Operational Programme of the European Union for Regional Development

PREPARATION OF MAIN DESIGN AND TENDER DOCUMENTATION FOR CONSTRUCTION OF NEW RAILWAY TRACK

SECTION KRIVA PALANKA-BORDER WITH THE REPUBLIC OF BULGARIA,

PART OF CORRIDOR VIII

Ref. No. EuropeAid/36050/IH/SER/MK

Environmental and Social Impact Assessment Study for the construction of new railway track at the section Kriva Palanka-Republic of Bulgaria, part of Corridor VIII

November, 2017

This project is funded by the European Union

Project implemented by IDOM in consortium with ADT OMEGA and Željezničko projektno društvo d.d.

Document control sheet:

Project Name:	Preparation of Detailed design and tender documentation for construction new railway section Kriva Palanka – Border with Republic of Bulgaria, as part of Corridor VIII
Reference No:	EuropeAid/136050/IH/SER/MK
Contracting Authority:	Central Financing and Contracting Department, Ministry of Finance, Republic of Macedonia
Beneficiary:	Ministry of Transport and Communications
Final Beneficiary:	Public Enterprise for Railway Infrastructure
Consultant:	IDOM in consortium with ADT OMEGA and ZPD DEKONS EMA
Report:	Environmental and Social Impact Assessment study (ESIA) for construction new railway section Kriva Palanka – Border with Republic of Bulgaria, as part of Corridor VIII
Reporting period:	11/2017

	Prepared by	Checked by	Approved by
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Date	11/2017	11/2017	

Incidentals/Reimbursables

	Activity	Outputs/Deliverables	Incidentals/Reimbursables
	Component 1		

Comments on Report

	Section in text	Comment by the Contracting Authority/Beneficiaries	Accepted		
			Yes	No	Comment

PROJECT SYNOPSIS

Programme Name	The European Union's Operational Programme for Regional Development		
Project Name	Preparation of Detailed design and tender documentation for construction new railway section Kriva Palanka – Border with Republic of Bulgaria, as part of Corridor VIII		
Reference No:	EuropeAid/136063/IH/SER/MK		
Contract Number	12-8859/1		
Project Duration	22 months		
Project Commencement Date	4th January 2016		
Project End Date	4th November 2017		
Name:	Ministry of Finance, Central Financing and Contracting Department (CFCD)	Ministry of Transport and Communications, MoTC (Project Implementation Unit)	IDOM, ADT OMEGA and ZPD
Role:	Contracting Authority / Employer	Beneficiary	Consultant
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Contact Person:	Head of CFCD – Mrs Radica Koceva	Darko Spiroski – Head of Department for European Union	Project Manager – Mr Ignacio Balsa
Overall Objective:	The overall objective of this project is improvement of the rail infrastructure along the trans-European transport network, by establishing an operational continuity of railway corridor VIII, Albania (Port of Durres) – Macedonia (Kumanovo – Beljakovce – Kriva Palanka – state border) – Bulgaria (Port of Burgas), in order to meet the required EU standards.		
Purpose:	The purpose of this project is the provision of design documentation which will allow MZ-I to implement the construction of the section 3 of the corridor, Kriva Palanka – state border, and the electrification and GSM-R for the sections 1, 2 and 3, in the scope defined in the project documentation to be delivered.		
Expected Results:	• To enlarge transport capacities (not only railways). • To shorten travelling time (passenger and freight trains). • To harmonize technical condition and technical properties of the Macedonian railway infrastructure, with conditions provided within the valid European Railway		

