational phases. The baseline assessment will consider the interrelationship between relevant factors, as well as the exposure, vulnerability, and resilience of these factors to natural and manmade risks.
- Analysis of the likely impacts of the Project on the physical, biological, and socio-economic environment, which should identify and characterize its potential E&S beneficial and adverse impacts. It will be structured to include all relevant stages of the Project's lifecycle, e.g. pre-construction, construction, operation and maintenance, closure and residual E&S impacts. The level of analysis and reporting will be commensurate with the risk magnitude of the issues identified while mitigation measures will be proposed using the mitigation hierarchy.

The summary headings in the ESIA report are provided in the table below.

Table 80. Summary headings in the ESIA report

Section	Summary of Contents
Non-Technical Summary	Provides a Non-Technical Summary (NTS) for the ESIA.
Introduction	The Introduction will include: General background (also including information of Developer) Project objectives and scope Project history Existing studies
Legal framework	Legislation will include: Environmental Law and other relevant national legislation Permits and licences International Standards/Guidelines
Project Description	The Project Description will include: Project design (alignment-permanent way, stations, structures, other) Project schedule Description of construction and operation activities Description of the key role players and purpose of the ESIA study and report.
Evaluation of alternatives	Evaluation of alternatives will include: General methodology Summarized presentation of the MCA Environmental and social evaluation of options Environmental and social evaluation of options, including the no project alternative.
ESIA Methodology	ESIA methodology will include: Introduction to ESIA Baseline environmental and socio economic conditions Spatial and temporary scope Key assumptions and impact assessment methodology Impact identification

Section	Summary of Contents
	Cumulative impacts
ENVIRONMENTAL PARAMETERS	
Noise and vibration, air quality, climate change, geology, soils and hydrogeology, agriculture land landscape and visual, surface and groundwaters waters, ecology , biodiversity, protected areas, waste	Per parameter will include: Baseline conditions Potential impacts Mitigation measures Residual impacts Monitoring
SOCIO ECONOMIC BASELINE;	Description of the affected communities, including population and demographics data, economic activity and employment, education and health, community infrastructure, land use and property, as well as any other topics relevant for the impact assessment.
SOCIO ECONOMIC IMPACTS AND MITIGATION MEASURES	Impacts will be considered for the construction and operation phase, including but not limited to: Land use, land acquisition, physical and economic displacement Community severance and loss of access Access to infrastructure and utilities Employment and procurement opportunities Labour and working conditions, Community health safety and security
Stakeholder Engagement Plan (SEP) Annex	Presentation of stakeholder engagement activities carried out during the ESIA development phase and how feedback has been incorporated in the design as well as impact assessment and development of mitigation measures. The SEP Annex will also provide guidelines for engagement with relevant stakeholders at the time of the ESIA disclosure and during construction and operation phases.
Environmental and Social Management Plans (ESMP)	Develop an Environmental and Social Management Plan as a part of the ESIA.

10.6. Timeline for the ESIA

Task	
Belgrade – Niš	
Preparation of Environmental Impact Assessment (EIA)	
EIA preparation according to current LCs	May 2024 – October 2024
Approved Spatial Plan	October 2024 – 1st week of November 2024
Location conditions	October 2024 – 3rd week of November 2024
Location conditions received	November 2024 – December 2024

Implementation of locaton conditons	One month after Lc received
Scoping report	February 2025
Decision on Scope of EIA	1st week of March 2025
EIA process begining	2nd week of March 2025
EIA process	3rd week of March 2025–2nd week of June 2025
Decision on accepting of EIA Study	3rd week of June 2025
SECTION 1 Belgrade - Velika Plana	
Preparation of Environmental and Social Impact Assessment study (ESIA)	
Scoping Report - draft	July 2024 -August 2024
Scoping Report - final	August 2024 – 3rd week
Scoping Report - submission	August 2024 – 4th week
Biodiversity surveys – winter	DONE
Biodiversity surveys – spring	DONE
Biodiversity surveys - summer	July 2023
Biodiversity surveys - autumn	September 2023 – October 2023
Preparation of Biodiversity Action Plan (BAP)	2nd week of October 2023–1st week of December 2023
BAP draft	2nd-4th week of December 2023
BAP final	1st week of January 2024
Field survays	April-May 2024
Field survays - reports	June 2024
Site visits and stakeholder engagement activities	June 2024–November 2024
ESIA	November 2023–December 2024
EBRD Approval	2nd week December 2024–2nd week of February 2025
ESIA update package final submission	3rd week of February 2025
ESIA disclousure	4th week of February 2025–3rd week of June 2025
Update ESIA following PC? - PC report	4th week of June 2025–1st week of July 2025
TENDER	1st week of June 2025–4th week of August 2025
SECTION 2 Velika Plana - Paraćin	
Preparation of Environmental and Social Impact Assessment study (ESIA)	
Scoping Report - draft	June 2023 – July 2023
Scoping Report - final	July 2023 – 4thweek
Scoping Report - submission	August 2024 – 1st week
Biodiversity surveys - winter	DONE
Biodiversity surveys	DONE
Biodiversity surveys - summer	July 2023
Biodiversity surveys - autumn	September 2023 – October 2023
Preparation of Biodiversity Action Plan (BAP)	2nd week of October 2023–1st week of December 2023
BAP draft	2nd-4th week of December 2023
BAP final	1st week of January 2024
Field surveys	September, October, November 2023
Field surveys - reports	December 2023–January 2024
Site visits and stakeholder engagement activities	November 2023–April 2024
ESIA	July 2023–May 2024
EBRD Approval	1st week of June 2024–4th week of July 2024

ESIA update package final submission	1st and 2nd week of August 2024
ESIA disclousure	3rd week of August 2024–2nd week of December 2024
Update ESIA following PC? - PC report	3rd and 4th week of December 2024
TENDER	2nd week of October 2024–2nd week of January 2025
SECTION 3 Paraćin - Niš (Trupale)	
Preparation of Environmental and Social Impact Assessment study (ESIA)	
Scoping Report - draft	April 2023–June 2023
Scoping Report - final	2nd week of July 2023
Scoping Report - submission	3rd week of July 2023
Biodiversity surveys - winter	DONE
Biodiversity surveys – spring	DONE
Biodiversity surveys - summer	July 2023
Biodiversity surveys - autumn	September 2023–October 2023
Preparation of Biodiversity Action Plan (BAP)	2nd week of October 2023–1st week of December 2023
BAP draft	2nd-4th week of December 2023
BAP final	1st week of January 2024
Field surveys	September, October, November 2023
Field surveys - reports	December 2023–January 2024
ESIA	May 2023–June 2024
Site visits and stakeholder engagement activities	November 2023–April 2024
EBRD Approval	1st week of June 2024–4th week of July 2024
ESIA update package final submission	1st and 2nd week of August 2024
ESIA disclousure	3rd week of August 2024–2nd week of December 2024
Update ESIA following PC? - PC report	3rd and 4th week of December 2024
TENDER	2nd week of October 2024–2nd week of January 2025

REFERENCES LIST:

1. Adopted from “Environmental Impact Assessment Handbook”. Scottish Natural Heritage. 2018
2. Biodiversity of Serbia, Institute for Nature Conservation of the Republic of Serbia, Belgrade, 2012 (in Serbian) (Biodiverzitet Srbije, stanje i perspektive, Zavod za zaštitu prirode Srbije, Beograd, 2012)
3. Čađo, S., Denić, Lj., Dopuđa-Glišić, T., Đurković, A., Novaković, B., Stojanović, Z., Žarić, D. (2021). Status of surface waters of Serbia during the period 2017–2019. Ministry of Environmental Protection, Environmental Protection Agency.
4. Climate Regionalization of Serbia According to Köppen Climate Classification, https://doi.org/10.2298/IJGI1702103M
5. CORINE land cover of the area; EUNIS habitat type map of the area
6. Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment
7. Environmental impact assessment study, Reconstruction and modernization of the Velika Plana - Niš railway

8. Environmental Impact Assessment Study, Reconstruction and Modernization of the Velika Plana - Niš Railway, Environmental Protection Agency, Annual report on the state of air quality in the Republic of Serbia

9. Environmental Protection Agency of the Republic of Serbia

10. Filipović, B., Krunić, O., & Lazić, M. (2005). Regional hydrogeology of Serbia. Belgrade: University of Belgrade, Faculty of Mining and Geology

11. Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

12. http://www.sepa.gov.rs/index.php?menu=319&id=14&akcija=showXlinked_filters&tema=Vazduh&godina=2020

13. https://balkangreenenergynews.com/

14. https://nasledje.gov.rs/index.cfm?jezik=Serbian_CIR

15. Institute for Nature Conservation of Serbia

16. Integrated Biodiversity Assessment Tool IBAT, International Union for Conservation of Nature - IUCN Red List, Birdlife Data Zone

17. Law on Environmental Protection ("Official Gazette of RS" no. 135/2004, 36/2009, 36/2009 - other law, 72/2009 - other law, 43/2011 - US decision, 14/2016, 76 /2018, 95/2018-second law and 95/2018-second law)

18. Law on Nature Protection ("Official Gazette of the RS", No. 36/2009, 88/2010, 91/2010 – corr., 14/2016 and 71/21)

19. Law on waste management ("Official Gazette of RS", no. 36/09, 88/10, 14/16 and 95/2018 - other laws)

20. Matvejev, S.D. (1950): Distribution and life of birds in Serbia. SASA, Belgrade (in Serbian)

21. Matvejev, S.D. (1950): Distribution and life of birds in Serbia. SASA, Belgrade (in Serbian).

22. Milanović, S., Stevanović, Z., Đurić, D., Petrović, T., Milovanović, M., Mandić, M. (2011). Project: Monitoring of groundwater resources Srbije. Subproject: Creation of a map of the risk of groundwater in Serbia. https://geoliss.mre.gov.rs/prez/KartaUgrPodVodWeb/index.html

23. Ministry of Environmental Protection, Results of surface and underground water quality monitoring in 2020, 2021.

24. Nature Conservation Strategy of the Republic of Serbia, Nature Conservation Programs of the autonomous province and local government units and State of Nature Reports

25. Official Gazette of RS", No. 50/12

26. Official Gazette of the FRY No. 29/1996, RS No. 101/2005, 103/2012

27. Official Gazette of the RS 09/2020

28. Official Gazette of the RS 53/95, 16/01 – Federal Constitutional Court decision, 20/09, 55/13 – Constitutional Court decision and 106/16)

29. Official Gazette of the RS No. 120/2004, 54/2007, 104/2009, 36/2010

30. Official Gazette of the RS No. 125/2004, 104/2009, 50/2018

31. Official Gazette of the RS No. 22/2009, 52/2021

32. Official Gazette of the RS No. 24/2005, 61/2005, 54/2009, 32/2013, 75/2014, 13/2017, 113/2017 and 95/2018

33. Official Gazette of the RS No. 32/2019

34. Official Gazette of the RS No. 34/2003, 64/2004, 84/2004, 85/2005, 101/2005, 63/2006, 05/2009, 107/2009, 101/2010, 93/2012, 62/2013, 108/2013, 75/2014, 142/2014, 73/2018, 46/2019, 86/2019

35. Official Gazette of the RS No. 52/2021

36. Official Gazette of the RS No. 69/2005

37. Official Gazette of the RS No. 98/2006

38. Protić, D. (1995). Mineral and thermal waters of Serbia. Belgrade: Geoinstitut.

39. Register of Seveso Plants in the Territory of the RoS, Ministry Of Environmental Protection, Sector for Environmental Management, Department for Protection against Major Chemical Accidents, Belgrade, 2023.

40. Report on the State of the Environment in RoS in 2020, Ministry of Environmental Protection, Belgrade, 2021

41. Report on waste management in the RoS for the period 2011 - 2021, Ministry of Environmental Protection, Belgrade, 2022.

42. Republic Hydrometeorological Institute of Serbia, https://www.hidmet.gov.rs/

43. Republic Hydrometeorological Institute of Serbia, Hydrological yearbooks, Groundwaters 2017-2021, https://www.hidmet.gov.rs/

44. Republic Hydrometeorological Institute, Determination of the relative fraction of wind speed by direction for the Kragujevac meteorological station, https://www.hidmet.gov.rs/ciril/meteorologija/stanica_sr_kragujevac.php

45. Republic Hydrometeorological Institute, Determination of the relative fraction of wind speed by direction for the Kragujevac meteorological station, tps://www.hidmet.gov.rs/ciril/meteorologija/stanica_sr_kragujevac.php

46. Republic Hydrometeorological Institute, Meteorological yearbook for the period 2000-2020. year

47. Rulebook on the content of the Accident Prevention Policy and the content and methodology of the preparation of the Safety Report and Accident Protection Plan ("Official Gazette of RS", no. 41/2010, 51/2015 and 50/2018)

48. Rulebook on the method of determining and maintaining sanitary protection zones of water supply sources, "Official Gazette of RS", no. 92/2008

49. Specific plan for the implementation of the EU Directive 1999/31/EC on landfills

50. Status Report of land in the Republic of Serbia for 2016-2017, www.sepa.gov.rs

51. Stevanović V. and Vasić V. (Eds.) (1995): Biodiversity of Yugoslavia with an overview of species of international importance. Faculty of the biology of the University of Belgrade.

52. Stojadinović, D. (1992) Hydrogeological characteristics of alluvial deposits and rims of Great Morava from the perspective of the possibility of using spring water (Doctoral dissertation). Belgrade: University of Belgrade, Faculty of Mining and Geology.

53. Study of Flood Prone Areas in Serbia - Phase 1 & Phase 2

54. Vasiljević, B. (2017). Benthic silicate algae (Bacillariophyta) in the assessment of the ecological status of the Great Morava and Sava rivers (doctoral dissertation). Kragujevac: University of Kragujevac, Faculty of Science.

55. Vollhofer, O., Dimkić, M., Stevanović, Z., & Đurić, D. (2012). Chapter 2.10: Groundwater management in individual countries. In: Dimkić, M., Brauch, H. J., & Kavanaugh, M. (Ed.), Groundwater Management in Large River Basins (pp.87-109). Belgrade: Jaroslav Černi Institute for Water Management.

56. Vujisić, T., Kalenić, M., Navala, M., & Lončarević, Č. (1977b). Interpreter for the Lapovo paper, L 34-139. Belgrade: Federal Geological Institute.

57. Waste management program in the Republic of Serbia for the period 2022 - 2031 ("Official Gazette of RS", number 30/18) p. 22

APPENDIX 1

TOR FOR BASELINE SURVEYS

SOIL MONITORING PLAN IN THE CORRIDOR OF RAILWAY 102, BELGRADE–NIŠ, SECTION II VELIKA PLANA–PARAĆIN

REQUIREMENTS FOR MEASURING SOIL QUALITY

Soil quality testing is carried out in accordance with:

- The Law on Environmental Protection (“Official Gazette of RS", no. 135/04, 36/09-dr. law, 72/09-another law, 43/11 - US decision, 14/16, 76/18 and 94/18 - another the law),
- The Law on Land Protection ("Official Gazette of RS", no.. 112/15),
- The Law on Agricultural Land ("Official Gazette of RS", no. 62/06, 65/08-another law, 41/09, 112/15, 80/17 и 95/18 – another law),
- Rulebook on permitted amounts of hazardous and harmful substances in soil and irrigation water and their testing methods (“Official Gazette of RS ”, no. 23/94),
- Regulations on systematic monitoring of soil condition and quality (“Official Gazette of RS”, no. 88/20),

- Regulations on limit values of polluting substances, harmful and dangerous substances in the soil ("Official Gazette of RS", no. 30/18 и 64/19).

Sampling and analysis of soil quality must be carried out by an accredited and authorized soil quality testing laboratory by the competent Ministry of Environmental Protection, in accordance with current standards and using accredited methods.

MEASURING EQUIPMENT

The laboratory hired for soil quality testing must have at its disposal correct and calibrated instruments for soil quality sampling and analysis. The evidence for this is the valid Calibration Certificates issued by accredited equipment calibration laboratories.

MEASURING PLACES

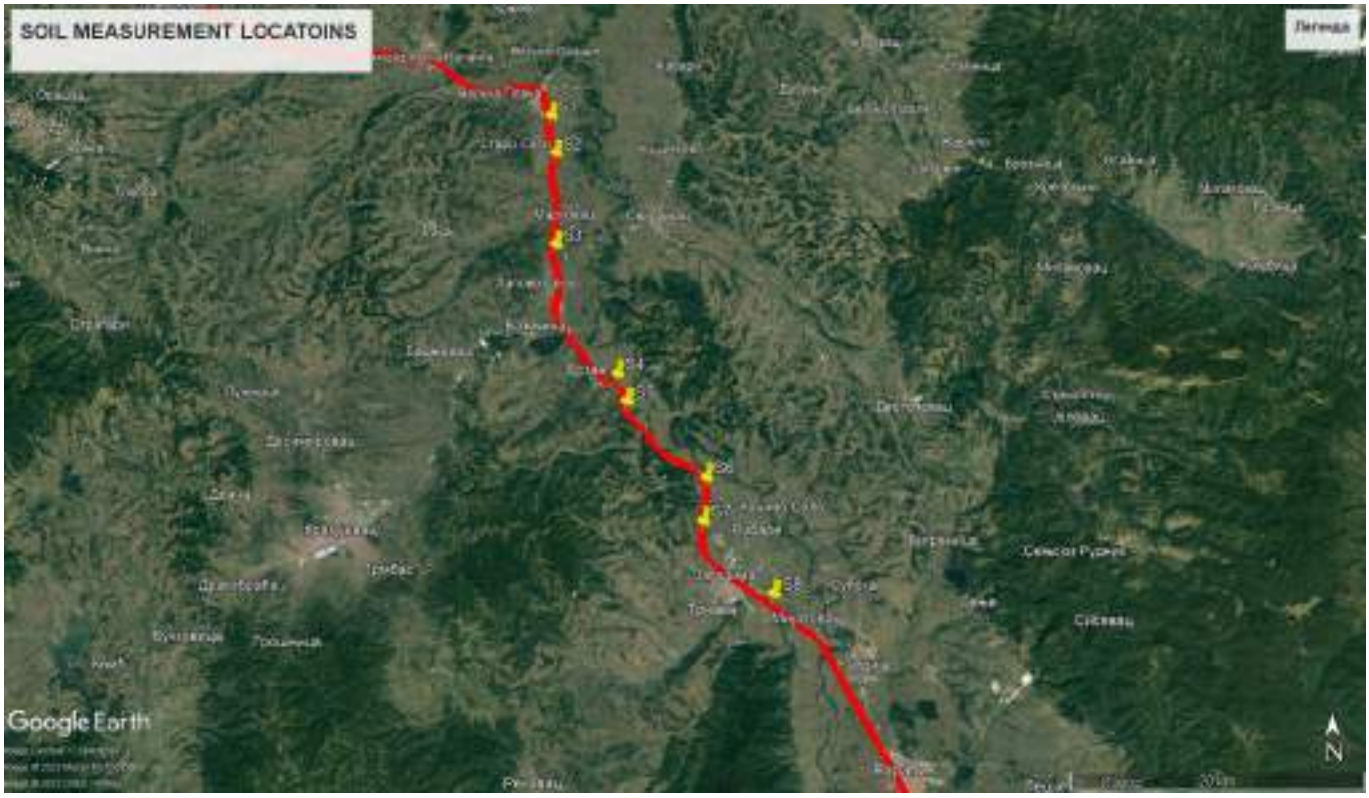
Soil quality testing should be conducted near the settlements, agricultural land, water supply sources, ecological corridors and in locations where activities that may affect soil quality are planned, or in places near works where there may be a possible risk of contamination.

Soil quality testing should be carried out by taking a composite soil sample within the narrow protection zone of the railway corridor (infrastructural strip on both sides of the railway with a width of 25 m from the axis of the end track, which functionally serves for the use, maintenance and technological development of infrastructure capacity) at a depth of 0 .0 to 0.3 m.

Soil sampling should be carried out in at least eight locations:

- In the zone of agricultural land near the local ecological corridor – Velika Plana,
- In the zone of agricultural land near the local ecological corridor – Lapovo
- In the zone of agricultural land near the local ecological corridor – Miloševo
- In the zone of agricultural land near the local ecological corridor – Bagrdan
- In the zone of agricultural land near the local ecological corridor – Lanište
- In the zone of agricultural land near the local ecological corridor – Jagodina
- In the zone of agricultural land near the local ecological corridor – area between Jagodina and Gilje

(a)


SOIL MEASUREMENT LOCATOINS
Google Earth

(b)


SOIL MEASUREMENT LOCATOINS
Google Earth

(c)


SOIL MEASUREMENT LOCATOINS
Google Earth

(d)


SOIL MEASUREMENT LOCATOINS
Google Earth

(e)


SOIL MEASUREMENT LOCATOINS
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(f)


SOIL MEASUREMENT LOCATOINS
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(g)


SOIL MEASUREMENT LOCATOINS
Google Earth

(h)


SOIL MEASUREMENT LOCATOINS
Google Earth

(i)

Figure 49a–i. Locations of soil sampling

TESTED PARAMETERS

In order to analyze the impact of existing railway traffic on soil quality, it is necessary to analyze the following parameters in soil samples: mineral oils, pH value, moisture percentage, metal content (arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), zinc (Zn), cobalt (Co), molybdenum (Mo), antimony (Cb)), polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), volatile organic substances, content of organic matter, granulometric composition.

REPORTING

Based on the measurements carried out by an accredited and authorized laboratory, a soil quality test report is issued in accordance with the requirements of the Accreditation Body of Serbia (ATS) and the Regulation on limit values of polluting, harmful and dangerous substances in soil („Official Gazette of RS“. no 30/18 and 64/19).

The report should contain the following as contents:

- Introduction (time, place, purpose of monitoring and testing)
- Brief explanation of the client and activity
- Monitoring parameters
- Description of used instruments and equipment for sampling and testing
- Interpretation/comments on results

- Suggestions
- Annexes
- Sampling analysis results
- Photo essays
- Monitoring points map

The report should be submitted in Serbian and English language.

SURFACE WATER MONITORING PLAN IN THE CORRIDOR OF RAILWAY 102, BELGRADE–NIŠ, SECTION II VELIKA PLANA–PARAĆIN

Surface water quality testing is conducted in accordance with:

- Law on Environmental Protection ("Official Gazette of RS", no. 135/04 and 36/09, 36/09-another law, 72/09-another law, 43/11- Decision US, 14/16, 76/18 и 94/18- another law),
- Water Law ("Official Gazette of RS", no. 30/10, 93/12, 101/16 and 95/18),
- Regulations on limit values of polluting substances in surface and underground waters and sediment and deadlines for reaching them ("Official Gazette of RS", no. 50/12, ("Official Gazette of RS", no. 50/2012, attachment 1, tables 1, 2 and 3).

Sampling and analysis of surface water quality must be carried out by an accredited and authorized surface water testing laboratory by the competent Ministry of Environmental Protection, in accordance with current standards and using accredited methods.

MEASURING EQUIPEMENT

The laboratory hired for surface water testing must have at its disposal correct and calibrated instruments for sampling and analysis of surface water quality. The evidence for this is the valid Calibration Certificates issued by accredited equipment calibration laboratories.

MEASURING PLACES

Determination of the physical and chemical parameters of the water as well as the assessment of the ecological status of the investigated localities will be carried out by taking 3 samples (on the location of bridge construction/reconstruction - upstream of both riverbanks, and one sample downstream) at each suggested location:

- River Rača near Markovac
- River Lepenica near Batočina
- River Great Morava near Bagrdan
- River Osaonica near Bagrdan
- River Belica near Jagodina

- River Lugomir near Jagodina
- River Great Morava near Ćuprija

b)

c)


SURFACE WATER MEASUREMENT LOCATOINS

d)


SURFACE WATER MEASUREMENT LOCATOINS
Google Earth

e)


SURFACE WATER MEASUREMENT LOCATOINS
Google Earth

f)


SURFACE WATER MEASUREMENT LOCATOINS

g)

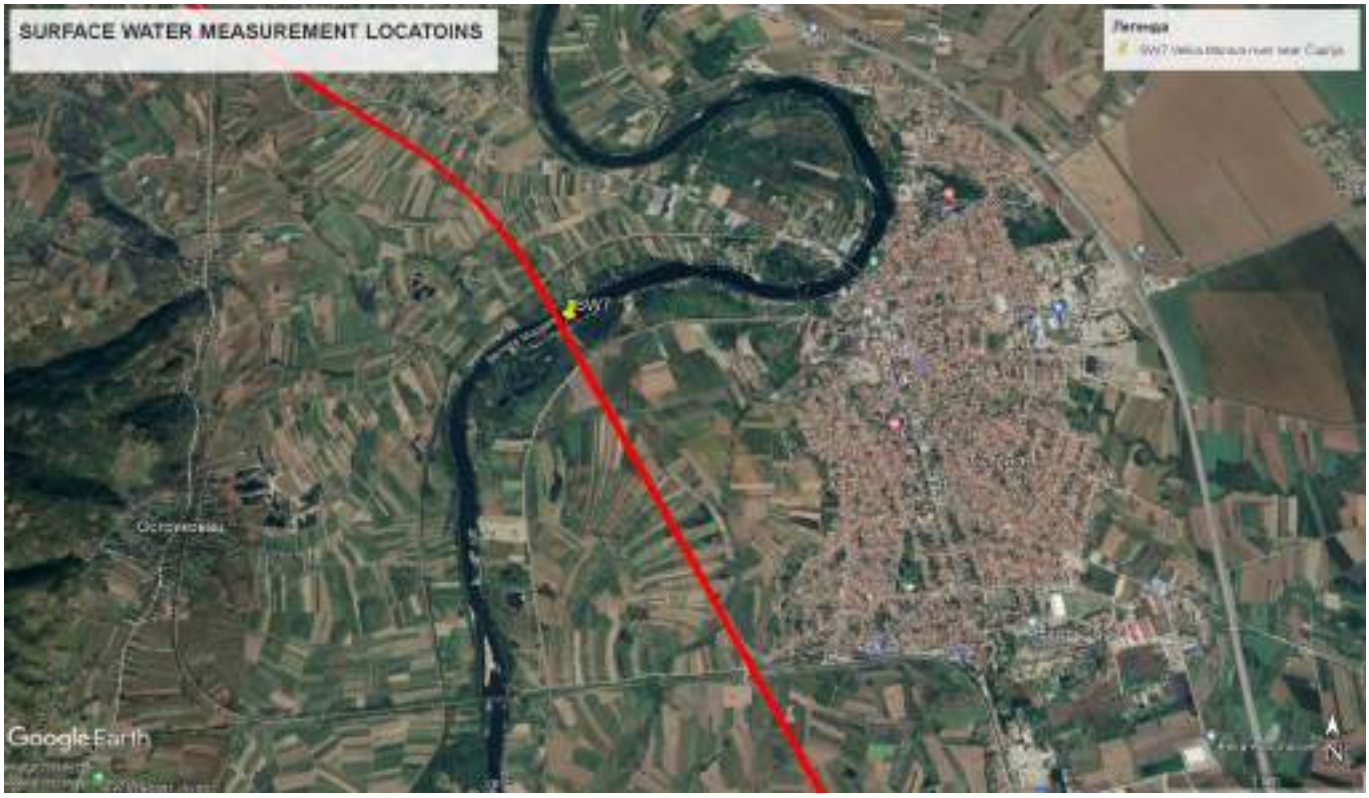

Figure 50a–g. Locations of surface water measurements

TESTED PARAMETERS

In order to analyze the quality of the surface waters of watercourses that intersect with the railroad, it is necessary to test the following parameters: Air temperature, Water temperature, Visible waste matter, pH value, Electrical conductivity, Ammonium ion (NH_4-N), Total nitrogen, Total organic carbon (TOC), Suspended matter, Nitrites, Nitrates, Sulfates, Chlorides, Total mineralization, Surfactants , Phenols (phenolic index), Chemical oxygen consumption (COD), Biochem. oxygen consumption (BOD_5), Arsenic, Boron, Manganese (total), Copper, Chromium (total), Zinc, Iron (total), Total phosphorus, Orthophosphates, Dissolved oxygen, Total coliforms in 100 ml, Faecal coliforms in 100 ml, Intestinal enterococci in 100 ml, Number of aerobic heterotrophs in 100 ml.