	Regulations. • To implement railway interoperability (quality standards of the TEN-T network). • To connect Macedonia with neighboring countries and with EU. • To open new opportunities for integrated and sustainable economic and social growth of the Southeast Europe.
Key Activities:	• Execution of the investigation works (topography, geology, hydrology, etc.) on the basis of the accepted “Survey Programme”. • Approval of the update alignment by the competent authority. • Implementation of economic and financial assessment ensures the viability of the proposed actions. • Successful integration of the designs for permanent way, civil engineering structures, electrification and sub-systems. • Assessment of compatibility of systems required for an efficient and fast border crossing of trains by e.g. service communication links and train related data exchange.
Key Stakeholders and Target Groups:	The main actors and target groups of the project are: • Overall beneficiaries: citizens and visitors to the Republic of Macedonia, citizens of surrounding countries. • Contracting Authority: Central Financing and Contracting Department. • Beneficiary : Ministry of Transport and Communications, • Final Beneficiary: Public Enterprise for Railway Infrastructure. • Other involved stakeholders: Macedonian Railways (MZ-I) ¡V Transport, Ministry of Environment and Physical Planning, European Bank for Reconstruction and Development, the Ministry of Transport, Information Technology and Telecommunications of the Republic of Bulgaria (MTITT), the railway infrastructure manager of the Republic Bulgaria (NRIC), municipalities, owners of public utilities, academic community.

1 INTRODUCTION

Corridor VIII is an integral part of one of the five new Trans-National European axles: the Southeast axle. In the context of the Euro-Asiatic transport links, Corridor VIII was identified to connect Europe with Asia, and the Middle and far East to the Balkans and Turkey with both railway and road infrastructure.

The existing stretch of railway line along the Corridor VIII is 156 km long. As part of the Corridor VIII it is planned to construct new railway tracks connecting the existing east – west line by:

- A 89 km link in the East, from Kumanovo to the Bulgarian Border, which would connect Macedonia to Varna (Bulgaria) and to the Black Sea,
- A 66 km link in the West, from Kicevo to the Albanian Border, which would connect Macedonia to Durrës (Albania) and to the Adriatic Sea.

The East link between Kumanovo and the Bulgarian Border includes 3 sub-sections:

a) Kumanovo - Beljakovce, was previously operational (1994) and reconstruction works of the existing line are under construction since 2014 (under EBRD financing).

b) Beljakovce - Kriva Palanka was under construction until 2004 when it stopped probably because of lack of funding. Macedonia's Public Enterprise for Railway Infrastructure plans to open two tenders for construction and reconstruction works on the Beljakovce – Kriva Palanka railway section.

c) ***Kriva Palanka - Bulgarian Border, a new railway alignment that should be constructed and which is subject to this project.***

A Feasibility Study, henceforth “previous FS” and EIA Study have been prepared by an international consortium (Eptisa & DB) under EBRD funding, covering the whole link development from Kumanovo to the Bulgarian Border.

The Macedonian authorities, Ministry of Transport and communication, intend to proceed with the development of the Section 3. For this purpose, EU IPA funding is intended for the project-Preparation of detailed design and tender documentation for construction of new railway section Kriva Palanka-border with Republic of Bulgaria, as part of corridor VIII. The holder of the Project is a consortium composed of IDOM, ADT OMEGA and JPD. Under this project (contract number EuropeAid / 136050 / IH / SER / MK), the consortium led by IDOM started with the realization of the work task for the Project, which includes the preparation of: Updated Feasibility Study, Study / Traffic Model, Cost-Benefit Analysis (CBA), Environmental Impact Assessment and Social Impact Assessment (ESIA), preliminary and main designs, for section 3 of the eastern part of the railway corridor VIII.

As already mentioned, in 2011-2012 an ESIA Study was prepared for the eastern part of the Corridor VIII stretching from Kumanovo to the border with the Republic of Bulgaria (for all 3 sections), for which the Ministry of environment and physical planning issued a Consent for the ESIA Study on 05.11.2012 (number 11-1974/5). Because of the expired relevance of the issued Consent and the fact that during the technical documentation preparation process (preliminary and detailed designs) for the section 3 (Kriva Palanka-border with Bulgaria) there were some changes in the number of bridges and tunnels, as well as the fact that in the prepared ESIA from 2012 the border tunnel No. 22 was not taken into consideration (with a total length of 2.383 m, out of which 1,193.70 m belong to the territory of Bulgaria, at the chainage km 87+280,00 to km 89+560,00), on the last technical meeting (1-2.11.2016) with the main beneficiary, designers and Jaspers was decided to be prepared completely new ESIA Study for the third section of the railway (it was a requirement also in the ToR for the current project activities). In the new version of the ESIA study the tunnelling activities will be described and the impact and mitigation measures (during construction and operation) as well.