REPORTING

Based on the measurements carried out by the accredited and authorized laboratory, a Report on the quality of surface water is issued in accordance with the requirements of the Accreditation Body of Serbia (ATS) and the

Regulation on limit values of pollutants in surface and underground waters and sediment and deadlines for their achievement ("Official Gazette of RS ", br. 50/12, attachment 1, tables 1, 2 and 3).

The report should contain the following as contents:

- Introduction (time, place, purpose of monitoring and testing)
- Brief explanation of the client and activity
- Monitoring parameters
- Description of used instruments and equipment for sampling and testing
- Interpretation/comments on results and conclusions
- Suggestions
- Annexes
- Sampling analysis results
- Photo essays
- Monitoring points map

The report should be submitted in Serbian and English language.

GROUNDWATER MONITORING PLAN IN THE CORRIDOR OF RAILWAY 102, BELGRADE–NIŠ, SECTION II VELIKA PLANA–PARAĆIN

REQUIREMENTS FOR MEASURING GROUNDWATER QUALITY

Groundwater quality testing is conducted in accordance with:

- The Law on Environmental Protection (“Official Gazette of RS”, no. 135/04 and 36/09, 36/09- another law, 72/09- another law, 43/11- Decision US, 14/16, 76/18 and 94/18- another law),
- Water Law ("Official Gazette of RS ", no. 30/10, 93/12, 101/16 and 95/18),
- Regulation on limit values of polluting, harmful and dangerous substances in the soil, Appendix 2: remediation values of polluting, harmful and dangerous substances in the aquifer ("Official Gazette of RS", no. 30/18 and 64/19),
- Regulation on limit values of pollutants in surface and groundwaters and sediment and deadlines for reaching them, Annex 2, Groundwater, Table 1, limit values of pollutants in groundwater (“Official Gazette of RS”, no. 50/12).

Sampling and analysis of groundwater quality must be performed by an accredited and authorized laboratory for groundwater testing by the competent Ministry of Environmental Protection, in accordance with valid standards and using accredited methods.

MEASURING EQUIPEMENT

The laboratory hired for groundwater testing must have at its disposal correct and calibrated instruments for sampling and analysis of groundwater quality. The evidence for this is the valid Calibration Certificates issued by accredited equipment calibration laboratories.

LOCATIONS

Groundwater quality testing should be performed by taking samples from piezometers in sanitary protection zones installed for purposes of water supply of municipalities along the railway line. Suggestion is to take samples from two piezometers (highlighted locations if possible) at each groundwater source.

Groundwater source:

- "Livade"

Well	x	y
B-4	4 909 553	7 507 983
mB-5	4 909 546	7 508 084
B-7	4 909 749	7 508 067
B-8	4 909 452	7 508 099
B-9	4 909 572	7 508 204
B-10	4 909 641	7 508 326
B-11	4 909 501	7 508 350
B-12	4 909 327	7 508 383
B-13	4 909 362	7 508 607
B-14	4 909 686	7 508 552

- "Sto posto"

Well	x	y
1	4 907 830	7 506 810

- "Garevina"

Well	x	y
B-2'	4 891 172	7 509 398
B-3	4 891 284	7 509 330
B-4	4 891 288	7 509 315
B-5	4 891 114	7 509 129
B-5'	4 891 088	7 509 124
B-9	4 891 330	7 509 642
B-10	4 891 085	7 509 541
B-11	4 891 092	7 509 618

- "Yuhor"

Well	x	y
B-1	4 869 808	7 523 936
B-2	4 869 657	7 523 825
B-3	4 869 784	7 523 588

REPORTING

Based on the measurements, a report on the quality of groundwater is issued in accordance with the requirements of the Accreditation Body of Serbia (ATS), the Regulation on limit values of polluting, harmful and hazardous substances in the soil, Annex 2: remediation values of polluting, harmful and hazardous substances in aquifer ("Official Gazette of RS", no. 30/18 and 64/19) and the Regulation on limit values of pollutants in surface and underground waters and sediment and deadlines for reaching them, Annex 2, Groundwater, Table 1, limit values of pollutants in groundwater ("Official Gazette of RS", No. 50/12).

The report should contain the following as contents:

- Introduction (time, place, purpose of monitoring and testing)
- Brief explanation of the client and activity
- Monitoring parameters
- Description of used instruments and equipment for sampling and testing
- Interpretation/comments on results
- Suggestions
- Annexes
  - Sampling analysis results
  - Photo essays
  - Monitoring points map

The report should be submitted in Serbian and English language.

AIR QUALITY MONITORING PLAN IN THE CORRIDOR OF RAILWAY 102, BELGRADE–NIŠ, SECTION II VELIKA PLANA–PARAĆIN

REQUIREMENTS FOR MEASURING AIR QUALITY

All air quality measurements must be carried out in accordance with the legislation of the Republic of Serbia - Regulation on conditions for monitoring and air quality requirements (“Official Gazette of RS ”, no. 11/10, 75/10 and 63/13).

In any case, when measuring air quality, the following conditions must be met:

- Measurements are carried out by an accredited air quality testing laboratory authorized by the competent Ministry.
- Measurements should be carried out during regular traffic
- The measurement should be continuous for at least 24 hours in a 5 day interval.
- Measurements should be carried out in an open area near populated areas. Before measuring, it is necessary to obtain a permit for setting up the measuring equipment, as well as the power connection.

MEASURING EQUIPEMENT

Instruments for measuring air quality must be correct and calibrated by accredited laboratories for calibration of equipment.

LOCATIONS

Air quality measurements must be carried out in:

- Velika Plana (AQ1),
- Markovac (AQ2),
- Lapovo (AQ3),
- Novo Lanište (AQ4),
- Jagodina (AQ5),
- Ćuprija (AQ6).

The exact location of the measuring instrument will be determined on site depending on local conditions and available resources (power source, etc.).

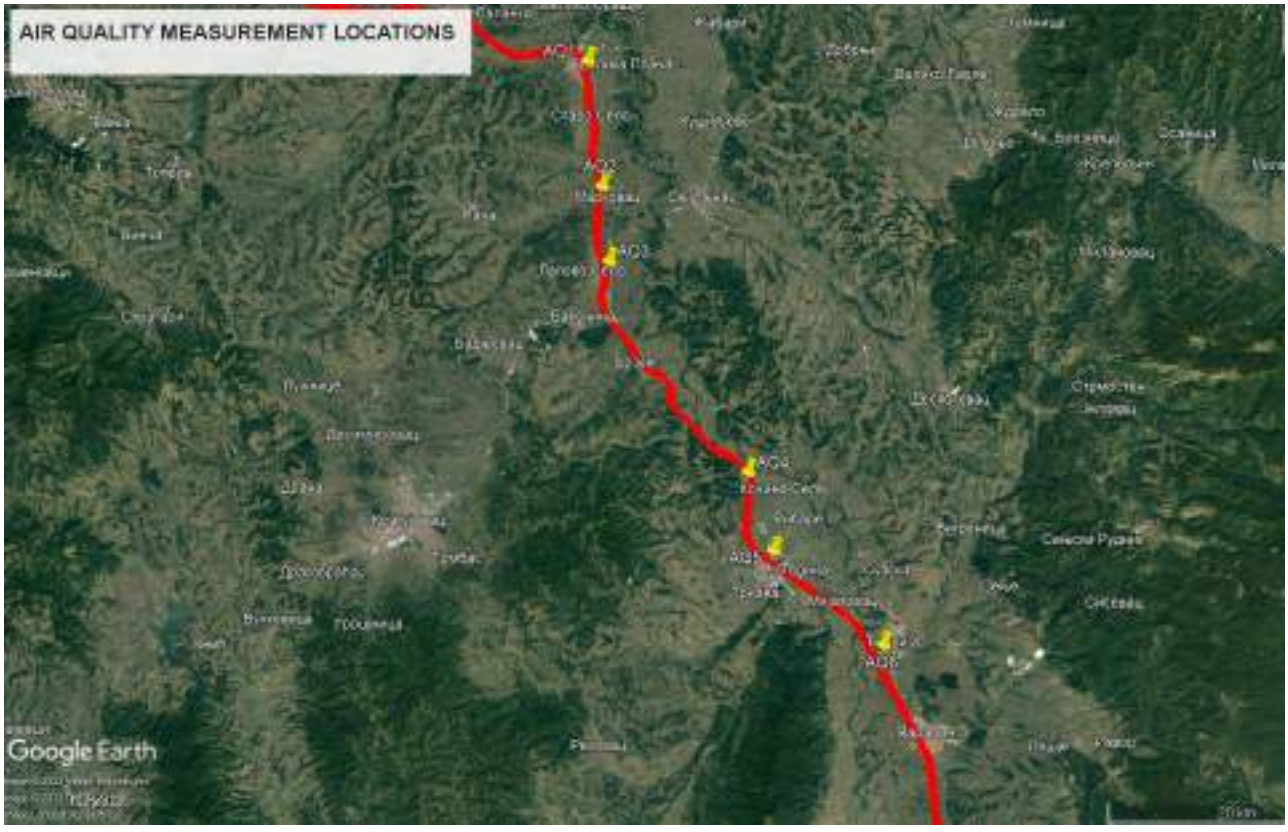

Figure 51. Locations of air quality measurements

TESTED PARAMETERS

Test parameters: Carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), benzene (C_6H_6), benzo (a) pyrene, suspended particles of the PM_{10} fraction, suspended particles of the $PM_{2.5}$ fraction, metals from of suspended particles of the PM_{10} fraction (As, Cd, Cu, Zn, Fe, Pb, Mn, Ni).

REPORTING

Based on the measurements, a report on air quality testing is issued in accordance with the requirements of ATS and the Regulation on conditions for monitoring and air quality requirements ("Official Gazette of RS ", no. 11/10, 75/10 and 63/13).

The report should contain the following as contents:

- Introduction (time, place, purpose of monitoring and testing)
- Brief explanation of the client and activity
- Monitoring parameters with prescribed national limits
- Description of used instruments and equipment for sampling and testing
- Interpretation/comments on results and conclusions
- Suggestions
- Annexes
- Sampling analysis results
- Photo essays
- Monitoring points map

The report should be submitted in Serbian and English language.

NOISE MONITORING PLAN IN THE CORRIDOR OF RAILWAY 102, BELGRADE–NIŠ, SECTION II VELIKA PLANA–PARAĆIN

NOISE MEASUREMENTS REQUIREMENTS

All noise level measurements must be performed in accordance with the legislation of the Republic of Serbia and SRPS ISO 1996-1 and SRPS ISO 1996-2 standards.

In any case, when measuring noise, the following conditions must be met:

- The measurements are carried out by an accredited laboratory for noise testing with the authority to measure noise from the competent Ministry.
- In all locations, the dominant source of noise should be railway traffic.
- Measurements should be carried out during regular traffic.
- Each of the measurements should be continuous for 24 hours, at least 5 days at each location .
- The weather conditions must be suitable for measuring noise in the environment (periods when the wind speed was higher than 5 m/s and/or when the amount of precipitation was higher than 6 mm/h should be excluded from the measurement).
- Measurements should be carried out in an open space in areas of objects sensitive to noise.
- The measuring microphone must be placed at a height of 1.5 meters above the ground.
- The measuring microphone must be at least three meters away from the acoustically reflective surface (if it is not possible to meet this condition, it is necessary to correct the measured values - exclude the influence of reflection).

MEASURING EQUIPMENT

Instruments for measuring sound pressure levels, including microphone(s), as well as cable(s), wind shield(s), recording devices and other accessories, if used, must meet the requirements for a Class 1 instrument in accordance with IEC 61672-1. The filters must meet the requirements for class 1 instruments according to IEC 61260. A wind shield must always be used during outdoor measurements.

At the beginning and at the end of each measurement, the entire sound pressure level measurement system must be checked at one or more frequencies using a sound calibrator that meets the requirements for a class 1 instrument in accordance with IEC 60942.

The conformity of the sound pressure level measuring instrument, filters and sound calibrators must be verified by the existence of a valid certificate of conformity with the measurement parameters established in the relevant test methods in IEC 61672-3, IEC 61260 and IEC 60942.

MEASURING PLACES

Noise measurements should be carried out in:

- Velika Plana (N1),
- Markovac (N2),
- Lapovo (N3),
- Novo Lanište (N4),
- Jagodina (N5),

- Ćuprija (N6).

Figure 52. Location of noise measurements

The exact location of the measuring instrument will be determined on site depending on local conditions and available resources (power source, etc.).

REPORTING

On the basis of the measurements performed, a Report on testing/measurement of noise is issued.

During the measurement, it is necessary to record the realization of railway traffic with data on the number of trains, type of train, traffic route, composition of the train (type of set and/or type of locomotive and number of cars) and length of the train. For freight trains, data on their net and gross mass is required. Data on the implementation of railway traffic must be an integral part of the Report on noise testing/measurement.

The report should contain the following as contents:

- Introduction (time, place, purpose of monitoring and testing)
- Brief explanation of the client and activity
- Monitoring parameters

- Description of used instruments and equipment for sampling and testing
- Interpretation/comments on results and conclusions
- Suggestions
- Annexes
- Sampling analysis results
- Photo essays
- Monitoring points map with topographic maps with and overlay of noise contours per dB intervals.

The report should be submitted in Serbian and English language.

APPENDIX 2

BIODIVERSITY SURVEYS METHODOLOGY

INTRODUCTION

The project concerns the comprehensive modernization, reconstruction and upgrade of the railway line connecting Belgrade and Niš, the most important city in Southern Serbia, over a total length of approximately 228 km. It is part of the Corridor X, the indicative extension of the pan-European TEN-T rail network in the Western Balkans and is defined as a priority for the development of the Serbian railway network.

Following a request of the Government of the Republic of Serbia to receive EU support in the preparation and possible financing of relevant sub-sections of the railway corridor, the PPF 9 team was assigned to prepare a part of the relevant project and technical documentation for the Project for modernization and construction of Belgrade – Niš – Preševo railways on Corridor X, with the focus on Belgrade – Niš section (section from Niš to Preševo is subject of IPF8 Technical Assistance).

Primary and secondary data will be collected to understand the terrestrial biodiversity values in the project area of influence and to identify the presence or potential presence of critical habitat (according to EBRD PR6 and IFC PS6) and priority biodiversity features (according to EBRD PR6). Also, all reports on biodiversity will be prepared in compliance with EIB Environmental and Social Standards (Environmental and Social Standard 3 on Biodiversity and Ecosystems)

A desktop review of the project area of influence is undertaken using the existing project documents, relevant available literature, online databases (e.g. Integrated Biodiversity Assessment Tool IBAT, International Union for Conservation of Nature - IUCN Red List, Birdlife Data Zone), satellite imagery and maps concerning the area of

influence and surrounding ecosystems; migration and movement corridors.; endemic/restricted-range species, invasive species; IUCN and nationally threatened (red-listed) species; Annex I habitats, Annex II and Annex IV species protected under the EU Habitats Directive; species protected at the national level.

Ecosystems that are a priority for conservation (habitats listed by the EU Habitats Directive (Annex 1), Bern Convention (Resolution 4), Key Biodiversity Areas, Alliance for Zero Extinction (AZE) sites, Red List of Threatened Ecosystems (IUCN) and ecosystems recognized by the scientific community as being associated with key evolutionary processes will be defined during the field surveys. Also, species and their habitats that are a priority for conservation, including species listed by the EU Habitats Directive and Birds Directive, Bern Convention, IUCN Red List of Threatened, as well as species and ecological network protected by national regulation (Rulebook on the Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Mushrooms ("Official Gazette of the RS", No. 5/10; The Regulation on the ecological network ("Official Gazette of the RS", No. 102/10) will be determined.

DESKTOP BASELINE REVIEW

Habitats along the corridor

The habitat types listed in the text that follows have been singled out on the basis of a study of the existing literature.

Within the affected zone of the railway corridor, two ecological corridors are identified: Velika Morava River and Juzna Morava River. These corridors have international importance and present ecological pathways and connections that enable the movement of individuals of populations and the genes flow between protected areas and ecologically important areas, according to the Decree on ecological network According to Law on nature protection, Article 130, The ecological network will be established and become part of the European ecological network Natura 2000 by the day of the accession of the Republic of Serbia to the European Union.

Seven protected areas are situated along the corridor, at a distance of up to 1 km: Rogot (0.1 km from the corridor), Miljakovačka Forest (0.32 km from the corridor), Brzansko Moravište (0.35 km from the corridor), Park Učiteljske škole Jagodina (0.6 km from the corridor), Bajfordova forets (0.8 km from the corridor), Forest Košutnjak (0.9 km from the corridor) and Topčiderski Park (0.97 km from the corridor).

According to their origin, the habitats along the railway corridor can be divided into natural and anthropogenic habitats. Natural habitats include forests, shrublands, grasslands, and water habitats. As anthropogenic influence is very strong along the whole area, the natural vegetation along the railway corridor is reduced to small fragments.

Through planned biodiversity surveys ecosystems and some species that could be a priority for conservation and protected areas are selected along the corridor. When it comes to the habitats, during the field surveys, special attention will be paid to natural habitats in order to determine if any of them qualify as priority biodiversity features or critical habitats. Table 81. Protected areas in the wider are of the corridor

Name of protected area	National category	IUCN category		Distance from the railway corridor (km)	The reason of protection
Rogot	Natural monument	III		0.1	Conservation of the last remnants of the *Quercus robur* forest
Miljakovačka Forest	Natural monument	III		>0.32	Conservation f *Quercus cerris* and *Q. petraea* forests
Brzansko Moravište	The Special nature reserve	IV		0.35	Conservation of swamp which presents very rare habitat type in Serbia
Park Učiteljske škole Jagodina	Natural monument	III		0.6	Historical values
Bajfordova Forest	Natural monument	III		>0.8	Protection and conservation of natural and aesthetic-environmental values of the forest complex which has significant ecological and spatial functions in connecting the green corridors of Belgrade.
Forest Košutnjak	Natural monument	III		Less than0.9 km	Conservation of *Quercus* forests as habitats for different species
Topčiderski Park	Natural monument	III		0.97	Historical and great biological value. Botanical value is reflected in the plant diversity and age of trees. Many trees date back to the XIX Century.

The Natural monument “Rogot” is situated in close vicinity of the railway corridor. This protected area is located in the central part of Serbia, 3 km from the Batočina village. The last remnants of the Quercus robur forest have been preserved in this area. In the past, these forests were widespread in Serbia, and today they have fragmentary distribution. During the next stage, field investigations will end up, among others, in the preparation of habitat maps, where the distribution of Quercus robur forests will be indicated.

Figure 53. Rogot in relation with the proposed variants (approximately 0.1 km)

The Special nature reserve "Brzansko moravište" is situated in the vicinity of the railway corridor. This reserve is located in Pomoravlje region, along the Great Morava River flow between the villages of Brzan and Miloševo near Batočina village.

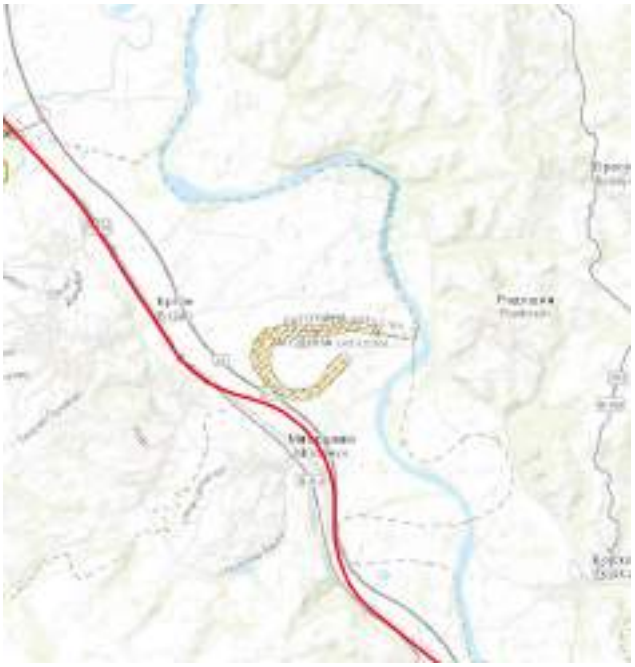

Figure 54. Brzansko Moraviste in relation with the proposed variants (in a distance of 0,35km)

The proposed alignment passes through the area of potential vegetation belonging to the association of:

- Quercetum frainetto-cerris Rudski 1949 (the Hungarian oak-Turkey oak forest). Reference to EUNIS Habitats: G1.761
- Helleno-Moesian [Quercus frainetto] forests Reference to EU HD Annex I: none Reference to CoE BC Res. No. 4 1996: none

These are thermophilous deciduous forests. In the typical Hungarian oak-Turkey oak forest, the following species are the most present: Quercus frainetto, Q. cerris, Tilia argentea, Pyrus pyraster, Sorbus domestica, S.torminalis, Fraxinus ornus, Acer campestre, Acer tataricum, Cornus mas, Crataegus monogyna, Viburnum lantana, Rosa gallica, Lonicera carifolium, Tamus commuis. On the ground floor, Lathyrus niger, Danna cornubiens, Lychnis coronaria, Silene viridiflora, Tanacetum corymbosum, Hellebrus odorus, Trifolium alpestre, Campanula persicifolia, Veronica chamaedrys are the most abundant species.

However, along the railway corridor, these forests have been degraded in order to increase agricultural areas. Therefore, the floristic composition and structure of these forests is endangered. Species Quercus frainetto is especially endangered due to its higher quality of wood. The thermophilous species of Quercetum frainetto-cerris forests are suppressed by xerophilous shrubs and the most resistant trees, such as: Fraxinus ornus, Carpinus orientalis, Acer tataricum, Cornus mas, Euonymus sp., Ligustrum vulgare, Rhamnus cathartica, Viburnum lanthanum, Rubus spp. Along the investigated area autochthonous forests Quercetum frainetto-cerris are present in small fragments or as individual trees.

The primary characteristic of these habitat types is the presence of numerous allochthonous plants, essentially decorative trees and shrubs. Also, most plant species are strictly adapted to urban environmental conditions. Ruderal plant species have a dominant presence within all mentioned urbanized areas. These are common ruderal plants of urbanized areas, such as: Chenopodium album, Atriplex hastata, Amaranthus retroflexus, Amaranthus sp. Urtica dioica, Parietaria officinalis, Conium maculatum, Artemisia vulgaris, Arctium lappa, Cichorium intybus, Daucus carota, Setaria glauca, Sambucus ebulus, Bidens tripartitus, Senecio vulgaris, Dactilys glomerata etc. The urban environment is very suitable for plant invasions. In these areas the habitats are fragmented, climate conditions are specific, and soil is nitrophilous. All these characteristics make urban areas congenial to the invasive plants colonization and spread. Some of them are Ailanthus altissima, Acer negundo, Amorpha fruticosa, Phytolacca americana, Robinia pseudoacacia, Erigeron annus, Echinocystis lobata, Syphiotrichum lanceolatum, Sorghum halepense.

Table 83. Natural habitats recorded along the corridor and their status according to different sources

Name of habitat type according to EUNIS habitat classification	Annex 1 of EU Habitats Directive	Annex 1 of EU Habitats Directive marked as "priority habitat type"	Habitat of high priority for conservation by national systematic conservation

			planning
G1.762 Helleno-Moesian Quercus frainetto forests (*Quercetum frainetto - cerris*)	✓		✓
G.1A Meso- and eutrophic Quercus, Carpinus, Fraxinus, Acer, Tilia, Ulmus and related woodland	✓		✓
G1.69 - Moesian *Fagus* forests	✓		✓
G1.1 - Riparian and gallery woodland, with dominant *Alnus, Betula, Populus* or *Salix*	✓		✓

Table 84.Characteristics of the natural habitats according to EBRD PR6

Name of habitat type according to EUNIS habitat classification	Priority Biodiversity Feature	Critical Habitat
G1.762 Helleno-Moesian Quercus frainetto forests (*Quercetum frainetto - cerris*)	Habitat type is listed in the Annex 1 of EU Habitats Directive or Resolution 4 of the Bern Convention	Habitat is determined to be of high priority for conservation by national systematic conservation planning
G.1A Meso- and eutrophic Quercus, Carpinus, Fraxinus, Acer, Tilia, Ulmus and related woodland	Habitat type is listed in the Annex 1 of EU Habitats Directive or Resolution 4 of the Bern Convention	Habitat is determined to be of high priority for conservation by national systematic conservation planning
G1.69 - Moesian *Fagus* forests	Habitat type is listed in the Annex 1 of EU Habitats Directive or Resolution 4 of the Bern Convention	Habitat is determined to be of high priority for conservation by national systematic conservation planning
G1.1 - Riparian and gallery woodland, with dominant *Alnus, Betula, Populus,* or *Salix*	Habitat type is listed in the Annex 1 of EU Habitats Directive or Resolution 4 of the Bern Convention	Habitat is determined to be of high priority for conservation by national systematic conservation planning

Habitat map prepared based on CORINE land cover data and EUNIS habitat classification is given below, while the final will be provided after biodiversity survey is carried out.

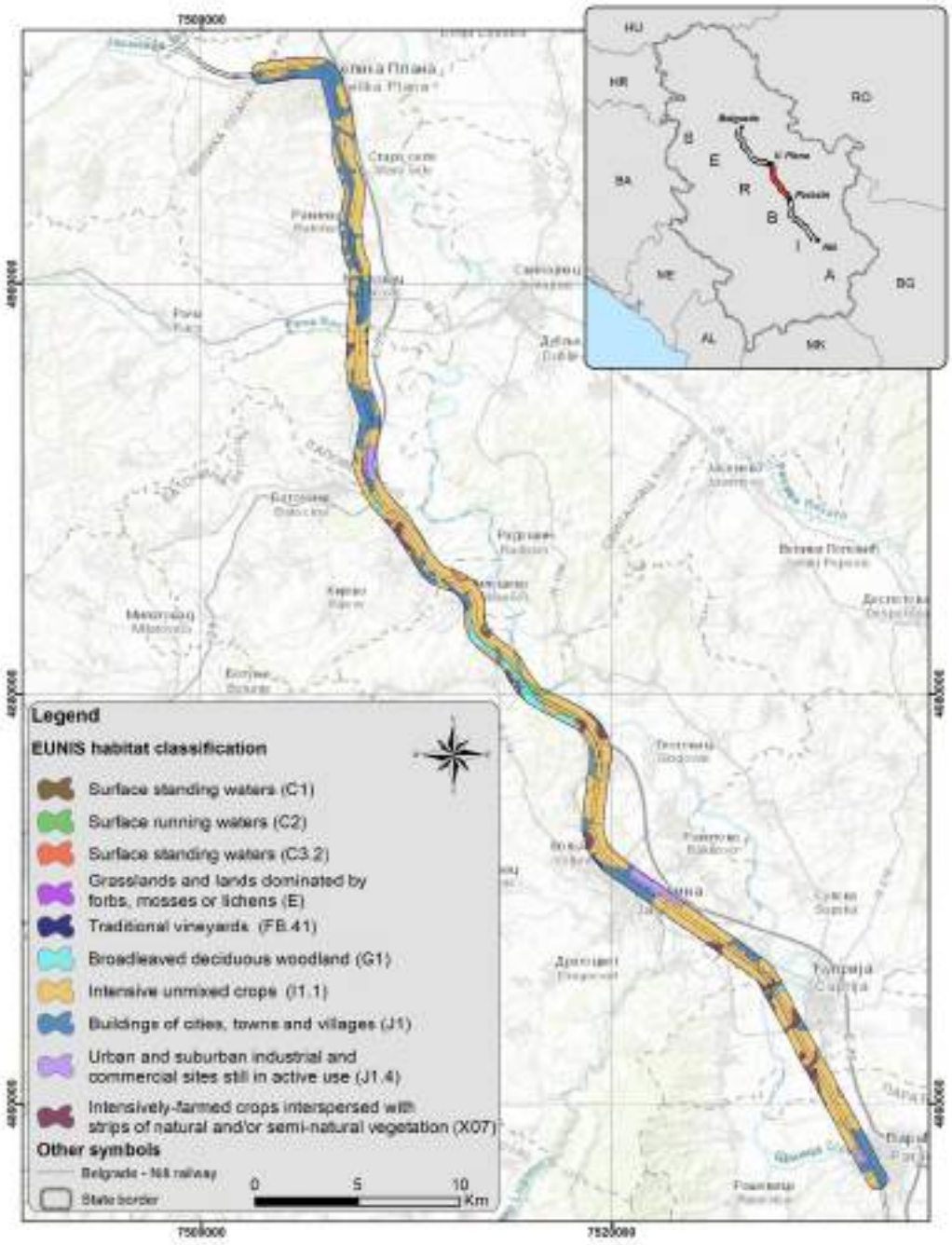

Figure 55. EUNIS habitat classification It is important to emphasize that all habitat types are selected and presented based on existing literature data. However existing literature data are provided for orientation purposes, so validation of important habitats will be done during planned biodiversity surveys along the entire one-year cycles.

List the available sources of data:

- ENOVA Consultants and Engineers (July 2022): CORRIDOR ENVIRONMENTAL & SOCIAL ASSESSMENT REPORT - Corridor Level Environmental and Social Assessment for the Belgrade-Nis High Speed Railway Corridor, Serbia.

- https://eunis.eea.europa.eu/habitats-code-browser.jsp : EUNIS habitat classification version 2012 (amended 2019)

Identified GAPs in available data:

- Habitat map of the Republic of Serbia does not exist. Mapping of habitats along the railway corridor will be done during planned biodiversity surveys after one-year cycle.

- Confirmation of data to prepare accurate assessment of impacts and development of effective mitigation measures following the mitigation hierarchy regarding habitats. Time and site-specific data will be collected and used to prepare an assessment regarding impact and mitigation measures for habitats.

- Confirmation of data to identify priority biodiversity features (PBF) or critical habitats (CH) according to EBRD PR6. During the field survey habitat and species-specific data will be collected following EBRD PR 6 requirements and final list of habitats will be identified.

Flora

Overview of flora along the railway corridor is presented based on existing literature data. Native plant species that can be identified within all habitat types are: Quercus frainetto, Q. cerris, Q. robur, Fraxinus angustifolia, Populus alba, Salix alba, Carpinus betulus, Viburnum opuslus, Cornus sanguine, Euonymus europaeus, Frangula alnus, Sorbus torminalis, Phragmites communis, Typha latifolia, T. angustifolia, T. laxmanii, Thymus serpyllum, Hypericum perforatum, Sparganium erectum, Achillea millefolium, Mentha longifolia, Iis pseudoacorus, Symphytum officinale, Althaea officinalis etc. Given that ruderal communities are common along the railway corridor, a large number of species characteristic of this type of community have been noted, such as: Sambucus ebulus, Lolium perrene, Prunus spinosa, Daucus carota, Dactylis glomerata, Dipsacus laciniatus, Urtica dioica, Artemisia vulgaris, Raphanus raphanistrum, Arctium lappa, Rubus sp., Bromus racemosus, Chenopodium album, Consolida regalis, Cichorium intybus, Cirsium arvense, Chelidonium majus and others. Considering strong anthropopressure in wide area of proposed railway corridor, it is expected presence of different invasive plants, such as: Reynouria japonica, Ailanthus altissima, Acer negundo, Amorpha fruticosa, Ambrosia artemisifolia, Phytolacca americana, Robinia pseudoacacia, Erigeron annus, Echinocystis lobata, Datura stramonium, Paspalum distichum Iva xanthifolia, Syphiotrichum lanceolatum, Sorghum halepense etc.

Considering the existing data on habitats along the corridor it can be expected great floristic diversity of the project area. A complete list of plant species present along the corridor will be formed after the field surveys is completed.

List the available sources of data:

- ENOVA Consultants and Engineers (July 2022): CORRIDOR ENVIRONMENTAL & SOCIAL ASSESSMENT REPORT - Corridor Level Environmental and Social Assessment for the Belgrade-Nis High Speed Railway Corridor, Serbia.

- Josifović, M. (ed.) 1970-1977: Flora SR Srbije 1-9. Srpska akademija nauka i umetnosti, Beograd.

- Sarić, M., Diklić, N., (eds.) 1986: Flora SR Srbije, 10. Srpska akademija nauka i umetnosti, Beograd.

- Stevanović, V., (ed.) 1992: Flora SR Srbije, 1 (Second edition). Srpska akademija nauka i umetnosti, Beograd.

- Stevanović, V., (ed.) 2012: Flora SR Srbije, 2 (Second edition). Srpska akademija nauka i umetnosti, Beograd.

- Stevanović (ed.), 2023: Flora SR Srbije, 3 (Second edition). Srpska akademija nauka i umetnosti, Beograd.

- Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA, editors. 1968. Flora Europea 2. Cambridge: University Press.

- Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA, editors. 1972. Flora Europea 3. Cambridge: University Press.

- Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA, editors. 1976. Flora Europea 4. Cambridge: University Press.

- Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA, editors. 1980. Flora Europea 5. Cambridge: University Press.

- Tutin TG, Burges NA, Chater AO, Edmondson JR, Heywood VH, Moore DM, Valentine DH, Walters SM, Webb DA, editors. 1993. Flora Europea 1. Second edition. Cambridge: University Press.

- https://www.iucnredlist.org/: the IUCN Red List of Threatened Species (IUCN 2016)

- https://ww2.bgbm.org/EuroPlusMed/query.asp: Euro+Med Plantbase (2006-)

Identified GAPs in available data:

- Lack of up-to-date spatially and taxa specific data regarding flora along the corridor that potentially represent CH or PBF, which will be confirmed by field investigation.

- Confirmation of data to prepare accurate assessment of impacts and development of effective mitigation measures following the mitigation hierarchy concerning flora. Time and site-specific data covering flora will be collected and used to prepare an assessment regarding impact and mitigation measures.

- Confirmation of data to identify priority biodiversity features (PBF) or critical habitats (CH) according to EBRD PR6. During the field survey habitat and species-specific data will be collected following EBRD PR 6 requirements and final list of habitats will be identified with flora species check list.

Fauna

Fauna of the region around the area of the railway is sporadically investigated, and data on collected data are available from various available literature sources.

A number of data regarding insects exist for the area around the City of Belgrade, especially for PBA Avala and Kosmaj, which are among the best-studied regions in Serbia. Gradojević (1930-1931) published the first records on butterflies. Recently Anđus (2008) published more records for Avala Mt. Having in mind all records of butterfly species

available (111 butterfly species registered for PBA Avala and 106 butterfly species registered for Kosmaj PBA), in the wider area of Avala Mt. live more than half of the butterfly species of Serbia, in a relatively small area. Plećaš and Pavićević (2007) listed 98 longhorn beetle species from Avala Mt. three of them Cerambix cerdo, Rosalia alpina, and Morimus funereus are listed as vulnerable (VU) at the global level in the IUCN (2022) Red List of Threatened Species. Around the area of Belgrade, namely Avala Mt., Rakovica (Grebenščikov, 1949), as well as Topčider (Us, 1938), one of the orthopteran species Tessellana vittata (Charpentier, 1825) has been recorded and listed in Red Data Book of Fauna of Serbia IV – Orthoptera as Near Threatened (NT), due to populations fragmentation. The reason is that habitats for this species, mainly steppes, are being converted into agricultural land and urban areas.

Prime Butterfly Areas (PBA)

Two Prime Butterfly Areas (PBA) in Serbia: 01 Avala and 17 Kosmaj are located along the existing railway. Together with IBA, PBA are part of Ecological network in Serbia. The main characteristics of PBA are given in Table below.

Table 86. Prime butterfly areas along the corridor.

	01 Avala	17 Kosmaj
Coordinates	44041'32'' 20031'35''	44028'28'' 20034'48''
Altitude span	300-506 m	209-626 m
Size	502 ha	1171 ha
Biogeographic region	Continental	Continental
No. of target species	11	8
Natura 2000	Colias myrmidone, Lycaena dispar, Nymphalis vaualbum	Colias myrmidone, Lycaena dispar, Nymphalis vaualbum
Distance from railway corridor	1,7 km	3 km

Avala is a low isolated mountain, located at the southern edge of the City of Belgrade. The PBA comprises the entire mountain and some adjacent flatter parts at its base. The region is surrounded by a predominantly agricultural landscape. Avala has a semi-arid continental climate and it is geologically comprised mainly of flysch, serpentine and loam deposits. The forest association is predominantly Quercetum frainetto-cerris serbicum and Fraxino orni-Quercetum petraeae. Beech-dominated forests covers the northern exposures. A total of 111 butterfly species have been registered. Among 11 target species known to occur in this region, Avala hosts of populations of the national importance of Thymelicus action, Zerynthia polyxena, Parnassius mnemosyne and Lycaena dispar. One of the species that has become extinct in this area is Colias myrmidone.

Kosmaj is a low mountain belonging to the Šumadija group of Mountains. This hilly area is situated 40 km south of Belgrade. The region occupies the mountain and its base, and the hill Košutica, The region has a semi-arid continental Danubian climate. Oak and hornbeam woods (Querceto-Carpinetum) are predominant in this region. The fragments of steppe can also be found, with steppe grass species typically present in xeromorphic habitats. In this region, 106 butterfly species have been registered. PBA hosts a nationally important population of one target species: Zerynthia polyxena. According to national legislation, the region has the status of the Landscape of Outstanding Features.

There are data from sporadic fish surveys, which were conducted to determine fishing areas (according to the Law on Protection and Sustainable Use of Fish Stock -"Official Gazette of RS" no. 36/2009). There are data from the locality Velika Morava, which confirm the presence of representatives of four families (*Esocidae, Cyprinidae, Siluridae, Gobiidae*). During the investigations, species will be determined together with the category of protection.

Some data related to herpetofauna refer to the 1950s (Radovanović, 1951). At least seven species of herpetofauna evidenced in this area belong to the strictly protected or protected species in Serbia (*Bombina variegata, Bufotes viridis, Rana dalmatina, Pelophylax ridibundus, Hyla arborea, Natrix natrix, Natrix tessellata*).

Regarding bird fauna, some data dated from the beginning of twenty century (Matvejev, 1950). Especially are important habitats for breeding birds, such as *Ardeola ralloides, Nycticorax nycticorax, Ixobrichus minutus, Ardea purpurea, Ciconia ciconia, Anas querquedula, Porzana porzana*, etc. It is also important to mention the representatives of passerine birds from the genera *Acrocephalus* and *Locustella* as characteristic species of wetlands. In addition, it is evidenced mix of different types of fauna, as a consequence of significant changes in habitats due to anthropogenic factors. Characteristic species that nest in such mosaic habitats are, for example Buteo buteo, Saxicola rubetra, *Streptopelia turtur, Sylvia atricapilla, Columba palumbus, Locustella fluviatilis, Cuculus canorus, Hippolais icterina, Picus viridis, Parus palustris, Dendrocopos major*. Almost 100 bird species registered in the project area are protected by national law as strictly protected or protected species. In addition, following the Convention on the Protection of European Wildlife and Natural Habitats (Law on Ratification of the Convention on the Protection of European Wildlife and Natural Habitats, “Official Gazette – International agreements no. 102/07), more than 70 species are found in Annex II to this Convention which implies their strict protection, while the other 36 species are listed in Annex III, which implies the possibility of controlled use of these species.

Important Bird Areas (IBA)

Four Important Bird Areas (IBA) are recorded along the corridor: Ušće Save u Dunav (3 km from the corridor), Donje Pomoravlje (1.7 km from the corridor), Gornje Pomoravlje (crossed by the corridor), and Dobrić-Nišava (crossed by the corridor). Given the respective distance of the two first areas to the railway line, the decision of the expert team is to scope them out the field investigations.

Gornje Pomoravlje IBA is located in Central Serbia in the valley of Great Morava River in the vicinity of Paraćin. The habitats of this area are presented by remnants of SSalix sp., Populus sp., Alnus sp., Fraxinus sp. and Quercus sp. forests. The following table indicates the two IBA crossed as well as the two IBAs in the wider area of the corridor. A description of the two IBAs of interest for this report is given further below.

Table 87. Important bird areas identified along the corridor

Name	Area	IBA criteria	Distance	Decree on ecological network
Ušće Save u Dunav	9,926 ha	A1, A4, B1b, B2a, B3a, B3b, C2, C3, C4, C6 (2019)	3 km (scoped out)	Yes RS040
Donje Pomoravlje	8,244 ha	B1b, C6 (2019)	1,7 km (scoped out)	YES RS049
GornjePomoravlje	4,265 ha	B1b, C6 (2019)	cross	YES RS044
Dobrić-Nišava	35,389 ha	B1b, B2a (2019)	cross	No RS048

The IBA Gornje Pomoravlje is an alluvial area in Central Serbia along Velika Morava River. It is more than 40 km far from Ćićevac and Stalać in the south to Krušar and Ribare in the north. The area is composed of several smaller units: Vidovački ključ, Čepursko Moravište, the mouth of Crnica river, and Supski rukavac. On the Velika Morava Rive, there is a huge amount of meanders, gravel islands, riparian woods, and a lot of active and old gravel pits. At the borders of IBA, more than 20 settlements are situated that belongs to five municipalities (Paraćin, Varvarin, Ćićevac, Ćuprija, and Jagodina) (Birdlife International (2022).

Dobric-Nisava IBA is situated in Central Serbia between Mali Jastrebac Mountain on the north, Vidojevica Mountain on the south, and Niš city on the east. This mostly agricultural flat area is interspaced with hilly tops, villages, rivers, creeks, gravel pits, and one lake (Oblačinsko jezero). There are more than 40 villages inside the IBA borders that belong to six municipalities (Niš, Aleksinac, Merošina, Prokuplje, Žitorađa, and Doljevac) (Birdlife International (2022).

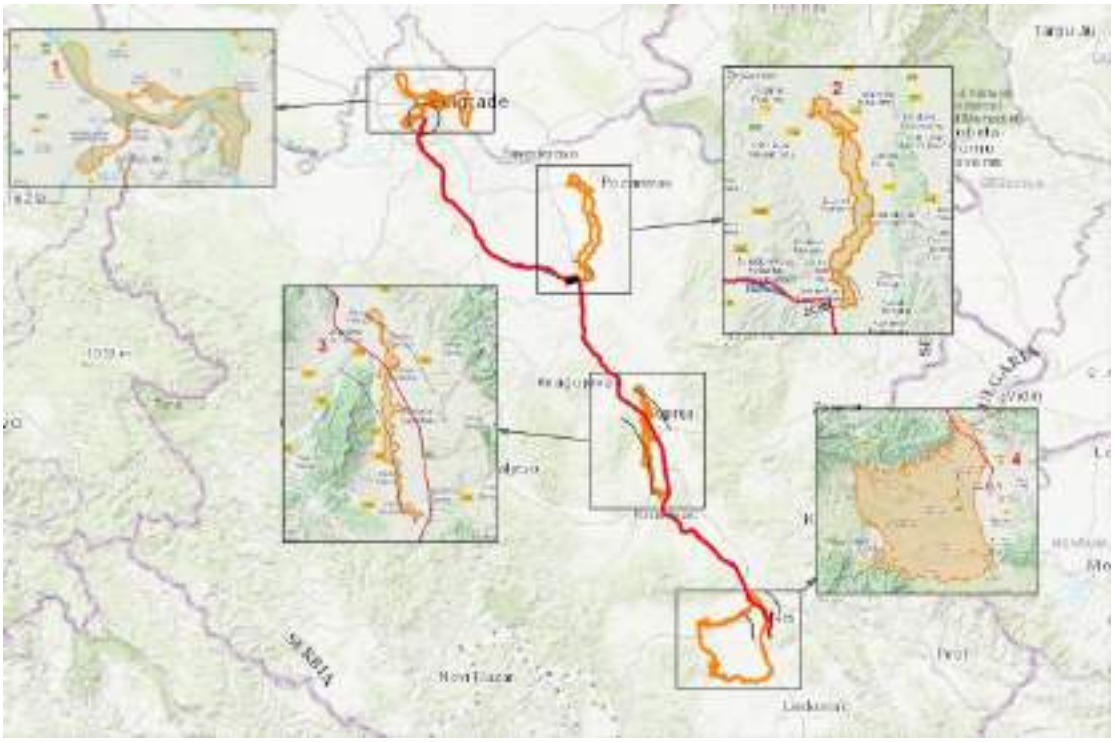

Figure 56. IBAs along the corridor

Table 88. Population of IBA trigger species – Gornje Pomoravlje and Dobrić–Nišava

Species	Current IUCN Red List Category	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered	IBA
Common Tern *Sterna hirundo*	LC	breeding	2016-2019	max 20 breeding pairs	C6	Gornje Pomoravlje
Common Kingfisher *Alcedo atthis*	LC	resident	2010-2019	20-40 breeding pairs	B1b, C6	Gornje Pomoravlje
Collared Sand Martin *Riparia riparia*	LC	breeding	2017-2019	1,500-2,500 breeding pairs	B1b	Gornje Pomoravlje
Grey Partridge *Perdix perdix*	LC	resident	2016-2019	1,000-1,500 breeding pairs	B1b	Dobric-Nisava
Black-headed Bunting *Emberiza melanocephala*	LC	breeding	2016-2019	700-1,000 breeding pairs	B2a	Dobric-Nisava

Up to now, there is very good and usable data on the presence and distribution of mammal species for the subject area of the projected railway line and the associated corridor. Part of the data comes from studies published so far on the mammalian fauna of Serbia (Petrov, 1992; Savić et al., 1995), and the most numerous are unpublished personal data from engaged mammal expert, covering field researches and notes from the quiet a long past period of time.

The corridor in question is located in an area that has been exposed to strong anthropogenic influence for centuries, which resulted in the current presence of highly altered ecosystems, mainly agroecosystems. Semi-natural ones are rare, while natural ones are almost non-existent. In such highly modified ecosystems, a specific and specialized fauna of mammals was formed, consisting mainly of species with high ecological plasticity and resilience, and even an expressed process of synanthropization. This mostly relates to communities of rodents and insectivorous species, followed by the fauna of small and mid-sized carnivores, which are species of wide geographical distribution in the territory of Serbia. The corridor of the planned railroad passes mostly through the geographical area of the Velika Morava (Great Morava) river valley and Južna Morava (South Morava) river valley, which in Serbia are designated as zones of lower diversity when speaking about the mammal fauna (Savić et al., 1995).

These are the most extensive and complete study of the bat fauna in Serbia so far. According to Paunovic (2016) and Paunovic *et al.* (2020) the geographical regions where Velika Morava (Great Morava) river valley and Južna Morava (South Morava) river valley belong and where most of the railway goes, are marked as a zone of low diversity of bat fauna, with only 8 species (out of 31 registered in Serbia) which are bionomically linked to altitudes (0-200 m a.s.l) and habitat types prevailing along the route. At the same time, the shelters and roosting places of these species are mostly in the urban environment of the surrounding settlements. Only the area of the city of Belgrade stands out as an area of high diversity, but it is about urban and suburban zones, and the high diversity is a consequence of expressed synanthropization and synurbanization of bats. Considering the quality and timeliness of the existing data, they will provide sufficient and reliable inputs for ESIA assessment.

Mammals: Insectivores (Eulipotyphla) are represented by 6 species out of 9 presented in Serbia so far. There are still no documented findings for three species (Pygmy shrew - Sorex minutus, Water shrew - Neomys fodiens, and Alpine shrew – Sorex alpinus). There are species that inhabit forests and forest-like habitats (Common shrew – Sorex araneus.

List the available sources of data:

- ENOVA Consultants and Engineers (July 2022): CORRIDOR ENVIRONMENTAL & SOCIAL ASSESSMENT REPORT - Corridor Level Environmental and Social Assessment for the Belgrade-Nis High Speed Railway Corridor, Serbia.

- BirdLife International (2022). IUCN Red List for birds. Downloaded from http://www.birdlife.org on 07/06/2022.

- Ferguson-Lees J. and Christie D. (2001): Raptors of the world. Cristopher Helm, London.

- Hume R. (2002): Complete birds of Britain and Europe. Dorling Kindersley.

- Kalezic, M., Tomovic, L.., & Dzukic, G. (2015). Red Book of Fauna of Serbia II. Amphibians. University of Belgrade, Faculty of Biology. Institute for Nature Conservation of Serbia, Belgrade

- MacDonald, D. and Barrett, P. (1999). The Collins Field Guide: Mammals of Britain & Europe. Harper Collins Publisher, London. 312 pp.

- Matvejev S.D. (1950): Distribution and life of birds in Serbia. Serbian Academy of Sciences and Arts, Belgrade.

- Mitchell-Jones, A. J., Amori, G., Bogdanowicz, W., Kryštufek, B., Reijnders, P. J. H., Spitzenberger, F., Stubbe, M., Thissen, J.B., Vohralik, V., Zima, J. (1999). The Atlas of European Mammals. T & J Poiser, London. 484 pp.

- Paunović, (2016). Rasprostranjenje, ekologija I centri diverziteta slepih miševa (Mammalia, Chiroptera) u Srbiji (PhD Thesis). (in Serbian). Distribution, ecology and centers of diversity of bats in Serbia.

- Paunović, M., Karapandža, B., Budinski, I., Stamenković, S. (2020). Fauna slepih miševa (Mammalia, Chiroptera) Srbije. Monografija. (in Serbian). Fauna of bats in Serbia.