ADT Omega, as part of the consortium that was responsible for the preparation of the project and tender documentation, hired "DEKONS-EMA"-Environmental Management Associates from Skopje, as a subcontractor with a Contract No.0307-57/1 from 11.05.2016 and 0307-45/1 from 16.08.2017, in order to prepare ESIA Study for the construction of a new railway line at the section Kriva Palanka-border with the Republic of Bulgaria, as part of Corridor VIII.

The following team was engaged in the preparation of the ESIA Study:

DEKONS EMA:

- Menka Spirovska, Bachelor of Science in Biology, authorized EIA expert and signatory of the ESIA Study;
- Julijana Nikova, BSc. technologist, authorized EIA expert;
- Ana Despodovska, BSc. In Ecology, authorized EIA expert;
- Bojan Manchev, Bachelor of Science in Ecology;
- Elena Shishkovska, B.E. chemical engineer;
- Iskra Stojanova, LL.B.

EXTERNAL CONSULTANTS:

- Ljupcho Melovski, PhD prof., biodiversity expert;
- Slavcho Hristovski, PhD prof., biodiversity expert;
- Zlatko Levkov, PhD prof., aquatic habitats expert;
- Valentina Slavevska Stamenkovikj, PhD prof., aquatic habitats expert;
- Ivan Blinkov, PhD prof., soil expert;
- Dushko Mukaetov, PhD prof., soil expert;
- Ivica Milevski, PhD prof., geology and geomorphology expert;
- Nikolcho Velkovski, PhD prof., forest expert;
- Boshko Nikov, PhD prof., noise expert;
- Lidija Krstevska, PhD prof., vibration expert;
- Josif Milevski, hydrology expert;
- Boris Stipcarov, social aspects expert.

Влада на Република Македонија
Министерство за транспорт и врски

Бр. 34Уп-503/2017
Датум: 18. 08. 2017 .2017

Министерство за транспорт и врски
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ПОТВРДА

Врз основа на член 42 став (1) од Законот за градење („Службен весник на Република Македонија" бр.130/09, 124/10, 18/11, 36/11, 54/11, 13/12, 144/12, 23/13, 79/13, 163/13, 27/14, 28/14, 115/14, 149/14, 187/14, 44/15, 217/15, 60/16, 31/16 и 39/16), а по поднесено барање заведено во Министерството за транспорт и врски под бр. 34 Уп-503 од 14.07.2017 година, од страна на правното лице „АДТ ОМЕГА" Консултанти инженери АД, со даночен број ЕЛ099365653 и генерален трговски регистерски број 003294201000, со седиште во Атина на адреса Ул.„Авлидос" број 25 Република Грција, Министерството за транспорт и врски му издава потврда за вршење на работи на проектирање во Република Македонија и тоа за:

-проектирање на градби за вршење на транспорт – железнички линии

Потврдата се издава со рок на важност до 09.02.2021 година.

Министер
М-р Горан Сугарески

ИСО 9001:2008 МТЦ-19-3П-27 1

Република Македонија

КОМОРА НА ОВЛАСТЕНИ АРХИТЕКТИ
И ОВЛАСТЕНИ ИНЖЕНЕРИ

Врз основа Член 42 од Законот за Градење, Правилникот за начинот и критериумите за издавање, продолжување и одземање на овластувања за изработка на проектната документација како одговорен проектант, ревизија на проектна документација, надзор и изведба на градби, Комората на овластени архитекти и инженери ја издава следнава

ПОТВРДА

за веродостојност на овластувањето на

Андрикопоулос Цхаралампос

дипломиран градежен инженер

Број на странското овластување: 45997 (Грција)

*името, презимето, ЕМБГ и академското звање во оригиналните документи се:

ΑΝΔΡΙΚΟΠΟΥΛΟΣ ΧΑΡΑΛΑΜΠΟΣ

AI 1459937 (passport)

ΠΟΛΙΤΙΚΟΥ ΜΗΧΑΝΙΚΟΥ

Комората потврдува дека овластувањето на именуваниот е соодветно (еквивалентно) на следното овластување во Република Македонија.