- Petrov, B. (1992). Mammals of Yugoslavia - Insectivores and Rodents. Nat. Hist. Mus. in Belgrade, Special issues, 37, Belgrade. 186 pp. (in English).

- Radisic D et al. (2018): Crvena knjiga faune ptica Srbije III, Ptice. Zavod za zastitu prirode Srbije. Departman za biologiju i ekologiju, PMF, Univerzitet u Novom Sadu. Drustvo za zastitu i proucavanje ptica Srbije. Beograd.

- Savić, I., Paunović, M., Milenković, M., Stamenković, S. (1995). Diverzitet faune sisara (Mammalia) Jugoslavije, sa pregledom vrsta od međunarodnog značaja. U: Biodiverzitet Jugoslavije sa pregledom vrsta od međunarodnog značaja (Eds. V. Stevanović, Vasić, V.), 517-554. Biološki fakultet i Ecolibri. Beograd. (in Serbian). The diversity of the mammalian fauna (Mammalia) of Yugoslavia, with an overview of species of international importance. In: Biodiversity of Yugoslavia with an overview of species of international importance.

- Speybroeck, J., Beukema, W., Bok, B., & Van Der Voort, J. (2016). Field guide to the amphibians and reptiles of Britain and Europe. Bloomsbury publishing.

- Sutherland W. et al. (2004): Bird ecology and conservation, a handbook of techniques. Oxford university, Oxford.

- Svenson L. (2009): Collins Bird Guide - 2nd edition. HarperCollins Publisher, London.

- Tomović, L., Ajtić, R., Ljubisavljević, K., Urošević, A., Jović, D., Krizmanić, I., Labus, N., Đorđević, S., Kalezić, M.L., Vukov, T. & Džukić, G. (2014). Reptiles in Serbia: Distribution and diversity patterns. Bulletin of the Natural History Museum, (7), 129-158.

- Tomovic, L., Kalezic, M., & Dzukic, G. (2015). Red Book of Fauna of Serbia II. Reptiles. University of Belgrade, Faculty of Biology. Institute for Nature Conservation of Serbia, Belgrade.

- Vukov, T., Kalezić, M. L., Tomović, L., Krizmanić, I., Jović, D., Labus, N. & Džukić, G. (2013). Amphibians in Serbia: distribution and diversity patterns. Bulletin of the Natural History Museum, (6), 90-112.

Identified GAPs in available data:

- Lack of up-to-date spatially specific data on fauna which will be confirmed by field investigation

- Confirmation of data to prepare accurate assessment of impacts and development of effective mitigation measures following the mitigation hierarchy regarding fauna. Time and site-specific data will be collected and used to prepare an assessment regarding impact and mitigation measures requirements for fauna

- Lack of data from the literature, regarding birds flight heights; data will be collected during field investigation by ornithologist

- Confirmation of data to identify priority biodiversity features (PBF) or critical habitats (CH) according to EBRD PR6. During the field survey habitat and species-specific data will be collected following EBRD PR 6 requirements and final list of habitats will be identified.

BIODIVERSITY FIELD SURVEYS

The preparational phase of the research study was dedicated to the selection of the appropriate areas that will provide the necessary insights regarding the status of habitats and vegetation along the entire section. Quantity and quality of the available scientific articles studying the area around the railway are limited. Based on the existing data about flora and habitats in relative proximity (2-5 km), as well as the heterogeneity of the assumed habitat types and vegetation cover, preliminary polygons will be drafted using Google Earth Pro Satellite Imagery. Considering the project area is composed of a mosaic of different habitats, the preliminary sample and survey points will be defined based on landscape heterogeneity, proximity to known sensitive habitats, and accessibility. During the preliminary sample and survey points could be changed.

Prior to the research of data on the field, the experts conducted a review of the existing related literature. Literature data on the distribution and conservation status of all species of flora and fauna from the area affected by the Project are collected from scientific papers and the Red Books. The degrees of endangerment of species are checked for all species according to the IUCN Red List of Threatened Species, the European Habitats and Birds Directives, the Bern Convention, and the CITES Convention, as well as the endangerment status according to the Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals, and fungi of the Republic of Serbia.

The main aim of the field survey is to collect data on plant and animal species of interest for protection, as well as data on important habitat types in order to understand the ecological processes and functions that sustain biodiversity (e.g. migratory corridors or hydrology) and to predict the possible effects and impacts of the reconstruction work on biodiversity. The collection of data directly from the field will enable covering gaps in data regarding habitats, flora and fauna, presented above. Having in mind that AoI is changing rapidly due to anthropic pressures and grooving agriculture development, it is not expected that number of species of interest for the protection will be growing. It is expected that field investigation during different seasons and covering the number of points will enable the collection of valuable data to provide recent and site-specific data to prepare an accurate assessment of impacts and the development of effective mitigation measures following the mitigation hierarchy.

In order to present visually where the various habitats are in line with survey areas points, for habitats and each group of flora and fauna a cross-referenced map will be prepared, and presented in each seasonal report. Survey points will be pre-determined before each field survey. The final seasonal report will consist of all points checked during the field investigation, with a short description regarding the current visual appearance of the area around each point (e.g. good condition, degraded, etc.). This will provide sufficient data to assess key habitats and enable a comprehensive coverage of the survey.

The biodiversity field survey will follow directions provided under the EBRD guidance on biodiversity surveys (Good Practices for the Collection of the Biodiversity Baseline data: https://www.ebrd.com/cs/Satellite?c=Content&cid=1395245538876&d=&pagename=EBRD%2FContent%2FDownloadDocument) and adapt it to the current situation.

The field survey will be undertaken in four seasons (winter, spring, summer, and autumn) and is designed to enable the collection of quality biodiversity data. Implemented activities will involve the following:

- Identification, mapping, and description of the natural, semi-natural, and artificial habitats along the corridor. Selection and determination of habitats will be done according to EUNIS habitat classification. A map the study area, including both areas of influence and a broader ecological context (determination of Ecologically Appropriate Areas of Analysis (EAAAs) will be defined.
- Cover all relevant areas and features that could be exposed to Project-related risks and impacts, including direct, indirect, and cumulative impacts
- Recording species associated with each habitat, with emphasis on species of conservation concern (globally/nationally threatened species, endemic/restricted range species, migratory/congregatory species, and bird flyways, Annex II/Annex IV species protected under the EU Habitats Directive, invasive species, and nationally protected species).
- Flora surveys will be performed by visual method, by collecting plants to determine the most important ones, and by taking photos.
- The habitat/flora survey will include more effort in the natural and semi-natural habitats and less effort in the modified/anthropogenic habitats such as agricultural fields and up-to-date data regarding vegetation types, and their overlap with the Project affected area will be provided.
- The terrestrial fauna surveys will cover terrestrial mammals, birds, reptiles, amphibians, and insects. Field surveys will involve a range of methods including direct observations, listening, collection of increments, and taking photos. Existing data on mammal species are considered sufficient for ESIA assessment, together with target surveys including visual method, trace gathering, feces observing, etc that will be carried out throughout each season during this planned biodiversity surveys. Additional methods of data collection using camera traps and/or bat detectors would not provide relevant additional data.
- Assessment of ecosystem services and benefits identified within the project area.

All data collected will serve to provide a clear rationale to show how this reflects distributions of habitats and species (including potential priority or critical features) and the ecological processes and functions needed to sustain them.

The area of influence (study area) will encompass 500 m of the corridor on both sides of the railway. In addition, the study area will be expanded to fully encompass the ecologically appropriate areas of analysis (EAAA) for features that require additional focused study. In accordance with existing data on the biodiversity of the project area, the study area will be expanded in the zone of ecosystems and habitats that are a priority for conservation and protected areas. The EAAAs will be defined further, once the fieldwork has been undertaken.

Experts for insects, fishes, reptiles and amphibians, birds, mammals, flora, and habitats will be engaged to perform all of these surveys.

A more detailed elaboration of the planned method that will be applied is given within the following subchapters where the description of surveys for each season is given.

Winter season

During the winter season, experts for birds and mammals will perform field research.

Flora and habitat survey

As the vegetation is in a dormant phase (dormancy) during the winter, the flora and habitat field surveys will not be performed during this season.

Fauna survey

Birds

Winter field research regarding ornithofauna will be conducted in January 2023, during the wintering season of birds, by ornithologist.

The techniques selected for the birds field study is the transect method (Sutherland et al., 2004), recording birds in the project area, and the point census method. For the ornithofauna field research, a number of transects will be determined after the field recognition (Table 82). Transects will be visited in the early morning, from 05:30 to 10:00, and in the evening, from 18:00 to 22:00. The described range synchronizes with the maximum activity of birds and at the same time, the activity of nocturnal birds. Transects were predetermined to set priorities due to the size of the research area and the short duration of the research. As the proposed design of the rehabilitated railway does not pass through any protected areas, the transects were determined based on the distance between the railway and the protected areas or IBAs (Important Bird Areas). The design of the rehabilitated railway line is foreseen to cross 2 IBAs, Gornje Pomoravlje and Dobric-Nisava.

The equipment which will be used for these investigations includes binoculars with 8x42 magnification, and a telescope 20-60x80 to observe birds on the open water surface. Photo data will be generated using Nikon and Fuji digital cameras. To collect data in the field, the expert will use the NaturaList application (https://data.biolovision.net/).

For each observation, the application records geographical coordinates with high precision (<5m), along with the exact date and time, and the number of encountered individuals for each species. The Collins Bird Guide - 2nd edition (Svensson, 2009) and Raptors of the World (Ferguson-Lees and Christie, 2001) will be used as identification manuals.

The locations of the survey points/areas and the transects are presented in Table 89, and on Figures 57 and 58.

Table 89. Coordinates of surveyed areas and transect lenghts

No	Locality name (route)	T1 Latitude	T1 Longitude	T2 Latitude	T2 Longitude
1.	Donje Medjurovo	43.302607°	21.830407°	43.313515°	21.827143°
2.	Vrtiste	43.380464°	21.805035°	43.388255°	21.793964°
3.	Mezgraja	43.396981°	21.773036°	43.416783°	21.750406°
4.	Stalac	43.669305°	21.412116°	43.677889°	21.413027°
5.	Cicevac	43.703075°	21.430235°	43.712185°	21.436286°
6.	Pojate	43.739190°	21.433921°	43.750653°	21.431356°
7.	Paracin	43.874192°	21.391694°	43.883947°	21.384501°
8.	Cuprija 1	43.911991°	21.363552°	43.923698°	21.355104°
9.	Cuprija 2	43.929178°	21.351006°	43.938348°	21.343980°
10.	Brzan	44.114416°	21.151044°	44.119142°	21.139545°
11.	Batocina 1	44.133915°	21.126262°	44.141760°	21.118307°
12.	Batocina 2	44.144710°	21.114555°	44.152147°	21.105810°
13.	Velika Plana 1	44.302623°	21.086508°	44.312090°	21.086433°
14.	Velika Plana 2	44.339279°	21.068332°	44.338858°	21.052957°
15.	Velika Plana 3	44.338313°	21.047952°	44.336726°	21.033677°
16.	Djurinci 1	44.506456°	20.635483°	44.521692°	20.614663°
17.	Djurinci 2	44.542995°	20.583396°	44.551242°	20.576584°
18.	Ripanj 1	44.642909°	20.533054°	44.653663°	20.526996°
19.	Ripanj 2	44.679663°	20.485047°	44.683103°	20.475209°
20.	Kosutnjak 1	44.749700°	20.445253°	44.758213°	20.445485°
21.	Kosutnjak 2	44.758629°	20.445391°	44.767185°	20.444714°

Figure 57. Positions of observation points

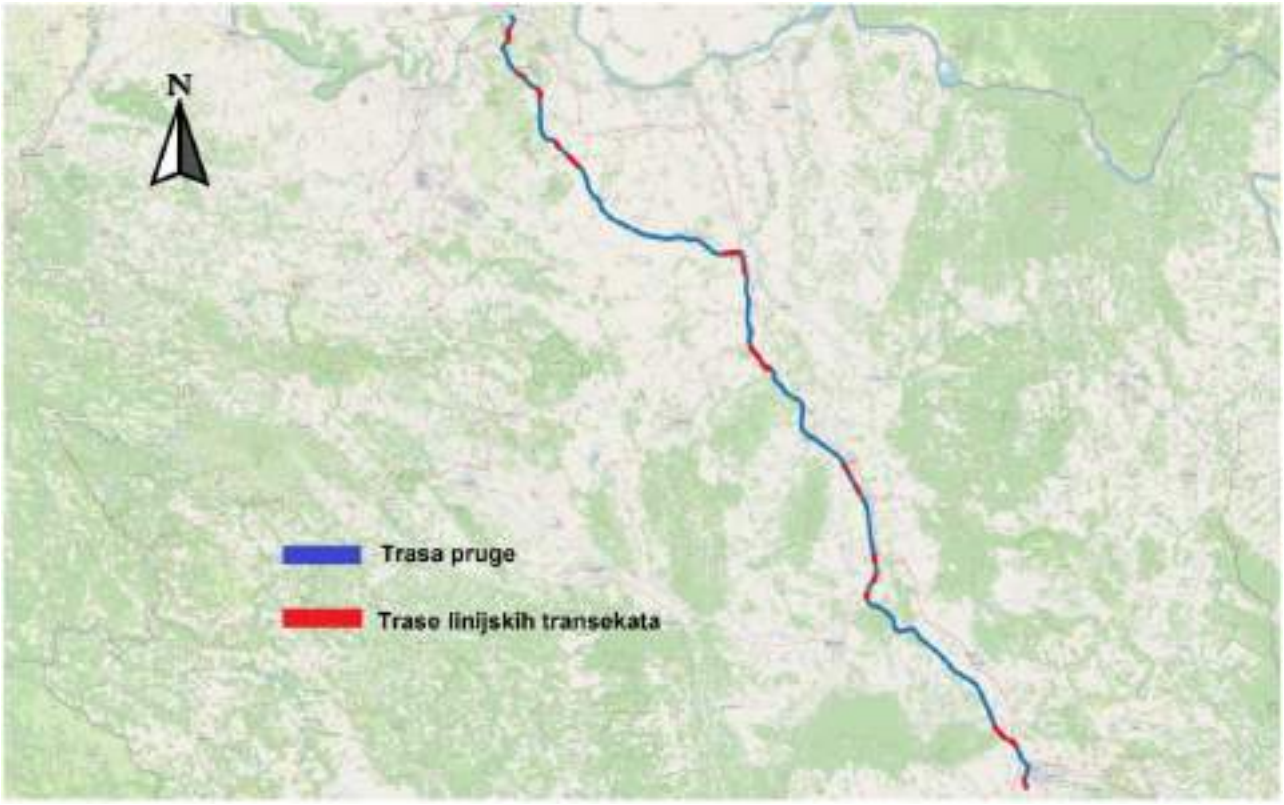

Figure 58. Positions of line transects

The species of birds which will be registered during surveys will be presented in a table, for which the proposed layout is proposed here below. Also, behavioural data and particularly fly heights will be recorded; in order to collect data necessary to assess collision risk in the ESIA.

Table 90. Birds survey results

No.	English name	Latin name	Location(s)	Conservation status				Suitable habitat?
				IUCN Global Red List	BD	Red Book of Serbia	Rulebook	

Mammals

Desk research for mammal fauna is conducted to analyse data from the available scientific literature. Field research will be conducted in the period between February and early March 2023 by expert - mammologist. Fieldwork will encompass visual inspection along the proposed route to obtain additional data and to check/confirm data from

available literature sources. Alive and dead animals will be recorded along the transects as well as additional data that indicate species presence such as traces, dens, holes, burrows, and excrements will be obtained. Information on the species, locality, and date will be collected, and the specifics of the habitat recorded.

The determination of the research area will be conducted by reviewing satellite images of the habitats in Google Earth software and determining locations along the entire section of the railway that will be visited. A table summarizing the exact locations visited will be provided, along with a map presenting these locations. The focus will be given to the areas representing preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of interest for protection and other importance. Also, as some of the present mammal species in the affected area are also game species, data from hunting management plans from local hunting societies will be used.

Most relevant data about bat fauna along the proposed route are collected in the comprehensive documents (Paunović, 2016; Stanković, Paunović and Raković, 2018; Paunović, Karapandža, Budinski and Stamenković, 2020.). Based on the existing data about bionomy, ecology, locations, and area of presence, the impact of the planned railroad will be assessed.

The locations of the survey points/areas will be presented in the following tables and figures.

Table 91. Preliminary determined coordinates for survey and transect lenghts

No.	Locality name	Coordinates of transect start point		Coordinates of transect endpoint		Length of covered railway	Area description
		Latitude	Longitude	Latitude	Longitude	meters	
1	Vrtište	43°22'38.15"N	21°48'24.97"E	43°23'10.77"N	21°47'48.73"E	1532	
2	Mezgraja – Veliki Drenovac	43°23'43.00"C	21°46'33.11"И	43°24'58.45"C	21°44'58.97"И	4092	
3	Ratare - Striža	43°48'18.56"C	21°25'17.20"И	43°49'20.92"C	21°25'5.89"И	1922	
4	Bagrdan	44° 3'1.95"C	21°13'57.17"И	44° 4'51.26"C	21°10'55.60"И	5427	
5	Bresje	44°20'12.17"C	21° 2'3.25"И	44°20'16.34"C	21° 0'29.02"И	2151	
6	Ripanj	44°39'43.49"C	20°30'25.80"И	44°41'0.01"C	20°28'26.82"И	3495	

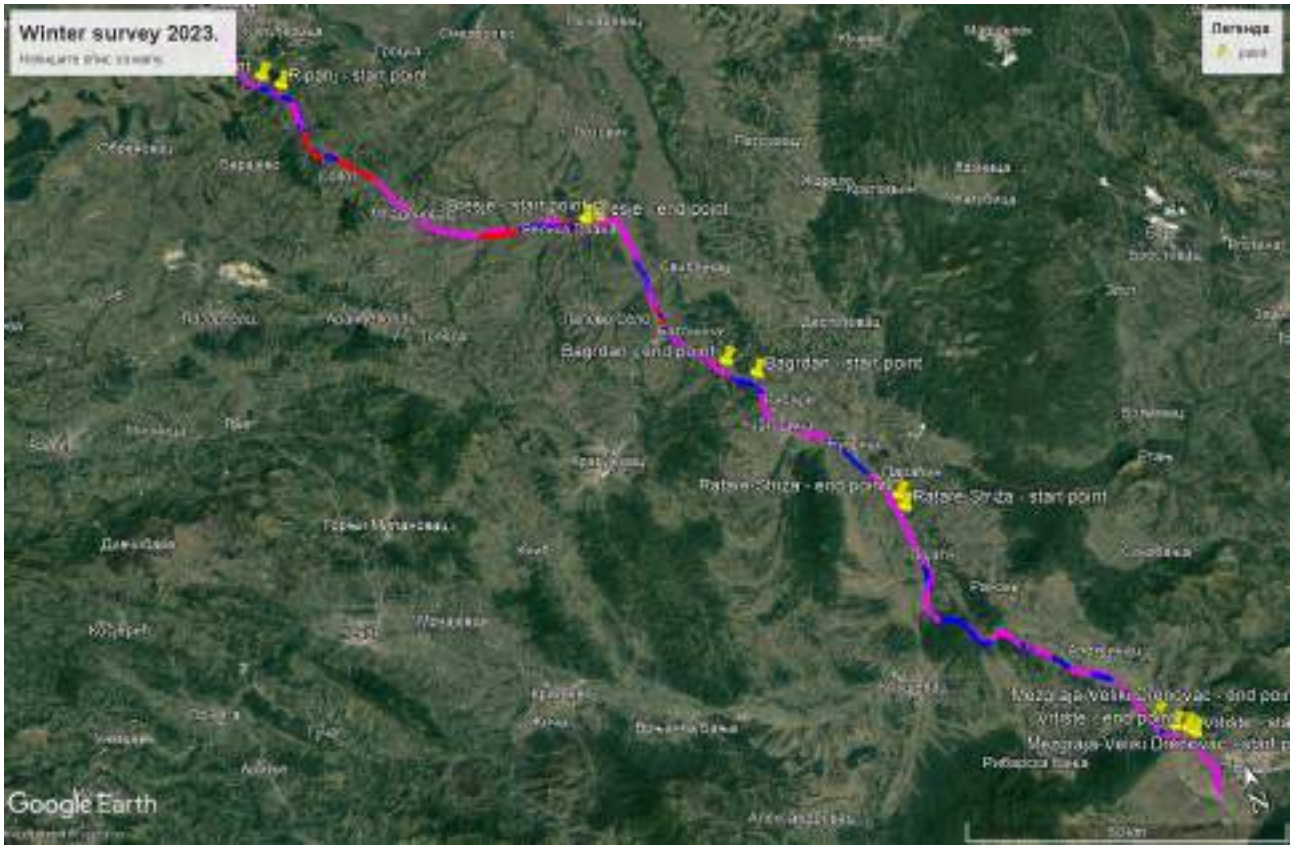

Figure 59. Winter survey - complete map with transects

The species of mammals which will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

Table 92. Mammals survey results

No.	English name	Latin name	Locations	IUCN	BC	HD	Suitable habitat?	Rulebook

Spring season

During the spring all biodiversity experts (for insects, reptiles and amphibians, birds, mammals, and flora) will perform field research.

Flora and habitat survey

Field surveys related to flora and habitats for the spring season will be conducted at the end of March and at the beginning of April 2023.

The floristic inventory for the sample points will be conducted either directly in the field or by collecting voucher specimens for laboratory identification. The classification of the present habitat types follows EUNIS version 2012 (amended 2019), and the digitalization will be performed using ArcGISPro within the final report.

The locations of the survey points/areas are presented in tables (with coordinates) and figures below. The results of the surveys will be presented for each polygon, for both habitats and flora in the final biodiversity report, after completed field surveys in all seasons. Also, maps of habitats will be provided, giving information on the polygons, survey points, sampled points and other relevant information (e.g. settlements, protected areas, other infrastructure, etc.) within the final report.

The flora species which will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

Table 93. Flora survey results

No.	Latin name	English name	Habitat	Conservation status				
				IUCN Global Red List	HD	Bern	CITES	Rulebook (Serbian Low: SP/P)

Table 94. Coordinates of habitat survey points

No.	Longitude	Latitude
1	43.30692	21.83387
2	43.30525	21.82832
3	43.31236	21.825
4	43.316333	21.826373
5	43.37982	21.80619
6	43.38156	21.80636
7	43.3825	21.8039
8	43.38483	21.80066
9	43.39044	21.7873
10	43.39139	21.78479
11	43.39168	21.78105
12	43.40632	21.76152
13	43.427822	21.751280
14	43.56186	21.59074
15	43.58538	21.5591
16	43.58771	21.55463
17	43.59228	21.55945
18	43.602689	21.543882

19	43.88289	21.38093
20	43.93259	21.35011
21	43.93862	21.34583
22	43.9488	21.3268
23	43.99407	21.24057
24	44.01252	21.2383
25	44.01677	21.23997
26	44.0454	21.23555
27	44.05297	21.23083
28	44.07796	21.19153
29	44.07946	21.18592
30	44.08388	21.18748
31	44.09025	21.17504
32	44.1036	21.16562
33	44.10322	21.16494
34	44.12643	21.12979
35	44.2223	21.0927
36	44.394020	20.7583
37	44.513003	20.629715
38	44.57253	20.54061
39	44.58848	20.53495
40	44.60057	20.53013
41	44.60968	20.53272
42	44.66873	20.49681
43	44.6715	20.49757
44	44.67259	20.49563
45	44.6788	20.48369
46	44.68124	20.48251
47	44.75826	20.45093

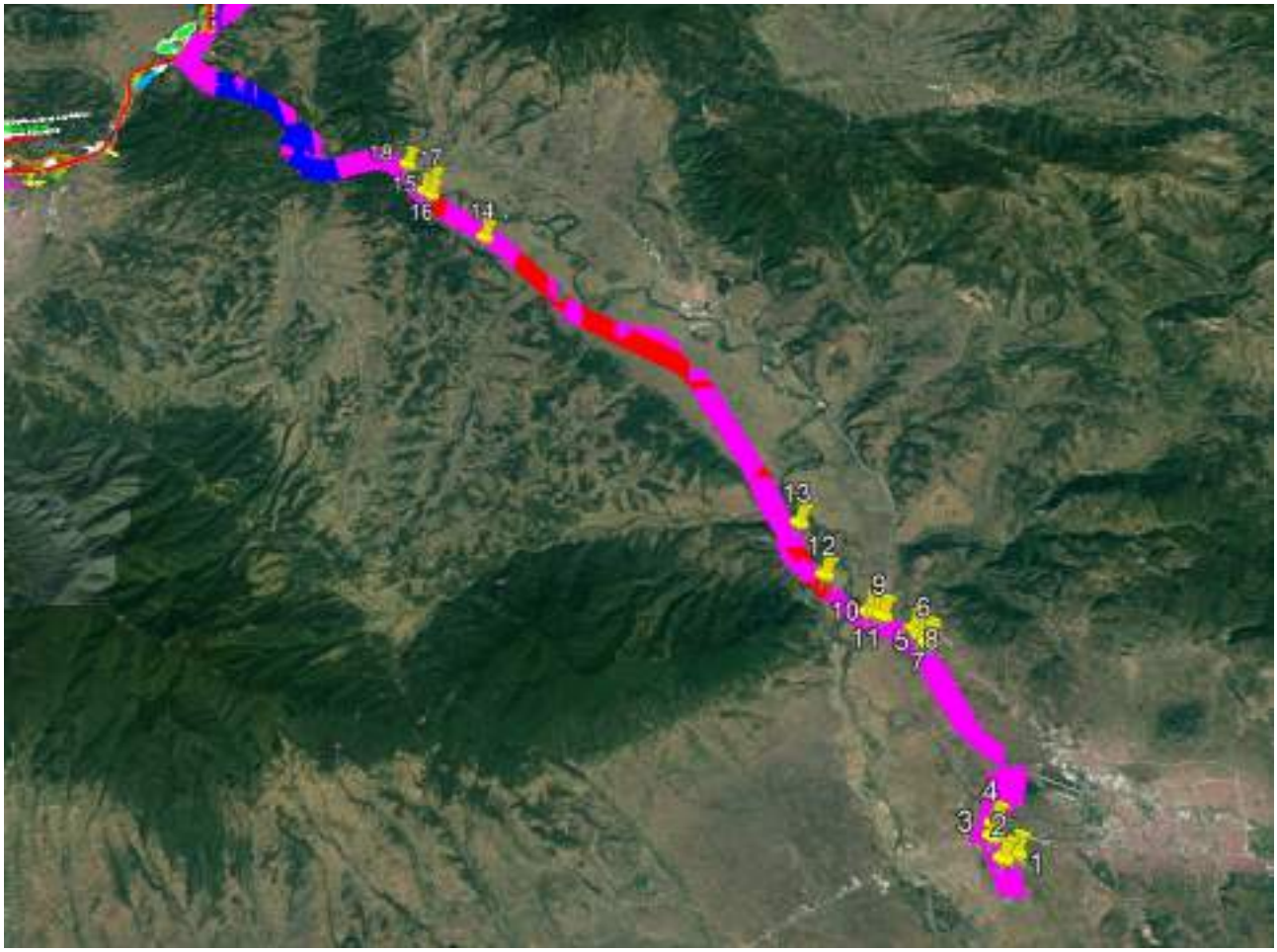

Figure 60. Habitats survey points within the Section Niš-Paraćin

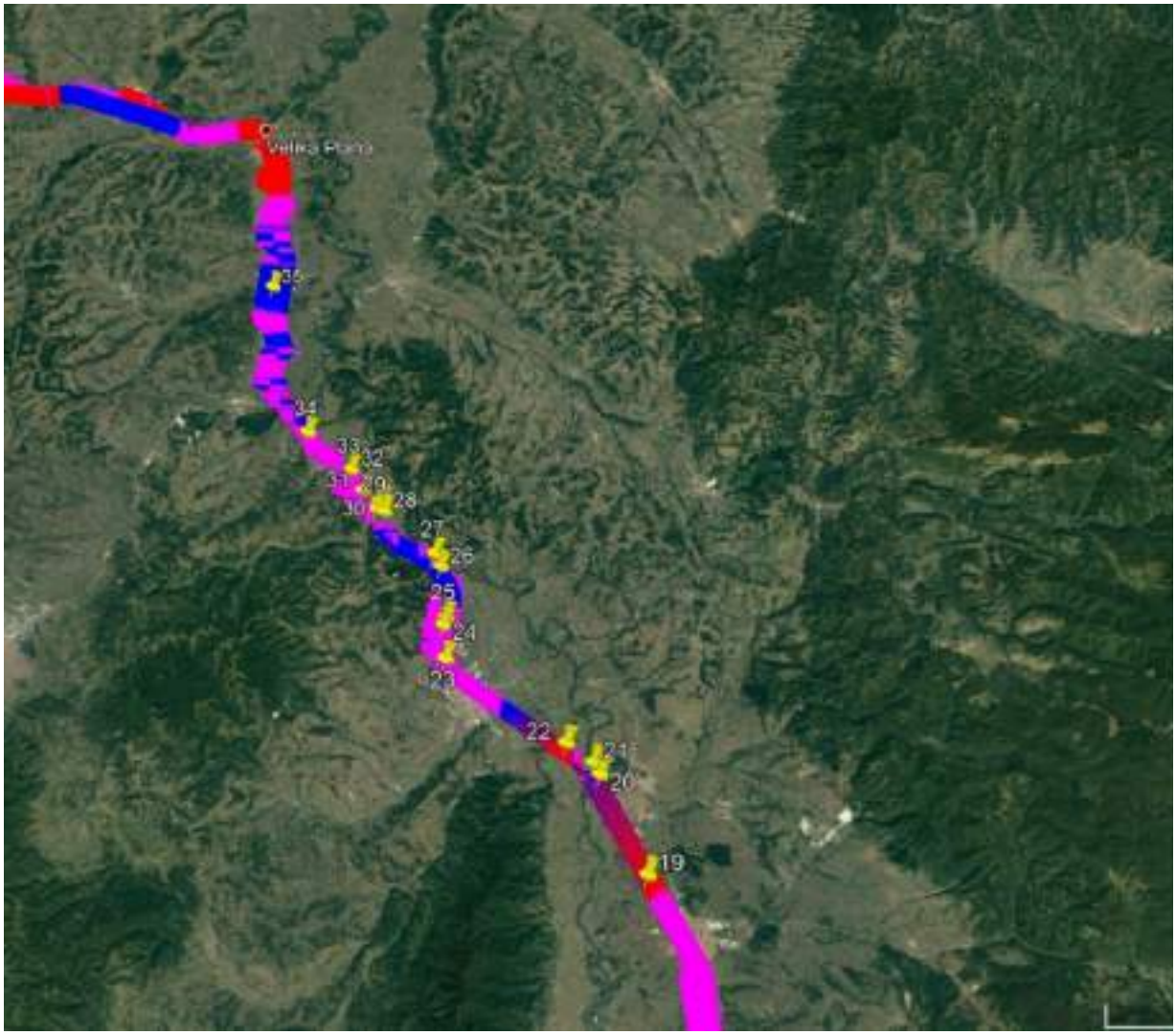

Figure 61. Habitats survey points within the Section Paraćin-Velika Plana

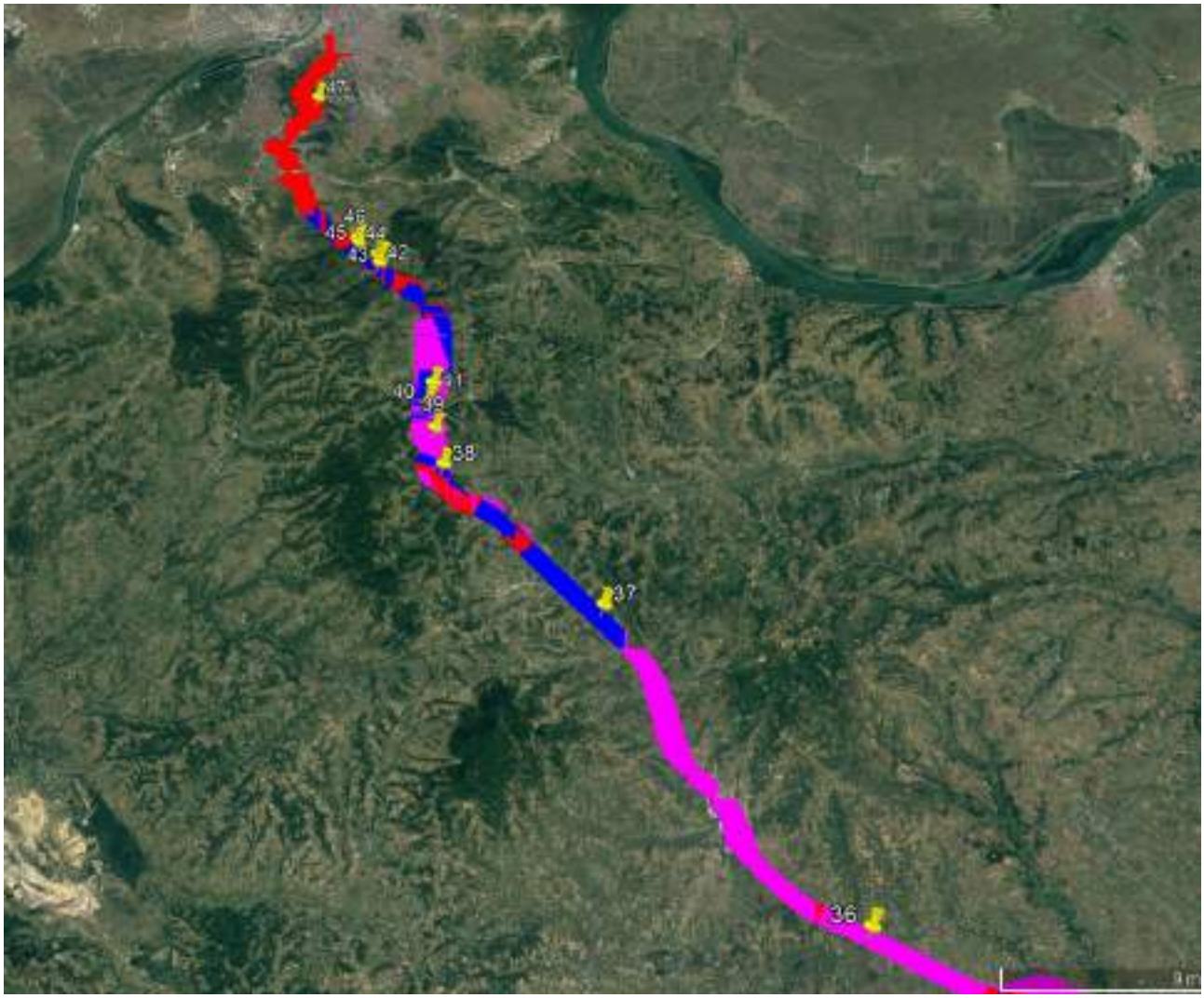

Figure 62. Habitats survey points within the Section Velika Plana-Beograd

Table 95. Coordinates of flora sample points

No.	Longitude	Latitude
1	43.3049	21.83031
2	43.30669	21.83531
3	43.38561	21.80151
4	43.39789	21.77348
5	43.39508	21.77125
6	43.39432	21.77022
7	43.57023	21.58971
8	43.57063	21.57717
9	43.579	21.57653

10	43.89067	21.3749
11	43.93647	21.34603
12	43.93299	21.34555
13	43.93057	21.34479
14	43.93117	21.3437
15	44.02288	21.23884
16	44.02538	21.23916
17	44.05301	21.22778
18	44.07884	21.19037
19	44.09094	21.17664
20	44.09719	21.16171
21	44.11525	21.15526
22	44.12643	21.12979
23	44.15187	21.10647
24	44.66226	20.50445
25	44.67258	20.49147
26	44.67434	20.49319

Figure 63. Flora survey points within the Section Niš-Paraćin

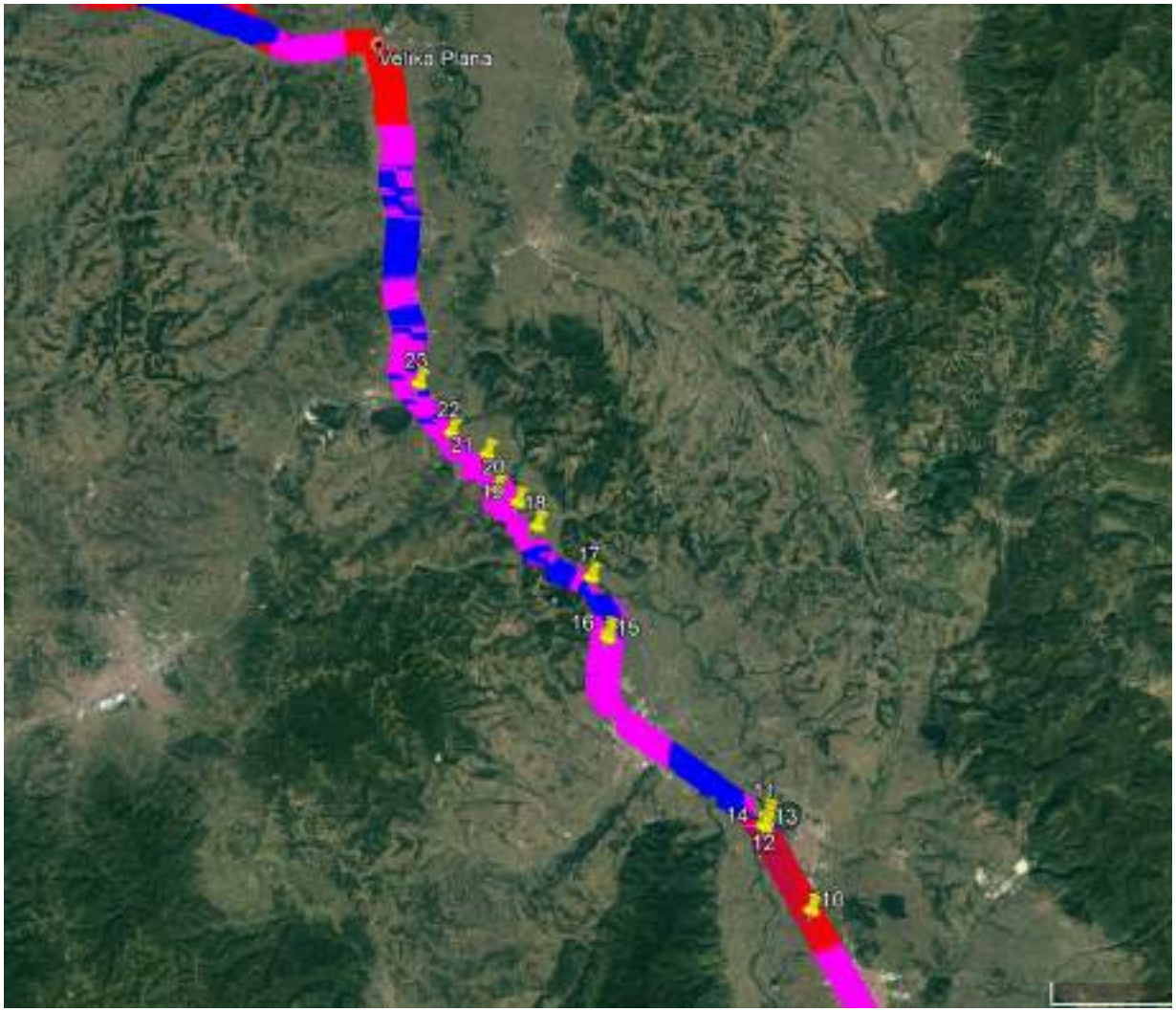

Figure 64. Flora survey points within the Section Paraćin-Velika Plana

Figure 65. Flora survey points within the Section Velika Plana-Beograd

Fauna survey

Birds

Field research related to the spring season for the ornithofauna will be conducted during the nesting season, in April and May 2023, by expert - ornithologist.

The techniques selected for the birds field study are the transect method (Sutherland et al., 2004), recording birds in the project area, and the point census method. For the ornithofauna field research, a number of transects will be determined after the field recognition. Transects will be visited in the early morning, from 05:30 to 10:00, and in the

evening, from 18:00 to 22:00. The described range synchronizes with the maximum activity of birds and at the same time, the activity of nocturnal birds. Transects were predetermined to set priorities due to the size of the research area and the short duration of the research. As the proposed design of the rehabilitated railway does not pass through any protected areas, the transects were determined based on the distance between the railway and the protected areas or IBAs (Important Bird Areas). The design of the rehabilitated railway line is foreseen to cross 2 IBAs, Gornje Pomoravlje and Dobric-Nisava.

The equipment which will be used for these investigations includes binoculars with 8x42 magnification, and telescope 20-60x80 to observe birds on open water surfaces. Photo data will be generated using Nikon and Fuji digital camera. To collect data in the field, the expert will use The NaturaList application (https://data.biolovision.net/). For each observation, the application records geographical coordinates with high precision (<5m), along with the exact date and time, and the number of encountered individuals for each species. The Collins Bird Guide - 2nd edition (Svensson, 2009) and Raptors of the World (Ferguson-Lees and Christie, 2001) will be used as identification manuals.

The locations of the survey points/areas and the transects are presented in the following tables and maps.

Table 96. Preliminary determined coordinates for survey and transect lenghts

No.	Locality name	Coordinates of transect start point		Coordinates of transect end point		Length of covered railway
Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	meters
1.	Donje Medjurovo	43.302607°	21.830407°	43.313515°	21.827143°	1235
2.	Vrtiste	43.380464°	21.805035°	43.388255°	21.793964°	1231
3.	Mezgraja	43.396981°	21.773036°	43.416783°	21.750406°	2880
4.	Bagrdan	44.087753°	21.172210°	44.100185°	21.166206°	1520
5.	Cicevac	43.703075°	21.430235°	43.712185°	21.436286°	1112
6.	Pojate	43.739190°	21.433921°	43.750653°	21.431356°	1293
7.	Paracin	43.874192°	21.391694°	43.883947°	21.384501°	1223
8.	Cuprija	43.929178°	21.351006°	43.938348°	21.343980°	1162
9.	Brzan	44.114416°	21.151044°	44.119142°	21.139545°	1082

10.	Batocina	44.144710°	21.114555°	44.152147°	21.105810°	1081
11.	Velika Plana	44.302623°	21.086508°	44.312090°	21.086433°	1073
12.	Djurinci	44.542995°	20.583396°	44.551242°	20.576584°	1119
13.	Ripanj	44.679663°	20.485047°	44.683103°	20.475209°	894
14.	Kosutnjak 1	44.749700°	20.445253°	44.758213°	20.445485°	952
15.	Kosutnjak 2	44.758629°	20.445391°	44.767185°	20.444714°	990

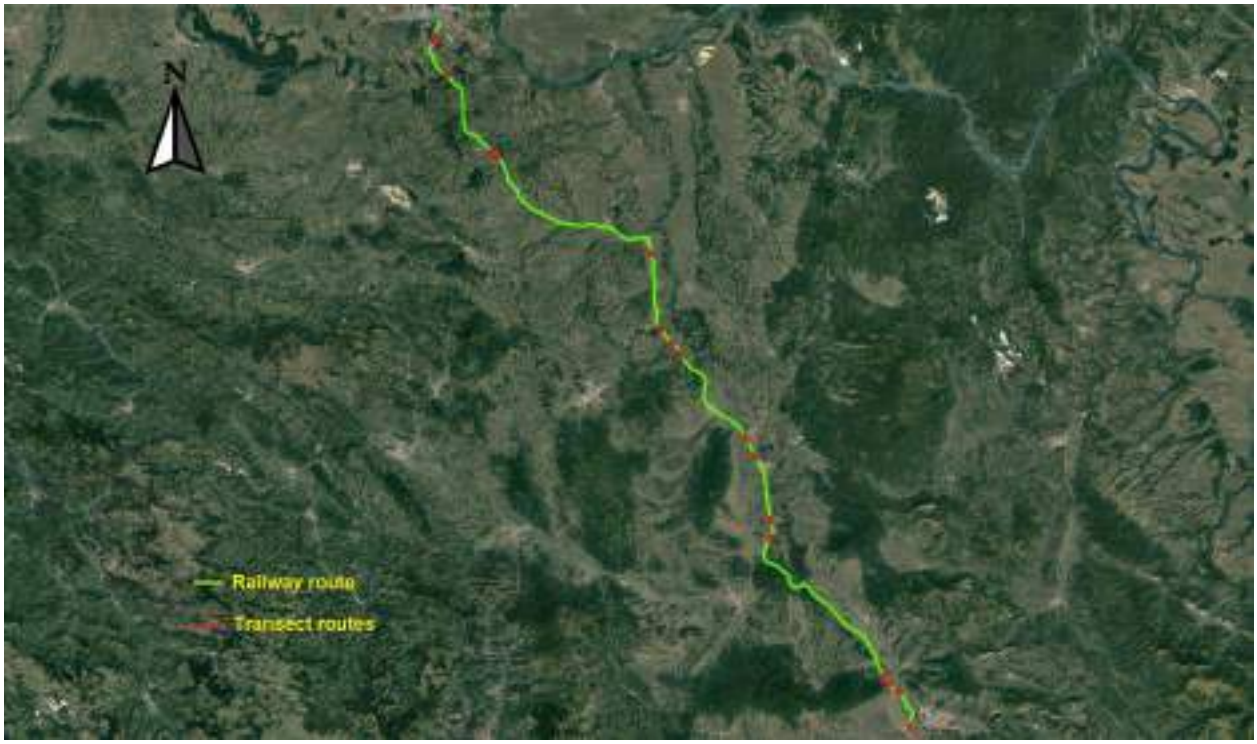

Figure 66. Positions of observation points

The species of birds which will be registered during field surveys of the Project area will be presented table form as proposed layout presented below. In the Birds Survey expert will present recorded behavioural data and particularly fly heights, for the species of interest for the protection.

Table 97. Birds survey results

No.	English name	Latin name	Location(s)	Conservation status				Suitable habitat?
				IUCN Global Red List	BD	Red Book of Serbia	Rulebook	

Mammals

Field research will be conducted in the period between March-April 2023 by expert - mammologist. Fieldwork will encompass visual inspection along the proposed route in order to obtain additional data and to check/confirm existing ones. Alive and also dead animals will be recorded along the transects as well as additional data indicative of species presence such as traces, dens, holes, burrows, and excrements will be obtained. Information on the species, locality, and date will be collected, and the specifics of the habitat recorded.

The determination of the research area will be conducted by reviewing satellite images of the habitats in Google Earth software and determining locations along the entire section of the railway that will be visited. A table summarizing the exact locations visited will be provided, along with a map presenting these locations. The focus will be given to the areas representing preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of interest for protection and other importance. Also, as some of the present mammal species in the affected area are also game species, data from management plans from the local hunting societies will be used.

Most relevant data about bat fauna along the proposed route are collected in the comprehensive documents (Paunović, 2016; Stanković, Paunović and Raković, 2018; Paunović, Karapandža, Budinski and Stamenković, 2020.). Based on the existing data about bionomy, ecology, locations and area of presence, the impact of the planned railroad will be assessed.

Table 98. Preliminary determined coordinates for survey and transect lengths

No.	Locality name	Coordinates of transect start point		Coordinates of transect end point		Length of covered railway
		Latitude	Longitude	Latitude	Longitude	meters
1	Vrtište	43°22'38.52"N	21°48'26.14"E	43°22'38.61"N	21°48'27.87"E	3070
2	Mezgraja – Veliki Drenovac	43°23'42.78"N	21°46'32.42"E	43°24'52.35"N	21°45'3.10"E	5570
3	Ratare - Striža	43°48'23.87"N	21°25'11.01"E	43°49'36.69"N	21°24'57.84"E	3160
4	Bagrdan	44° 2'59.51"N	21°14'2.57"E	44° 5'43.83"N	21° 9'52.82"E	16110
5	Bresje	44°20'10.22"N	21° 1'37.64"E	44°20'16.85"N	21° 0'25.33"E	2030

6	Ripanj	44°40'20.18"N	20°29'33.02"E	44°41'44.32"N	20°27'23.83"E	5330

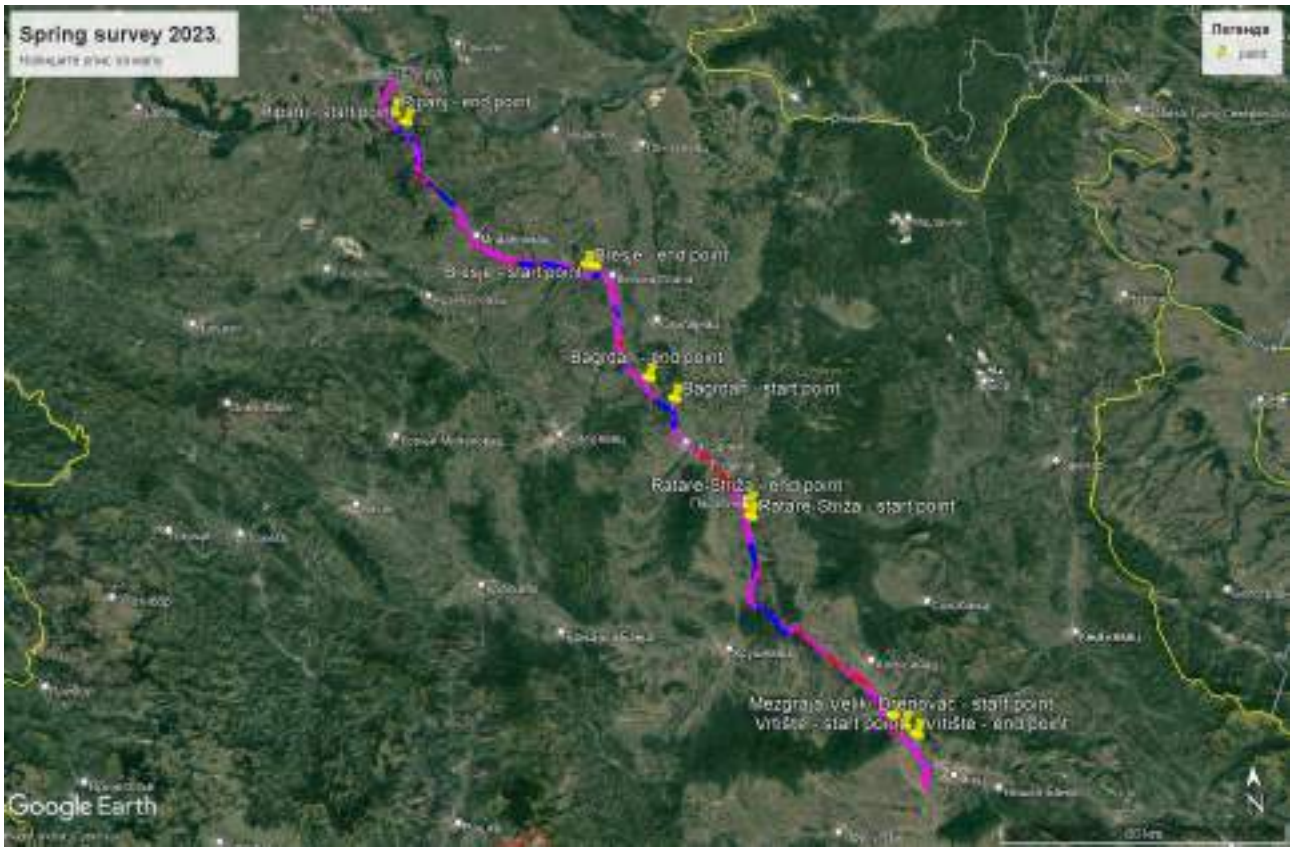

Figure 67. Positions of observation points

The species of mammals which will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is presented here below:

Table 99. Mammals survey results

No.	English name	Latin name	Locations	IUCN		BC	HD	Suitable habitat?	Rulebook
				Global	Serbia				

Insects

Insects survey will cover the presence and literature records of several insect groups, namely butterflies, beetles orthopterans, and dragonflies. All insects will be recorded during the spring field visits at locations identified by

overlaying satellite images and project infrastructure. The field surveys will be implemented in the period between March and April 2023. Insects will be caught, if necessary, with a hand entomological net (securing that insects will not be killed, collected in case identification could not be done in the field), and photographed.

The determination of the research area will be conducted by reviewing satellite images of the habitats in Google Earth software and determining locations along the entire section of the railway that will be visited. A table summarizing the exact locations visited will be provided, along with a map presenting these locations. The focus will be given to the areas representing more preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of importance for protection.

The species of insects that will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

The locations of the survey points/areas are presented in the following tables and supported by appropriate maps.

Table 100. Preliminary determined coordinates for survey

E	N	Location	City
44.7176	20.4433	Resnik	Belgrade, City municipality Rakovica
44.7071	20.4446	Resnik_2	Belgrade, City municipality Vozdovac
44.6806	20.4831	Pinosava_2	Belgrade, City municipality Vozdovac
44.6709	20.4958	Ripanj	Belgrade, City municipality Vozdovac
44.6110	20.5348	Mala Ivanca	Belgrade, City municipality Sopot
44.609356	20.533312	Mala Ivanca 2	Belgrade, City municipality Sopot
44.5916	20.5342	Ralja	Belgrade, City municipality Sopot
44.571962	20.539870	Ralja River	Belgrade, City municipality Sopot
44.5655	20.5367	Parcani	Belgrade, City municipality Sopot
44.5574	20.5561	Ralja_2	Belgrade, City municipality Sopot
44.5459	20.5818	Sopot	Belgrade, City municipality Sopot
44.5103	20.6311	Djurinci	Belgrade, City municipality Sopot
44.4935	20.6524	Vlaska	Belgrade, City municipality Mladenovac
44.3940	20.7583	Kusadak	Smederevska Palanka
44.3864	20.7709	Kusadak_2	Smederevska Palanka
44.375193	20.823543	Kusadak railway station 1	Smederevska Palanka
44.3749	20.8260	Kusadak railway station 2	Smederevska Palanka
44.2223	21.0927	Markovac	Velika Plana
44.1517	21.1065	Batočina	Batočina

44.148092	21.106856	Rogot	Batočina
44.09025	21.17504	Bagrdanske bare	Jagodina
44.091536	21.183644	Bagrdan	Jagodina
44.082735	21.188454	Velika Morava/Suspension Bridge	Jagodina
44.081863	21.182610	Bagrdan, railway crossing	Jagodina
44.0245	21.2331	Novo laniste	Jagodina
44.0219	21.2406	Novo laniste_2	Jagodina
44.0454	21.23555	Novo lanište_3	Jagodina
44.024964	21.229561	Bukovce-Novo lanište	Jagodina
44.0110	21.2374	Bukovce	Jagodina
44.0020	21.2386	Bukovce_2	Jagodina
43.93259	21.35011	Velika Morava River	Ćuprija
43.93862	21.34583	Velika Morava River– bridge	Ćuprija
43.7891	21.4220	Gornje Vidovo	Paraćin
43.88298	21.38093	Drenovac	Paraćin
43.884135	21.384939	Sikirica	Paraćin
43.6482	21.4659	Braljina Rasinska	Ćićevac
43.6473	21.4527	Braljina Rasinska_2	Ćićevac
43.6166	21.4840	Trubarevo	Ćićevac
43.6083	21.4878	Trubarevo_2	Ćićevac
43.5990	21.5452	Vitkovac	Aleksinac
43.5738	21.5816	Srezovac	Aleksinac
43.5196	21.6584	Donji Adrovac	Aleksinac
43.4390	21.7379	Bankovac/Tešica	Aleksinac
43.3970	21.7743	Mezgraja	Niš
43.3802	21.8060	Vrtiste	Niš
43.3673	21.8121	Vrtiste_2	Niš
43.3244	21.8289	Milka Protic	Niš
43.3122	21.8284	Deveti maj	Niš
43.322663	21.825890	Donje Međurovo 1	Niš
43.316333	21.826373	Donje Međurovo 2	Niš

Figure 68. Positions of observation points Section 1

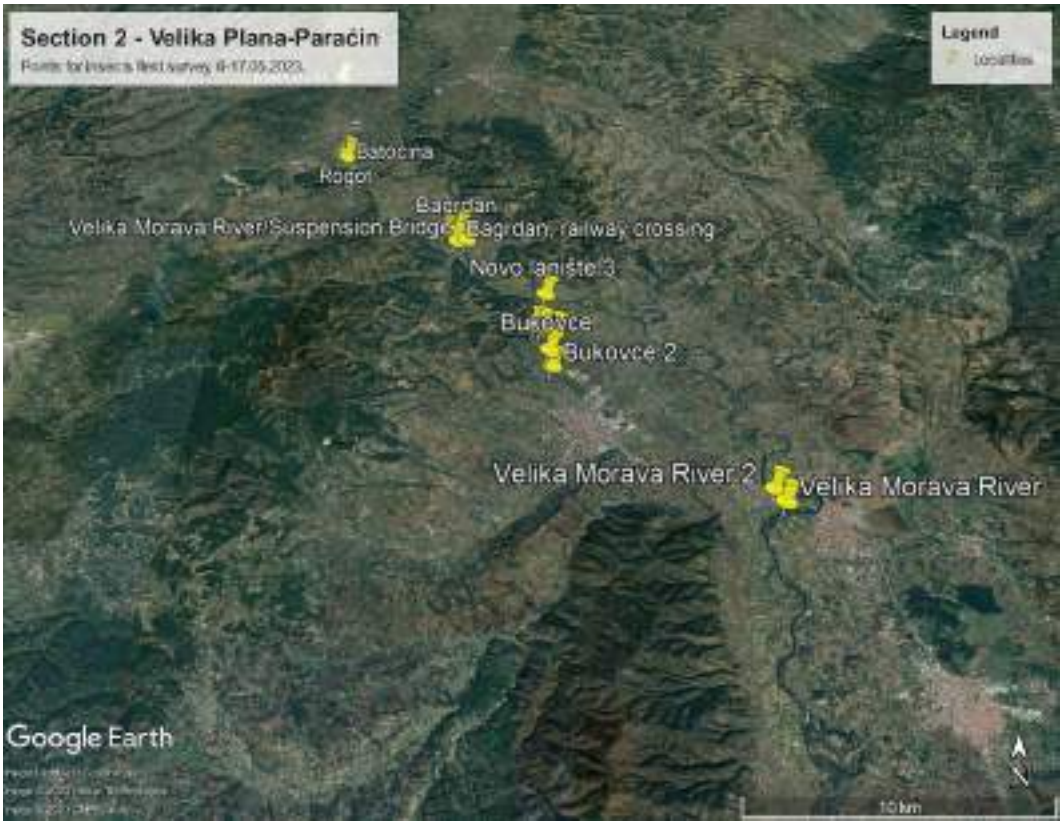

Figure 69. Positions of observation points Section 2

Figure 70. Positions of observation points Section 3

Table 101. Insects survey results

English name (and group)	Latin name	Data type (desktop/field)	The number of specimens observed	Conservation status				
				IUCN global red list	Red Book of Serbia	HD	BC	Rulebook

The significant species that can be expected within the project area will be described in detail.

Herpetofauna

Field research for herpetofauna will be conducted in the period between March and April 2023 (by expert-herpetologist. Fieldwork will encompass visual inspection along transects or detailed inspections of relevant amphibian and reptile-suitable habitats (i.e. ponds, canals, suitable places for basking, natural or artificial shelters). Information on the species, locality, and date will be collected, and the specifics of the habitat recorded. After

processing and photographs, each individual will be returned unharmed to the place of catch. To determine the species, the experts will use the field guide for the Reptiles and Amphibians of Britain and Europe (Arnold and Ovenden, 2002).

Regarding the sites selected for the field investigations, the choices were made based on literature data and previous field experience. The sites with a protection regime or sites characterized by habitat mosaic and less anthropogenic impact were privileged.

The experts will adapt their work to the different periods of activities and preferences regarding habitat and temperature conditions between amphibians and reptiles. Challenges in the complete study of species can also occur inside the same category, as some species of amphibians have explosive reproduction lasting only a couple of days at the beginning of spring, making later observation near impossible.

The locations of the surveys points/areas and the transects are presented in appropriate tables (with coordinates) and maps.

The species of amphibians and reptiles which will be recorded during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

Table 102. Herpetofauna survey results

English name	Latin name	Location(s), if found, and Literature reference	Conservation status					Suitable habitat in area
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook	

The significant species that can be expected within the project area will be described in detail.

Table 103. Preliminary determined coordinates for survey

No.	Locality	Coordinates	
		Latitude	Longitude
1.	Donje Medjurovo	43.302607°	21.830407°
2.	Vrtiste	43.380464°	21.805035°
3.	Mezgraja	43.396981°	21.773036°
4.	Bagrdan	44.087753°	21.172210°
5.	Cicevac	43.703075°	21.430235°
6.	Pojate	43.739190°	21.433921°
7.	Paracin	43.874192°	21.391694°
8.	Cuprija	43.929178°	21.351006°

9.	Brzan	44.114416°	21.151044°
10.	Batocina	44.144710°	21.114555°
11.	Velika Plana	44.302623°	21.086508°
12.	Djurinci	44.542995°	20.583396°
13.	Ripanj	44.679663°	20.485047°
14.	Kosutnjak 1	44.749700°	20.445253°
15.	Kosutnjak 2	44.758629°	20.445391°

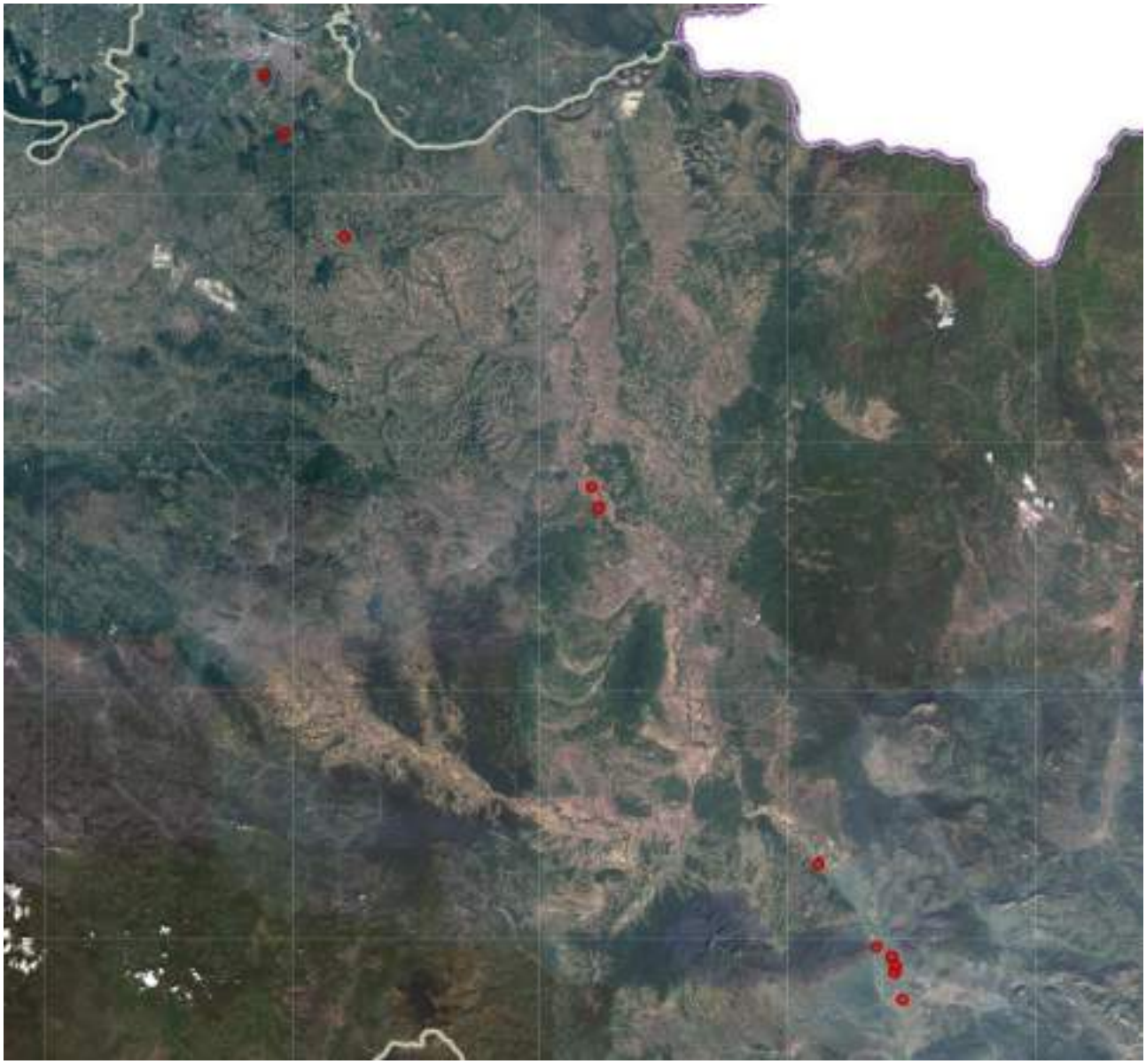

Figure 71. Positions of observation points

Summer season

Flora and habitat survey

Field surveys related to flora and habitats for the summer season will be performed at the beginning of July 2023.

The determination of the research area will be done during the spring field survey and the same locations will be visited in summer, along the entire section of the railway. A table summarizing the exact locations visited will be updated based on spring findings, if it would be necessary, along with a map presenting these locations.

The floristic inventory for the sample points will be conducted either directly in the field or by collecting voucher specimens for laboratory identification. The classification of the present habitat types follows EUNIS version 2012 (amended 2019), and the digitalization will be performed using ArcGISPro within the final report.

The locations of the survey points/areas will be presented in appropriate tables (with coordinates) and maps. The results of the surveys will be presented for each polygon, for both the habitats and the flora in the final biodiversity survey report, after completed field surveys in all seasons. Also, maps of habitats will be provided, giving information on the polygons, survey points, sampled points, and other relevant information (e.g. settlements, protected areas, other infrastructure, etc.) in the final biodiversity survey report, after completed field surveys in all seasons.

The flora species which will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

Table 104. Flora survey results

No.	Latin name	English name	Habitat	Conservation status				
				IUCN Global Red List	HD	Bern	CITES	Rulebook (Serbian Law: SP/P)

Table 105. Coordinates of habitat survey points

No.	Longitude	Latitude
1	43.30692	21.83387
2	43.30525	21.82832
3	43.31236	21.825
4	43.316333	21.826373
5	43.37982	21.80619
6	43.38156	21.80636

7	43.3825	21.8039
8	43.38483	21.80066
9	43.39044	21.7873
10	43.39139	21.78479
11	43.39168	21.78105
12	43.40632	21.76152
13	43.427822	21.751280
14	43.56186	21.59074
15	43.58538	21.5591
16	43.58771	21.55463
17	43.59228	21.55945
18	43.602689	21.543882
19	43.88289	21.38093
20	43.93259	21.35011
21	43.93862	21.34583
22	43.9488	21.3268
23	43.99407	21.24057
24	44.01252	21.2383
25	44.01677	21.23997
26	44.0454	21.23555
27	44.05297	21.23083
28	44.07796	21.19153
29	44.07946	21.18592
30	44.08388	21.18748
31	44.09025	21.17504
32	44.1036	21.16562
33	44.10322	21.16494
34	44.12643	21.12979
35	44.2223	21.0927
36	44.394020	20.7583
37	44.513003	20.629715
38	44.57253	20.54061
39	44.58848	20.53495
40	44.60057	20.53013
41	44.60968	20.53272
42	44.66873	20.49681
43	44.6715	20.49757
44	44.67259	20.49563
45	44.6788	20.48369
46	44.68124	20.48251
47	44.75826	20.45093

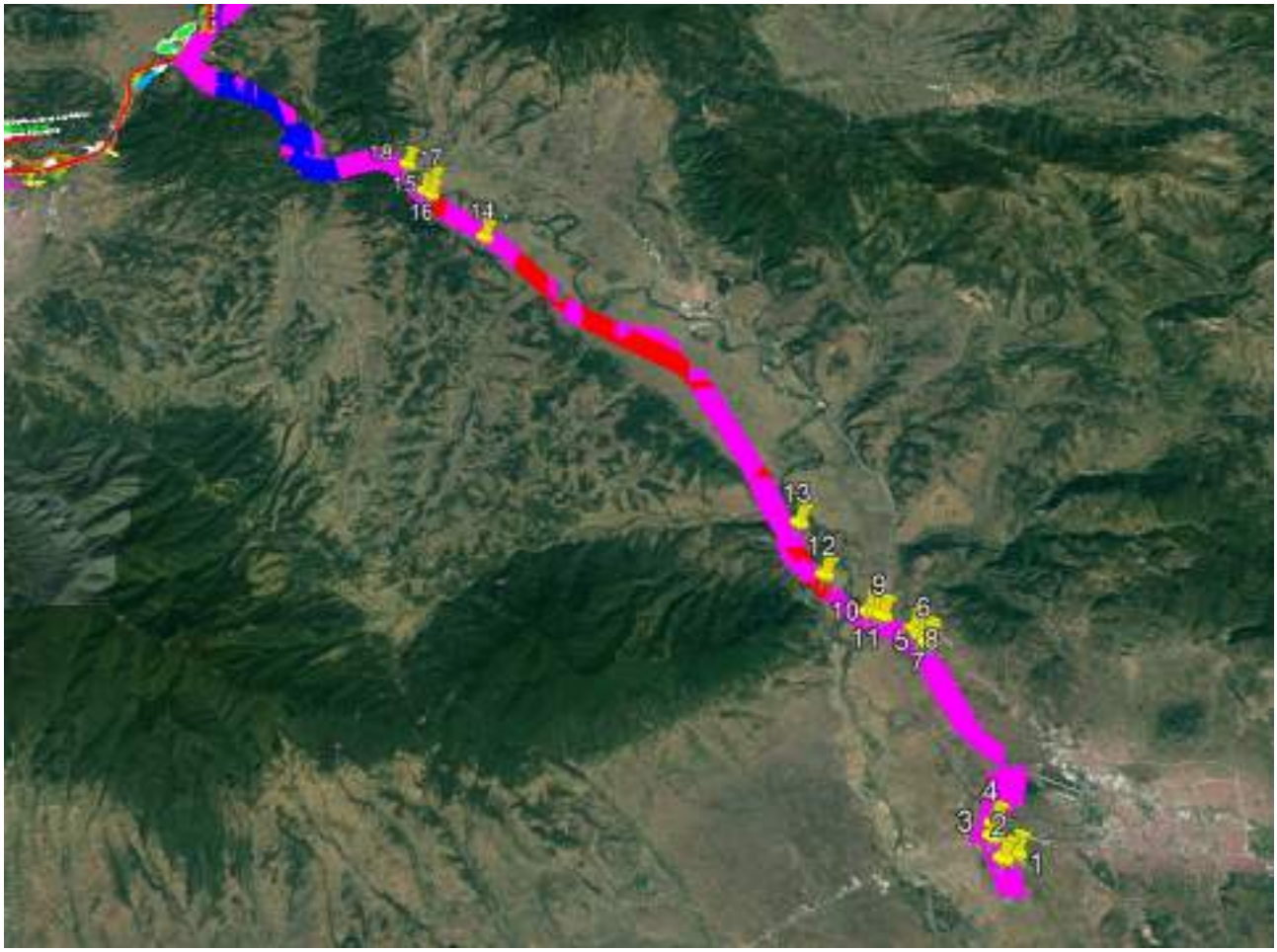

Figure 72. Habitats survey points within the Section Niš-Paraćin

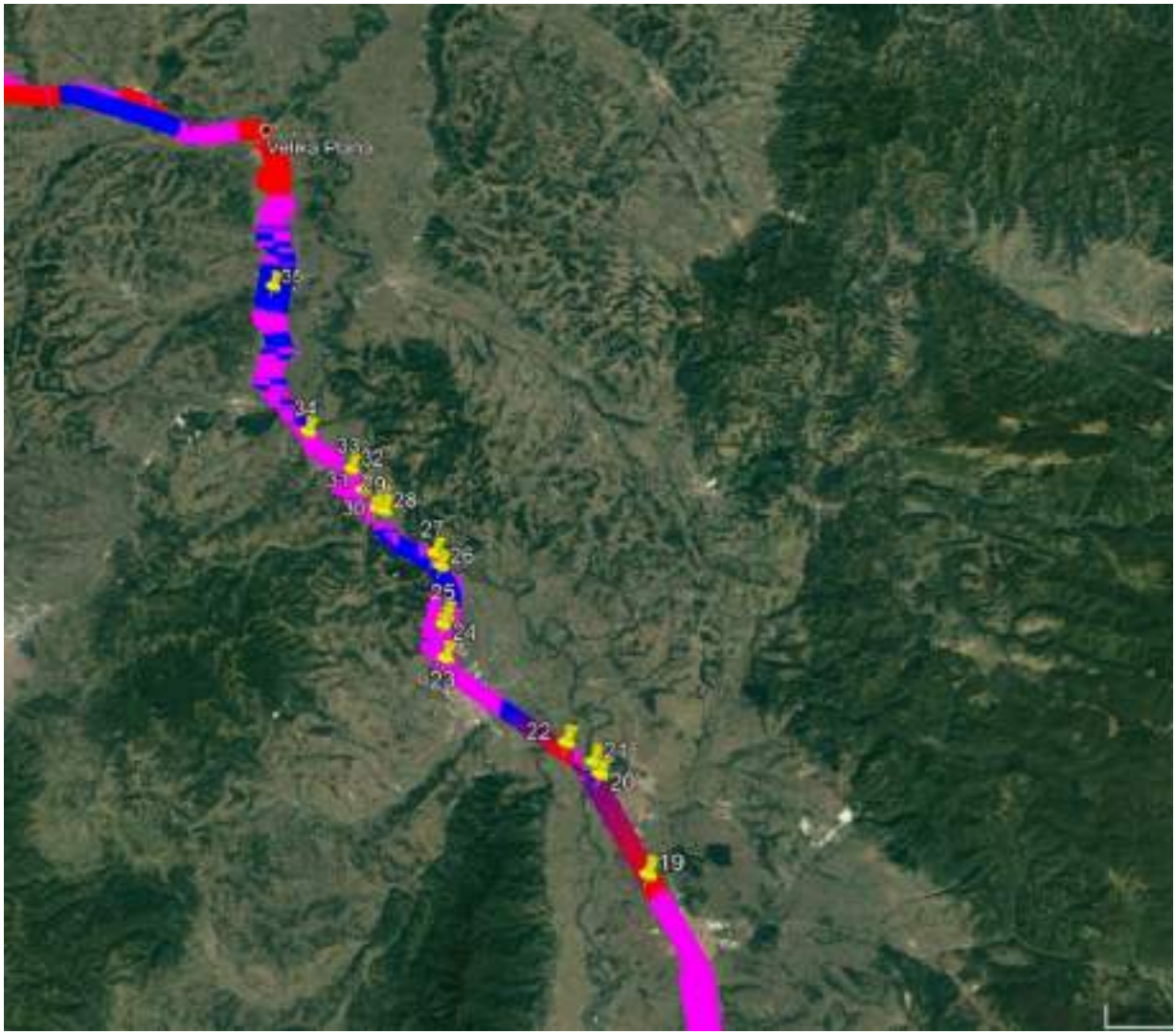

Figure 73. Habitats survey points within the Section Paraćin-Velika Plana

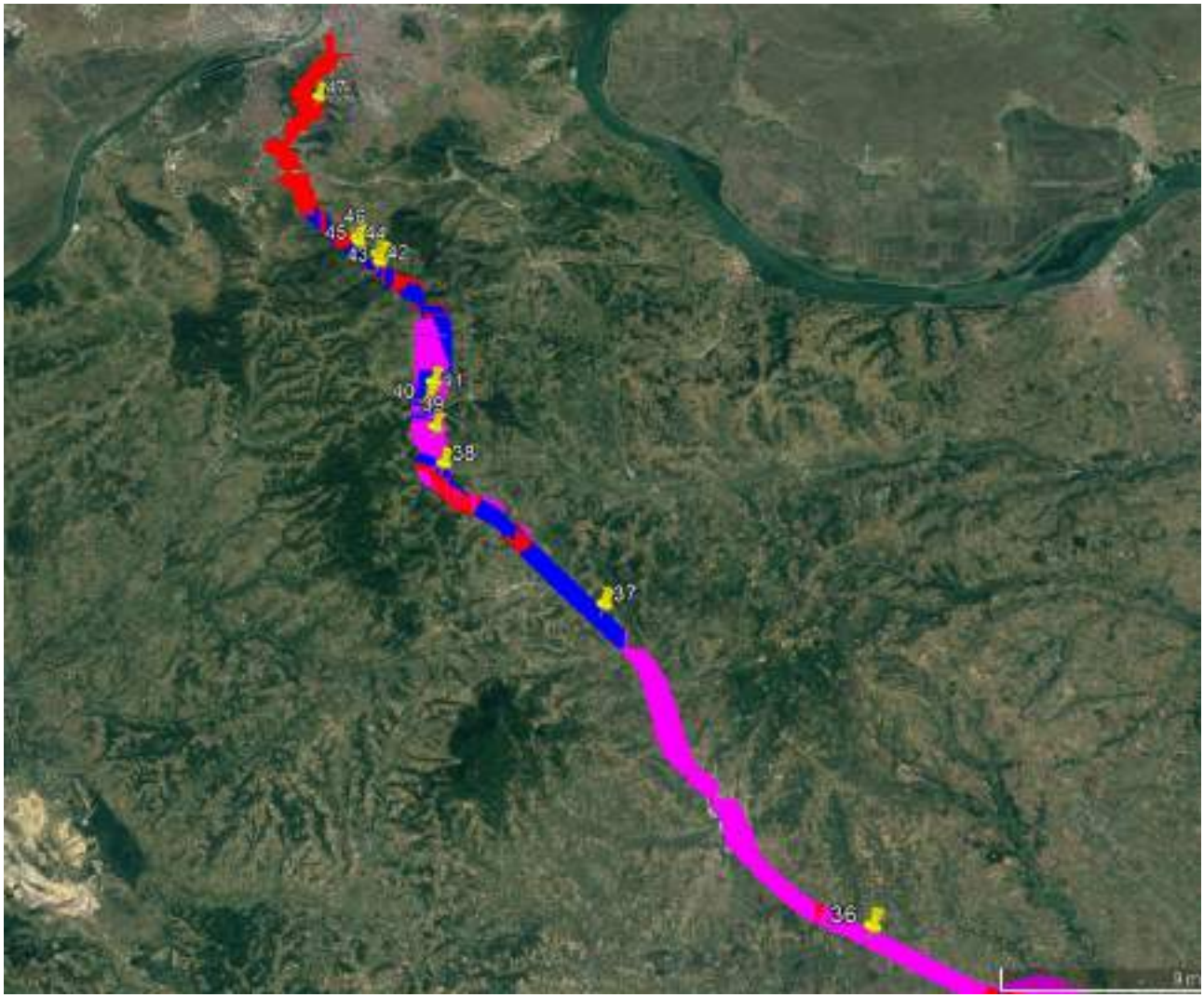

Figure 74. Habitats survey points within the Section Velika Plana-Beograd

Table 106. Coordinates of flora sample points

No.	Longitude	Latitude
1	43.3049	21.83031
2	43.30669	21.83531
3	43.38561	21.80151
4	43.39789	21.77348
5	43.39508	21.77125
6	43.39432	21.77022
7	43.57023	21.58971
8	43.57063	21.57717
9	43.579	21.57653

10	43.89067	21.3749
11	43.93647	21.34603
12	43.93299	21.34555
13	43.93057	21.34479
14	43.93117	21.3437
15	44.02288	21.23884
16	44.02538	21.23916
17	44.05301	21.22778
18	44.07884	21.19037
19	44.09094	21.17664
20	44.09719	21.16171
21	44.11525	21.15526
22	44.12643	21.12979
23	44.15187	21.10647
24	44.66226	20.50445
25	44.67258	20.49147
26	44.67434	20.49319

Figure 75. Flora survey points within the Section Niš-Paraćin

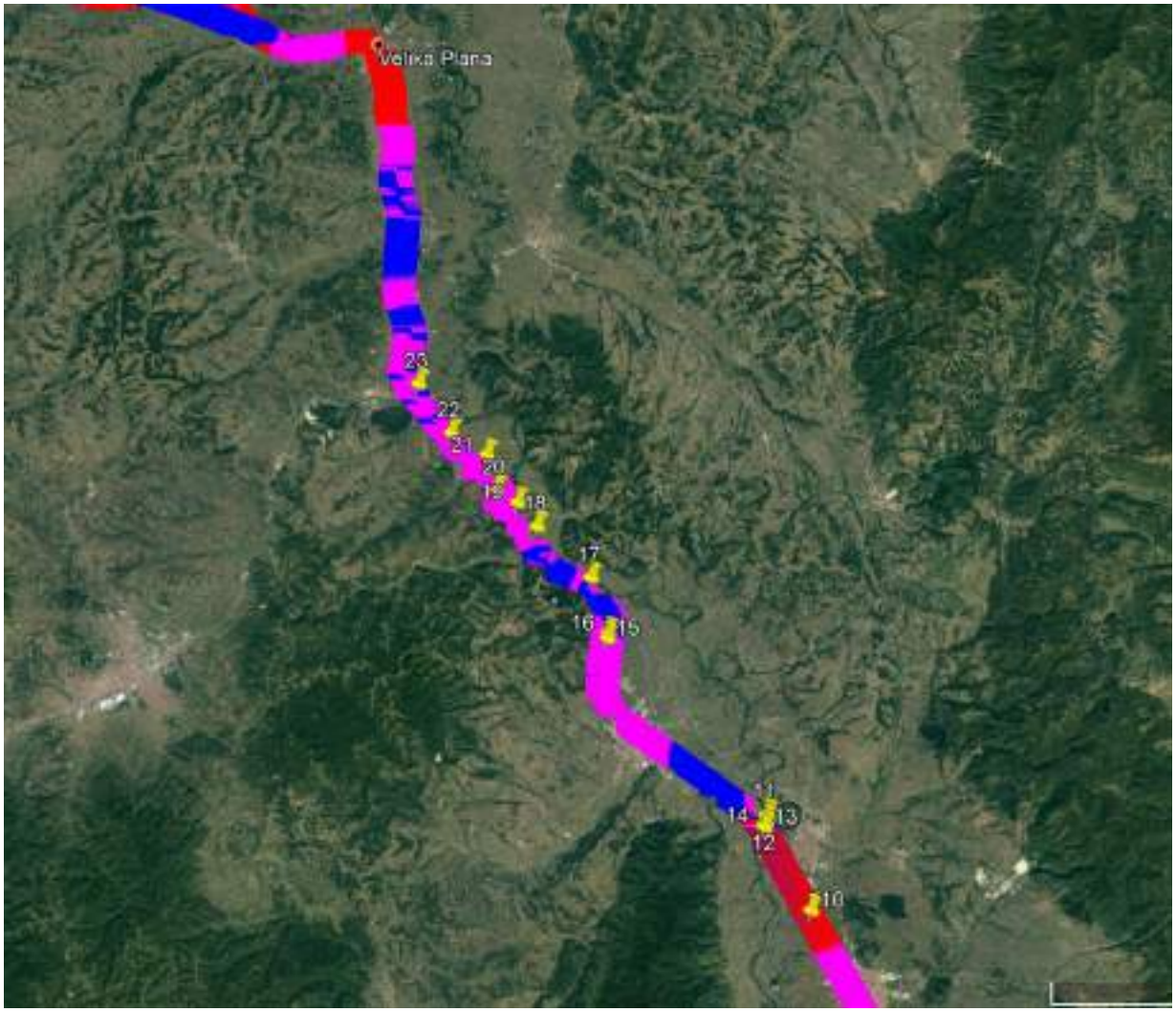

Figure 76. Flora survey points within the Section Paraćin-Velika Plana

Figure 77. Flora survey points within the Section Velika Plana-Beograd

Fauna survey

Birds

Field research related to the summer season for the ornithofauna will be conducted during the nesting season, in July 2023, by an expert - ornithologist.

The techniques selected for the birds field study are the transect method (Sutherland et al., 2004), recording birds in the project area, and the point census method. Transects will be visited in the early morning, from 05:30 to 10:00, and in the evening, from 18:00 to 22:00. The described range synchronizes with the maximum activity of birds and

at the same time, the activity of nocturnal birds. Transects were predetermined to set priorities due to the size of the research area and the short duration of the research. As the proposed design of the rehabilitated railway does not pass through any protected areas, the transects were determined based on the distance between the railway and the protected areas or IBAs (Important Bird Areas). The design of the rehabilitated railway line is foreseen to cross 2 IBAs, Gornje Pomoravlje and Dobric-Nisava.

The equipment Ih will be used for these investigations includes binoculars with 8x42 magnification,and telescope 20-60x80 to observe birds on the open water surface. Photo data will be generated using Nikon and Fuji digital camera. To collect data in the field, the expert will use the NaturaList application (https://data.biolovision.net/). For each observation, the application records geographical coordinates with high precision (<5m), along with the exact date and time, and the number of encountered individuals for each species. The Collins Bird Gu–de - 2nd edition (Svensson, 2009) and Raptors of the World (Ferguson-Lees and Christie, 2001) will be used as identification manuals.

The locations of the surveys points/areas and the transects are presented in the following tables and maps.

Table 107. Preliminary determined coordinates for survey and transect lengths

No.	Locality name	Coordinates of transect start point		Coordinates of transect end point		Length of covered railway
Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	meters
1.	Donje Medjurovo	43.302607°	21.830407°	43.313515°	21.827143°	1235
2.	Vrtiste	43.380464°	21.805035°	43.388255°	21.793964°	1231
3.	Mezgraja	43.396981°	21.773036°	43.416783°	21.750406°	2880
4.	Bagrdan	44.087753°	21.172210°	44.100185°	21.166206°	1520
5.	Cicevac	43.703075°	21.430235°	43.712185°	21.436286°	1112
6.	Pojate	43.739190°	21.433921°	43.750653°	21.431356°	1293
7.	Paracin	43.874192°	21.391694°	43.883947°	21.384501°	1223
8.	Cuprija	43.929178°	21.351006°	43.938348°	21.343980°	1162
9.	Brzan	44.114416°	21.151044°	44.119142°	21.139545°	1082
10.	Batocina	44.144710°	21.114555°	44.152147°	21.105810°	1081
11.	Velika Plana	44.302623°	21.086508°	44.312090°	21.086433°	1073
12.	Djurinci	44.542995°	20.583396°	44.551242°	20.576584°	1119
13.	Ripanj	44.679663°	20.485047°	44.683103°	20.475209°	894
14.	Kosutnjak 1	44.749700°	20.445253°	44.758213°	20.445485°	952
15.	Kosutnjak 2	44.758629°	20.445391°	44.767185°	20.444714°	990

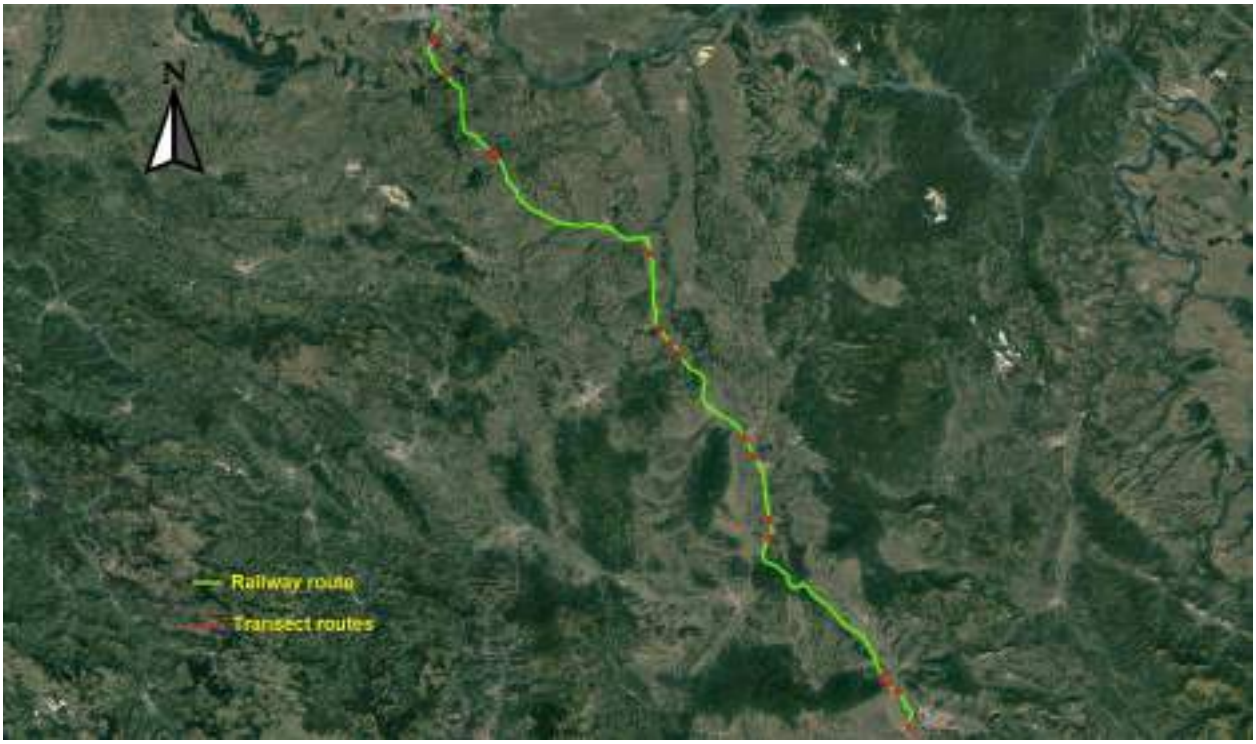

Figure 78. Positions of observation points

The species of birds which will be registered during field and/or desktop surveys of the Project area will be presented in Table 108, for which the proposed layout is presented here below. In the Birds Survey expert will present recorded behavioral data and particularly fly heights; for the species of interest for the protection, to collect data necessary to assess collision risk in the ESIA.

Table 108. Birds survey result

No.	English name	Latin name	Location(s)	Conservation status				Suitable habitat?
				IUCN Global Red List	BD	Red Book of Serbia	Rulebook	

Mammals

Field research will be conducted in July 2023 by a specialist mammologist. Fieldwork will encompass visual inspection along the proposed route in order to obtain additional data and to check/confirm existing ones. Alive and also dead animals will be recorded along the transects as well as additional data indicative of species presence such

as traces, dens, holes, burrows, and excrements will be obtained. Information on the species, locality, and date will be collected, and the specifics of the habitat recorded.

The determination of the research area will be conducted by reviewing satellite images of the habitats in Google Earth software and determining locations along the entire section of the railway that will be visited. A table summarizing the exact locations visited will be provided, along with a map presenting these locations. The focus will be given to the areas representing preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of interest for protection and other importance. Also, as some of the present mammal species in the affected area are also game species, data from management plans from the local hunting societies will be used.

Most relevant data about bat fauna along the proposed route are collected in the comprehensive documents (Paunović, 2016; Stanković, Paunović and Raković, 2018; Paunović, Karapandža, Budinski and Stamenković, 2020.). Based on the existing data about bionomy, ecology, locations and area of presence, the impact of the planned railroad will be assessed.

Table 109. Preliminary determined coordinates for survey and transect lengths

No.	Locality name	Coordinates of transect start point		Coordinates of transect end point		Length of covered railway
		Latitude	Longitude	Latitude	Longitude	meters
1	Vrtište	43°22'38.52"N	21°48'26.14"E	43°22'38.61"N	21°48'27.87"E	3070
2	Mezgraja – Veliki Drenovac	43°23'42.78"N	21°46'32.42"E	43°24'52.35"N	21°45'3.10"E	5570
3	Ratare - Striža	43°48'23.87"N	21°25'11.01"E	43°49'36.69"N	21°24'57.84"E	3160
4	Bagrdan	44° 2'59.51"N	21°14'2.57"E	44° 5'43.83"N	21° 9'52.82"E	16110
5	Bresje	44°20'10.22"N	21° 1'37.64"E	44°20'16.85"N	21° 0'25.33"E	2030
6	Ripanj	44°40'20.18"N	20°29'33.02"E	44°41'44.32"N	20°27'23.83"E	5330

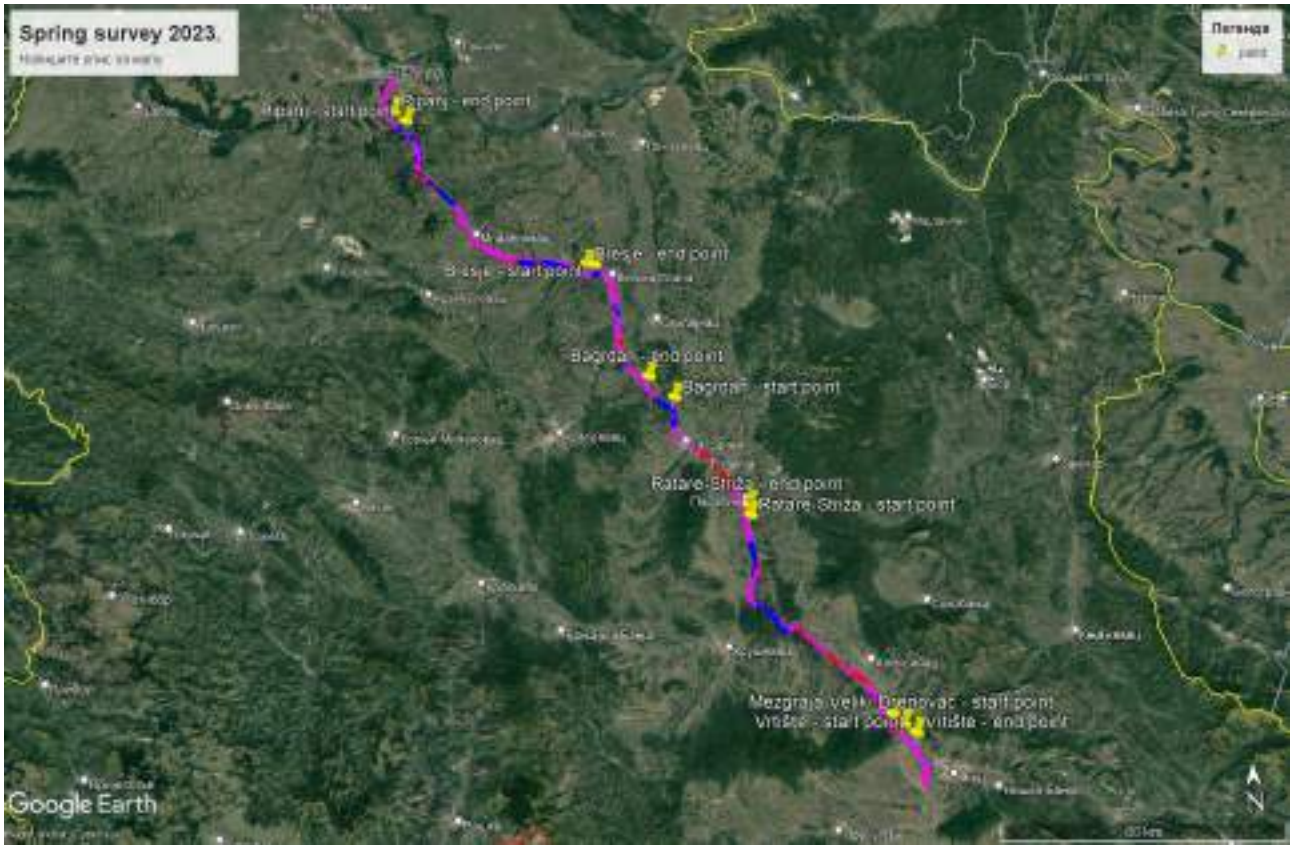

Figure 79. Positions of observation points (will be updated after the summer field survey)

The species of mammals which will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

Table 110. Mammals survey results

No.	English name	Latin name	Locations	IUCN		BC	HD	Suitable habitat?	Rulebook
				Global	Serbia				

Insects

During the summer field survey, all insects will be recorded at given locations determined by overlaying satellite images and project infrastructure. The field investigations related to insects will be implemented in July 2023. Insects will be caught, if necessary, with a hand entomological net (securing that insects will not be killed, collected in case identification could not be done in the field), and photographed.

The determination of the research area will be done during the spring field survey and the same locations will be visited in summer, along the entire section of the railway. A table summarizing the exact locations visited will be updated based on spring findings, if it would be necessary, along with a map presenting these locations. The focus will be on areas representing more preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of importance for protection. Figures 80–82–81 will be updated after the summer field survey.

The species of insects that will be registered during field and/or desktop surveys of the Project area will be presented in a table and maps.

Table 111. Preliminary determined coordinates for survey

E	N	Location	City
44.7176	20.4433	Resnik	Belgrade, City municipality Rakovica
44.7071	20.4446	Resnik_2	Belgrade, City municipality Vozdovac
44.6806	20.4831	Pinosava_2	Belgrade, City municipality Vozdovac
44.6709	20.4958	Ripanj	Belgrade, City municipality Vozdovac
44.6110	20.5348	Mala Ivanca	Belgrade, City municipality Sopot
44.609356	20.533312	Mala Ivanca 2	Belgrade, City municipality Sopot
44.5916	20.5342	Ralja	Belgrade, City municipality Sopot
44.571962	20.539870	Ralja River	Belgrade, City municipality Sopot
44.5655	20.5367	Parcani	Belgrade, City municipality Sopot
44.5574	20.5561	Ralja_2	Belgrade, City municipality Sopot
44.5459	20.5818	Sopot	Belgrade, City municipality Sopot
44.5103	20.6311	Djurinci	Belgrade, City municipality Sopot
44.4935	20.6524	Vlaska	Belgrade, City municipality Mladenovac
44.3940	20.7583	Kusadak	Smederevska Palanka
44.3864	20.7709	Kusadak_2	Smederevska Palanka
44.375193	20.823543	Kusadak railway station 1	Smederevska Palanka
44.3749	20.8260	Kusadak railway station 2	Smederevska Palanka
44.2223	21.0927	Markovac	Velika Plana
44.1517	21.1065	Batočina	Batočina
44.148092	21.106856	Rogot	Batočina
44.09025	21.17504	Bagrdanske bare	Jagodina
44.091536	21.183644	Bagrdan	Jagodina
44.082735	21.188454	Velika Morava/Suspension Bridge	Jagodina
44.081863	21.182610	Bagrdan, railway crossing	Jagodina
44.0245	21.2331	Novo laniste	Jagodina

44.0219	21.2406	Novo laniste_2	Jagodina
44.0454	21.23555	Novo lanište_3	Jagodina
44.024964	21.229561	Bukovce-Novo lanište	Jagodina
44.0110	21.2374	Bukovce	Jagodina
44.0020	21.2386	Bukovce_2	Jagodina
43.93259	21.35011	Velika Morava River	Ćuprija
43.93862	21.34583	Velika Morava River– bridge	Ćuprija
43.7891	21.4220	Gornje Vidovo	Paraćin
43.88298	21.38093	Drenovac	Paraćin
43.884135	21.384939	Sikirica	Paraćin
43.6482	21.4659	Braljina Rasinska	Ćićevac
43.6473	21.4527	Braljina Rasinska_2	Ćićevac
43.6166	21.4840	Trubarevo	Ćićevac
43.6083	21.4878	Trubarevo_2	Ćićevac
43.5990	21.5452	Vitkovac	Aleksinac
43.5738	21.5816	Srezovac	Aleksinac
43.5196	21.6584	Donji Adrovac	Aleksinac
43.4390	21.7379	Bankovac/Tešica	Aleksinac
43.3970	21.7743	Mezgraja	Niš
43.3802	21.8060	Vrtiste	Niš
43.3673	21.8121	Vrtiste_2	Niš
43.3244	21.8289	Milka Protic	Niš
43.3122	21.8284	Deveti maj	Niš
43.322663	21.825890	Donje Međurovo 1	Niš
43.316333	21.826373	Donje Međurovo 2	Niš

Figure 80. Positions of observation points Section 1

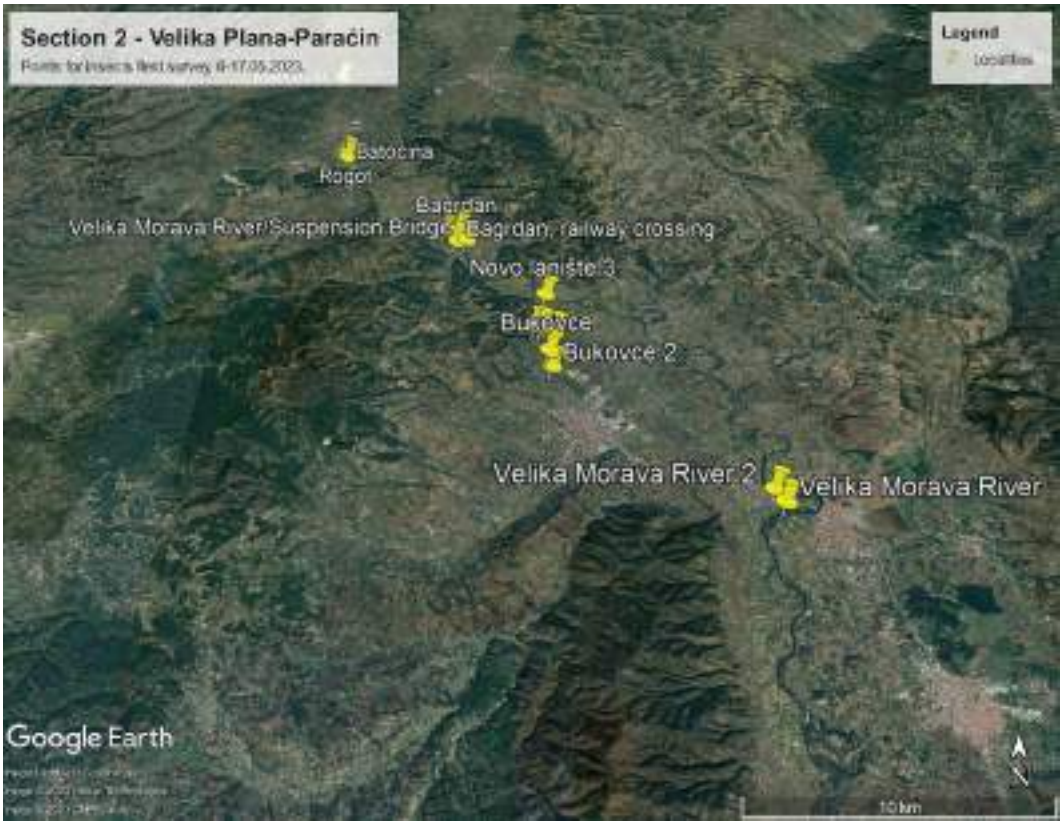

Figure 81. Positions of observation points Section 2

Figure 82. Positions of observation points Section 3

Table 112. Insects survey results

English name (and group)	Latin name	Data type (desktop/field)	The number of specimens observed	Conservation status				
				IUCN global red list	Red Book of Serbia	HD	BC	Rulebook

Herpetofauna

Field research for herpetofauna will be conducted in July 2023 (a total of 6 field days) by herpetologist. Fieldwork will encompass visual inspection along transects or detailed inspections of relevant amphibian and reptile-suitable habitats (i.e. ponds, canals, suitable places for basking, and natural or artificial shelters). Information on the species, locality, and date will be collected, and the specifics of the habitat recorded. After processing and photographs, each individual will be returned unharmed to the place of catch. To determine the species, the experts will use the field guide for the Reptiles and Amphibians of Britain and Europe (Arnold and Ovenden, 2002).

Table 113. Preliminary determined coordinates for survey

No.	Locality	Coordinates	
		Latitude	Longitude
1.	Donje Medjurovo	43.302607°	21.830407°
2.	Vrtiste	43.380464°	21.805035°
3.	Mezgraja	43.396981°	21.773036°
4.	Bagrdan	44.087753°	21.172210°
5.	Cicevac	43.703075°	21.430235°
6.	Pojate	43.739190°	21.433921°
7.	Paracin	43.874192°	21.391694°
8.	Cuprija	43.929178°	21.351006°
9.	Brzan	44.114416°	21.151044°
10.	Batocina	44.144710°	21.114555°
11.	Velika Plana	44.302623°	21.086508°
12.	Djurinci	44.542995°	20.583396°
13.	Ripanj	44.679663°	20.485047°
14.	Kosutnjak 1	44.749700°	20.445253°
15.	Kosutnjak 2	44.758629°	20.445391°

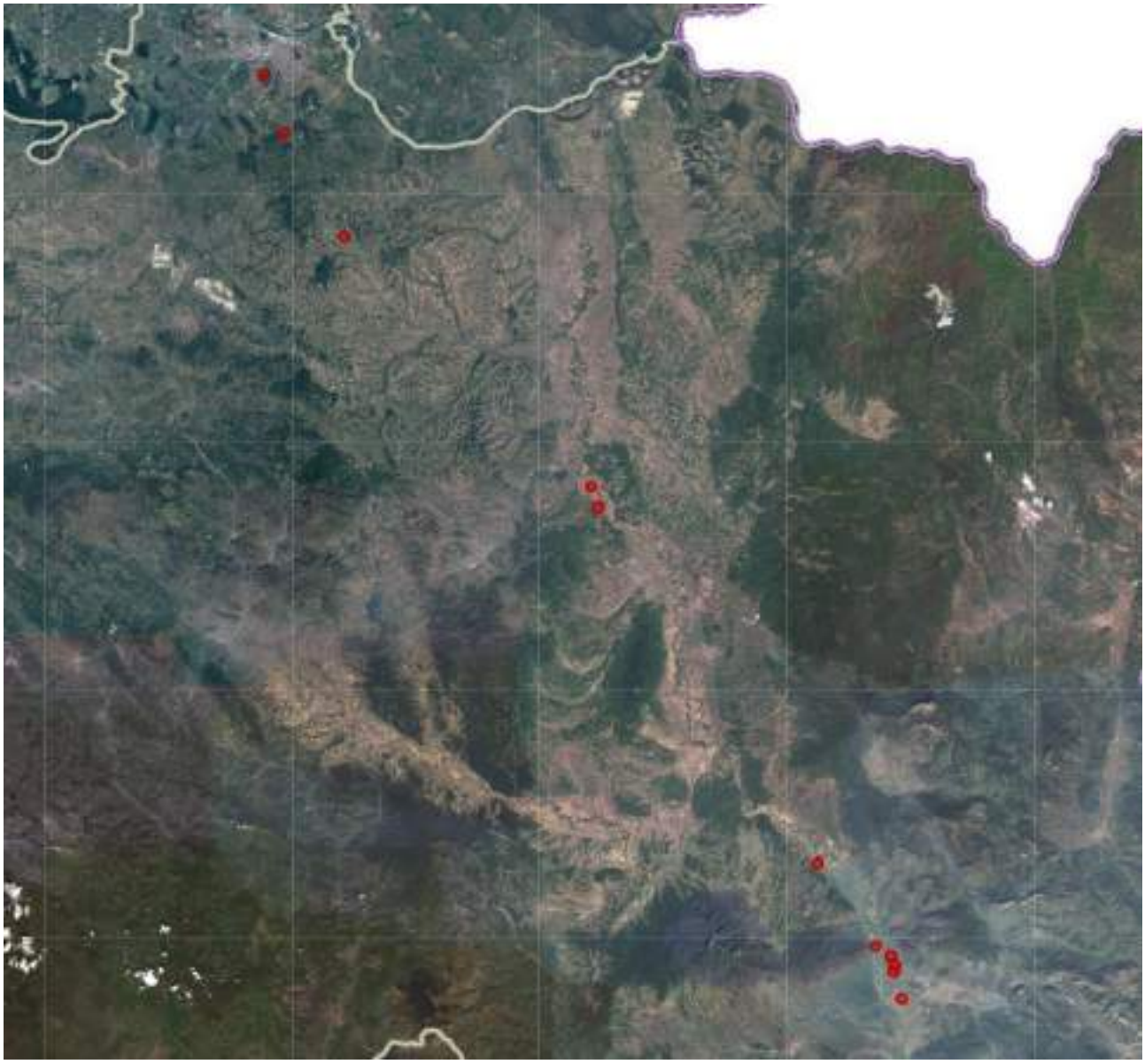

Figure 83. Positions of observation points

Table 114. Herpetofauna survey results

English name	Latin name	Location(s), if found, and Literature reference	Conservation status					Suitable habitat in area
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook	

The significant species that can be expected within the project area will be described in detail.

Autumn season

Habitats, flora and fauna field survey will be planned according to summer field report. For autumn field survey preliminary determined coordinates for survey and positions of observation points will be prepare prior to field survey.

Flora and habitat survey

Field surveys related to flora and habitats for the autumn season will be performed between September-October 2023. The exact dates of the field surveys will be defined in accordance with the weather conditions.

The floristic inventory for the sample points will be conducted either directly in the field or by collecting voucher specimens for laboratory identification. The classification of the present habitat types follows EUNIS version 2012 (amended 2019), and the digitalization will be performed using ArcGISPro within the final report.

The locations of the survey points/areas will be presented in appropriate tables (with coordinates) and maps. The results of the surveys will be presented for each polygon, for both the habitats and the flora in the final ESIA report, after completed field surveys in all seasons. Also, maps of habitats will be provided, giving information on the polygons, survey points, sampled points and other relevant information (e.g. settlements, protected areas, other infrastructure, etc.) in the final ESIA report, after completed field surveys in all seasons.

The flora species which will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

Table 115. Flora survey results

No.	Latin name	English name	Habitat	Conservation status				
				IUCN Global Red List	HD	Bern	CITES	Rulebook (Serbian Low: SP/P)

Fauna survey

Birds

Field research related to the autumn season for the ornithofauna will be conducted during the migration season, in September and October 2023, by ornithologist.

The techniques selected for the bird field study are the transect method (Sutherland et al., 2004), recording birds in the project area, and the point census method. Transects will be visited in the early morning, from 05:30 to 10:00,

and in the evening, from 18:00 to 22:00. The described range synchronizes with the maximum activity of birds and at the same time, the activity of nocturnal birds. Transects were predetermined to set priorities due to the size of the research area and the short duration of the research. As the proposed design of the rehabilitated railway does not pass through any protected areas, the transects were determined based on the distance between the railway and the protected areas or IBAs (Important Bird Areas). The design of the rehabilitated railway line is foreseen to cross 2 IBAs, Gornje Pomoravlje and Dobric-Nisava.

The equipment which will be used for these investigations includes binoculars with 8x42 magnification, and a telescope 20-60x80 to observe birds on the open water surface. Photo data will be generated using Nikon and Fuji digital camera. To collect data in the field, the expert will use the NaturaList application (https://data.biolovision.net/). For each observation, the application records geographical coordinates with high precision (<5m), along with the exact date and time, and the number of encountered individuals for each species. The Collins Bird Guide - 2nd edition (Svensson, 2009) and Raptors of the World (Ferguson-Lees and Christie, 2001) will be used as identification manuals.

The locations of the survey points/areas and the transects is presented in the following tables and maps.

The species of birds which will be registered during field and/or desktop surveys of the Project area will be presented in Table 118, for which the proposed layout is presented here below. In the Birds Survey expert will present recorded behavioural data and particularly fly heights; for the species of interest for the protection, in order to collect data necessary to assess collision risk in the ESIA.

Table 116. Birds survey results

No.	English name	Latin name	Location(s)	Conservation status			
				IUCN Global Red List	BD	Red Book of Serbia	Rulebook

Mammals

Field research will be conducted in the period between September and October 2023 (a total of 6 field days) by a specialist mammologist. Fieldwork will encompass visual inspection along the proposed route in order to obtain additional data and to check/confirm existing ones. Alive and also dead animals will be recorded along the transects as well as additional data indicative of species presence such as traces, dens, holes, burrows, and excrements will be obtained. Information on the species, locality, and date will be collected, and the specifics of the habitat recorded.

The determination of the research area will be conducted by reviewing satellite images of the habitats in Google Earth software and determining locations along the entire section of the railway that will be visited. A table summarizing the exact locations visited will be provided, along with a map presenting these locations. The focus will be given to the areas representing preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of interest for protection and other importance. Also, as some of the present mammal species in the affected area are also game species, data from management plans from the local hunting societies will be used.

Most relevant data about bat fauna along the proposed route are collected in the comprehensive documents (Paunović, 2016; Stanković, Paunović and Raković, 2018; Paunović, Karapandža, Budinski and Stamenković, 2020.). Based on the existing data about bionomy, ecology, locations and area of presence, the impact of the planned railroad will be assessed.

The species of mammals which will be registered during field and/or desktop surveys of the Project area will be presented in a table, for which the proposed layout is proposed here below:

Table 117. Mammals survey results

No.	English name	Latin name	Locations	IUCN		BC	HD	Suitable habitat?	Rulebook
				Global	Serbia				

Insects

During the autumn field survey, all insects will be recorded at given locations determined by overlaying satellite images and project infrastructure. The field investigations related to insects will be implemented in the period between September-October 2023 (in total 6 field days). Insects will be caught, if necessary, with a hand entomological net (securing that insects will not be killed, collected in case identification could not be done in the field), and photographed.

The research area determined during spring and summer field surveys will be visited during autumn field research, along the entire section of the railway. A table summarizing the exact locations visited will be updated based on spring/summer findings, if it would be necessary, along with a map presenting these locations. The focus will be on areas representing more preserved fragments of natural and semi-natural habitats and locations where it is expected to record species of importance for protection.

The species of insects that will be registered during field and/or desktop surveys of the Project area will be presented in a table and maps.

Table 118. Inverebrates survey results

English name (and group)	Latin name	Data type (desktop/field)	The number of specimens observed	Conservation status				
				IUCN global red list	Red Book of Serbia	HD	BC	Rulebook

Herpetofauna

Field research for herpetofauna will be conducted in the period between September and October 2023 (a total of 6 field days) by herpetologist. Fieldwork will encompass visual inspection along transects or detailed inspections of relevant amphibian and reptile-suitable habitats (i.e. ponds, canals, suitable places for basking, and natural or artificial shelters). Information on the species, locality, and date will be collected, and the specifics of the habitat recorded. After processing photographs, each individual will be returned unharmed to the place of catch. To determine the species, the experts will use the field guide for the Reptiles and Amphibians of Britain and Europe (Arnold and Ovenden, 2002).

Table 119. Herpetofauna survey results

English name	Latin name	Location(s), if found, and Literature reference	Conservation status					Suitable habitat in area
			IUCN global red list	Red Book of Serbia	HD	BC	Rulebook	

Ichthyofauna

Field surveys will be conducted during the early autumn season (August-September). The sites will be chosen according to the currently available railway layout and evaluation of possible impact. The electrofishing procedure will be conducted at 14 a priori proposed sampling stations. Fish will be sampled using the DC electrofisher “Aquatech” IG 1300 (2.6 kW, 80–470 V). A single electrofishing pass will be made in an upstream direction, along a 50 m transect for wadable streams and along 200 m when drifting from a boat. Each individual fish caught during the sampling campaign will be stored in a large bucket, before being individually counted, measured, weighed, and released back into the river. The following methods based on European Standards have been used during sampling, identification, and quantification of fish fauna: EN 14962:2006 (Water quality - Guidance on the scope and selection of fish sampling methods), and EN 14011:2003 (Water quality – Sampling of fish with electricity).

Aquatic macroinvertebrates and ecological status assessment

Macroinvertebrate community data will be collected in the early autumn season (August-September). At each sampling site, three benthic samples will be taken from the most common substrate types with a 0.625 m^2 Surbernet of 250 µm mesh. All three benthic samples will be merged into a single sample. The specimens will be sorted out of sediment and preserved in 70% alcohol. All macroinvertebrate species were identified to the lowest possible taxonomic level using the relevant taxonomic keys. Sampling, identification, and quantification of aquatic macroinvertebrates be performed according to the relevant European Standard: EN 17136:2019 (Water quality - Guidance on field and laboratory procedures for quantitative analysis and identification of macroinvertebrates from inland surface waters). The ecological status will be estimated based on both physical and chemical measurements as well as relevant biological quality elements using parameters and indices proposed by “Regulation on parameters of ecological and chemical status of surface waters and parameters of chemical and quantitative status of underground waters” (Official Gazette of RS" no. 74/2011).

ECOLOGICALLY APPROPRIATE AREAS OF ANALYSIS (EAAAS)

Ecologically appropriate areas of analysis (EAAAs) should encompass wider distributions of potentially affected biodiversity features and the ecological patterns, processes, and functions that are necessary for maintaining them throughout this distribution. EAAAs typically extend well beyond a project’s anticipated physical footprint and may also extend beyond the project’s area of influence. For some wide-ranging species, the EAAA should incorporate any important areas of aggregation, recruitment, and other habitat features, connectivity or ecosystem processes that are needed to maintain viable populations of the species. The purpose of this activity is to determine if any features in the study area qualify as priority biodiversity features or critical habitat, following EBRD’s definitions (see Table 121). These features will require attention in impact assessment and mitigation planning. This is an assessment of the context in which the development is proposed and therefore does not consider specific impacts at this stage of analysis.

The definition of EAAAs considers the area of direct project impacts (e.g., physical footprint, effluents, and emissions) and indirect impacts (e.g., development by third parties around a project site). The study area should then be expanded as needed to encompass the local ecosystems occurring in the area of impact, considering the ecological patterns, processes, and functions that are necessary to maintain them.

Table 120. Criteria and conditions for identifying priority biodiversity features and critical habitats*

Criterion	Priority Biodiversity Feature	Critical Habitat
1. Priority ecosystems		

Threatened ecosystems Habitats listed in Annex 1 of EU Habitats Directive (EU members only) or Resolution 4 of Bern Convention (signatory nations only) IUCN Red-List EN or CR ecosystems	(PR6 para. 12-i) (a) EAAA is the habitat type listed in Annex 1 of the EU Habitats Directive or Resolution 4 of the Bern Convention (b) EAAA** < 5% of the global extent of an *ecosystem* type with IUCN status of CR or EN	(PR6 para. 14-i) EAAA is the habitat type listed in Annex 1 of the EU Habitats Directive marked as "priority habitat type" EAAA ≥5% of the global extent of an ecosystem type with IUCN status of CR or EN EAAA is an ecosystem determined to be of high priority for conservation by national systematic conservation planning
2. Priority Species and their Habitats		
Threatened species Species and their habitats listed in EU Habitats Directive and Birds Directive (EU members only) or Bern Convention (signatory nations only) IUCN Red List EN or CR species IUCN Red List VU species Nationally or regionally (e.g., Europe) listed EN or CR species	(PR6 para. 12-ii) EAAA for species and their habitats listed in Annex II of Habitats Directive, Annex I of Birds Directive, or Resolution 6 of Bern Convention EAAA supports < 0.5% of global population OR < 5 reproductive units of a CR or EN species. EAAA supports VU species EAAA for regularly occurring nationally or regionally listed EN or CR species	(PR6 para. 14-ii) EAAA for species and their habitats listed in Annex IV of the Habitats Directive (See EU restrictions) EAAA supports ≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species EAAA supports a globally significant population of VU species necessary to prevent a change of IUCN Red List status to EN or CR, and satisfies a threshold (b) EAAA for important concentrations of a nationally or regionally listed EN or CR species
Range-restricted species	(PR6 para. 12-ii) (a) EAAA for regularly occurring range restricted species	(PR6 para. 14-iii) (a) EAAA regularly holds ≥ 10% of global population AND ≥ 10 reproductive units of the species***

Migratory and congregatory species	(PR6 para. 12-ii) (a) EAAA identified per Birds Directive or recognized the national or international process as important for migratory birds (esp. wetlands)	(PR6 para. 14-iv) EAAA sustains, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population at any point of the species lifecycle EAAA predictably supports ≥10 percent of the global population during periods of environmental stress

Source: EBRD Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources: Guidance Note (September 2022)

EAAAs definition facilitates Critical Habitat Assessment that is provided in full in the E&S Assessment Report. The CHA provides information on the most valuable biodiversity elements – priority biodiversity features (PBFs) and critical habitats (CHs). There mustn't be any net loss of PBFs and there must be net gain of CHs if the Project proceeds.

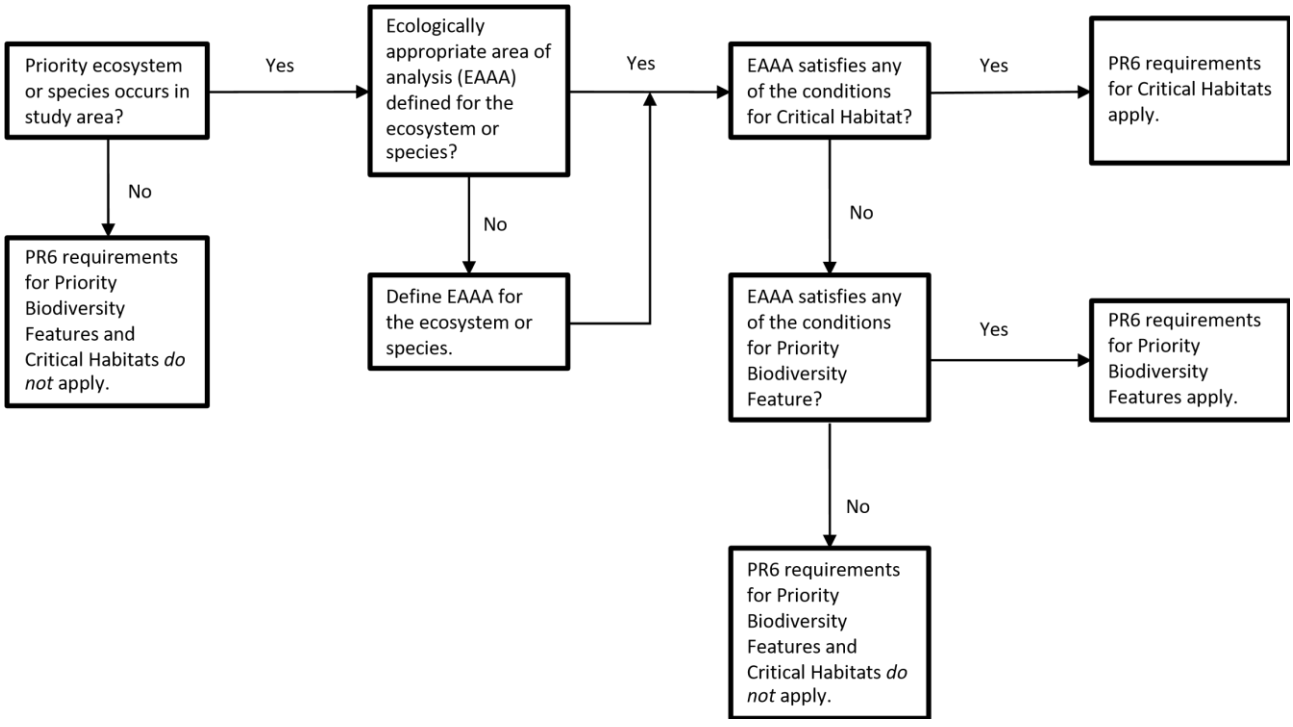

Figure 84. Logical flow of critical habitat assessment

Source: EBRD Performance Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources: Guidance Note (September 2022)

Preliminary list of habitats and fauna species identified as potential priority biodiversity features (PBF) or critical habitats (CH) is given below:

Habitats		
G1.1 - Riparian and gallery woodland, with dominant *Alnus, Betula, Populus*, or *Salix*	PBF	Annex 1 of the EU Habitats Directive, Resolution 4 of the Bern Convention
C3.2 - Water-fringing reedbeds and tall helophytes other than canes No sensitive zones and receptors have been identified	PBF	Annex 1 of the EU Habitats Directive
Insects		
***Euphydryas aurinia* (Marsh fritillary)**	PBF	Annex 2 of the Habitats Directive and Annex 2 of the Berne Convention
***Lycaena dispar* (Large copper)**	CH	Annex 2 and 4 of the Habitats Directive, Annex 2 and Resolution 6 of the Berne Convention, globally Near Threatened (NT)
***Nymphalis vaualbum* (Compton tortoiseshell)**	CH	Annexes 2 and 4 of the Habitats Directive, Annex 2 and Resolution 6 of the Berne Convention
***Phengaris arion* (Large blue)**	CH	Annex 4 of the Habitats Directive. Near-threatened species at the global level (NT), an endangered species in Europe (EN), in the territory of Serbia - Least Concern (LC)
***Parnassius mnemosyne* (Clouded Apollo)**	CH	Annex 4 of the Habitats Directive and Annex 2 of the Berne Convention. Near-threatened species in Europe (NT)
***Zerynthia polyxena* (Southern festoon)**	CH	Annex 4 of the Habitats Directive
***Lucanus cervus* (Stag beetle)**	PBF	Annex 2 of the Habitats Directive and Annex 3 and Resolution 6 of the Berne Convention
***Morimus asper* (Beech Longhorn Beetle)**	PBF	Annex 2 of the Habitats Directive. Globally endangered species (EN), its endangered status is not known at the European and national level
***Coenagrion ornatum* (Ornate bluet)**	PBF	Populations of these species are very rare and have local character
Herpetofauna		
Bombina variegata	PBF	Annex 2 of the Habitats Directive and Annex 2 and Resolution 6 of the Berne Convention
Emys orbicularis	PBF, CH	Annexes 2 and 4 of the Habitats Directive and Annex 2 and Resolution 6 of the Berne Convention
Podarcis muralis	PBF	Annex 2 of the Berne Convention
Lacerta viridis	PBF	Annex 2 of the Berne Convention
Dolichophis caspius	PBF, CH	Annex 4 of the Habitats Directive and Annex 2 of the Berne Convention
Birds		
***Accipiter gentilis* (Northern goshawk)**	PBF	National VU status in Serbia, and LC according to the IUCN.
***Alcedo atthis* (Common Kingfisher)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN
***Cettia cetti* (Cetti's Warbler)**	PBF	Strictly protected species in Serbia; national VU status in Serbia, and LC according to the IUCN.

***Circus aeruginosus* (Western Marsh Harrier)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Leiopicus medius* (Middle Spotted Woodpecker)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Dendrocopos syriacus* (Syrian Woodpecker)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Dryocopus martius* (Black Woodpecker)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Emberiza hortulana* (Ortolan Bunting)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Lanius collurio* (Red-backed shrike)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Lanius minor* (Lesser Grey Shrike)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Nycticorax nycticorax* (Black-crowned Night Heron)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Perdix perdix* (Grey Partridge)**	PBF	Annexes IIA and IIIA of the Birds Directive; protected in Serbia, national VU status in Serbia, and LC according to the IUCN.
***Pernis apivorus* (Honey buzzard)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national LC status in Serbia, and LC according to the IUCN.
***Sterna hirundo* (Common Tern)**	PBF	Annex I of the Birds Directive; strictly protected species in Serbia; national VU status in Serbia, and LC according to the IUCN.
***Streptopelia turtur* (Turtle dove)**	PBF	Annex IIB of the Birds Directive; protected species in Serbia, national VU status in Serbia, and VU according to the IUCN.
Mammals		
Canis lupus	PBF	Annexes 2 and 4 of the Habitats Directive; Resolution 6 of the Bern Convention
Felis silvestris	PBF	Annexes 2 and 4 of the Habitats Directive
Mustela putorius	PBF	Annex 5 of the Habitats Directive
Vormela peregusna	PBF	Resolution 6 of Bern Convention; IUCN – VU category
Lutra lutra	PBF	Annexes 2 and 4 of the Habitats Directive; Resolution 6 of the Bern Convention
Myotis daubentoniid	PBF	Annexes 2 and 4 of the Habitats Directive
Nyctalus noctule	PBF	Annexes 2 and 4 of the Habitats Directive
Pipistrellus kuhlii	PBF	Annexes 2 and 4 of the Habitats Directive
Plecotus austriacus	PBF	Annexes 2 and 4 of the Habitats Directive

Vespertilio murinus	PBF	Annexes 2 and 4 of the Habitats Directive

CONTENT OF THE BIODIVERSITY BASELINE REPORTS

- Protected Areas
- Flora and Habitats
- Insects
- Herpetofauna
- Ornithofauna
- Mammals
- Critical Habitats (and Priority Biodiversity Feature) Assessment

Republic of Serbia
Ministry of European Integration

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