проектирање - градежништво

ОВЛАСТУВАЊЕ А

Со овластување **А** именуваниот може да ги врши и работите за кои е предвидено овластување **Б**.

Број: **СЛ.0130/п**

Потврдата важи до:
4 Декември 2017

Претседател на Комората на овластени архитекти и овластени инженери

Блашко Димитров, дипл.град.инж.

ЦЕНТРАЛЕН РЕГИСТАР НА РЕПУБЛИКА МАКЕДОНИЈА
Трговски регистар и регистар на други правни лица

www.crm.com.mk

Број: 0809-50/150120160059236
Датум и време: 4.10.2016 г. 08:54:03

ПОТВРДА

за регистрирана дејност

ТЕКОВНИ ПОДАТОЦИ ЗА СУБЈЕКТОТ	
ЕМБС:	6247717
Назив:	Друштво за еколошки консалтинг ДЕКОНС-ЕМА ДООЕЛ увоз-извоз Скопје
Седиште:	МИТРОПОЛИТ ТЕОДОСИЈ ГОЛОГАНОВ бр.44-1/4 СКОПЈЕ - ЦЕНТАР, ЦЕНТАР

ПОДАТОЦИ ЗА РЕГИСТРИРАНА ДЕЈНОСТ	
Предмет на работење:	Регистрирана е општа клаузула за бизнис
Приоритетна дејност/ главна приходна шифра:	74.90 - Останати стручни, научни и технички дејности, неспомнати на друго место
Други дејности во внатрешниот промет:	Нема
Евидентирани дејности во надворешниот промет:	Има
Одобренија, дозволи, лиценци, согласности:	Нема

Изготвил:

Овластено лице:

Број: 0809-50/150120160059236

Страна 1 од 1

РЕПУБЛИКА МАКЕДОНИЈА
МИНИСТЕРСТВО ЗА ЖИВОТНА СРЕДИНА И ПРОСТОРНО ПЛАНИРАЊЕ

П О Т В Р Д А

за положен стручен испит за стекнување на статус експерт за оцена на влијанието на проектите врз животната средина

СПИРОВСКА Аритон МЕНКА

, диппломиран биолог од Скопје, родена на 28.12.1951 година, во Скопје, Република Македонија, на ден 10.09.2009 година, го положи **стручниот испит за стекнување на професионално знаење за оцена на влијанието на проектите врз животната средина,** пред Комисијата за полагање на стручен испит за оцена на влијанието на проекти врз животна средина, при Министерството за животна средина и просторно планирање, и се стекна со **статус на експерт за оцена на влијанието на проектите врз животната средина** и ги исполнува условите утврдени во член 85 став 2 од Законот за животна средина, со тоа се стекнува со право да биде **вклучен** во Листата на експерти за оцена на влијанието на проектите врз животната средина што ја води Министерството за животна средина и просторно планирање на Република Македонија.

Оваа потврда се издава врз основа на член 85 од Законот за животната средина ("Службен весник на Република Македонија" број 53/05, 81/05, 24/07 и 159/08).

Министерство за животна средина и просторно планирање

Министер,
Др. Нецати Јакупи

Број 07-2038/113
31.07.2009, година

Комисија за полагање на стручен испит за оцена на влијанието на проекти врз животна средина

Претседател,
М-р Јадранка Иванова

Република Македонија
КОМОРА НА ОВЛАСТЕНИ АРХИТЕКТИ
И ОВЛАСТЕНИ ИНЖЕНЕРИ

Врз основа на член 17 став 2 од Законот за градење ("Службен весник на Република Македонија" бр.130/09, 124/10, 18/11, 36/11, 54/11, 13/12, 144/12, 25/13, 79/13, 137/13, 163/13, 27/14, 28/14, 42/14, 115/14, 149/14, 187/14 и 44/15), Комора на овластени архитекти и овластени инженери издава

ОВЛАСТУВАЊЕ А

ЗА ИЗРАБОТКА НА ПРОЕКТНА ДОКУМЕНТАЦИЈА

од

ИНЖЕНЕРСТВО ЗА ЖИВОТНА СРЕДИНА

на

МЕНКА СПИРОВСКА

Дипломиран биолог

Овластувањето е со важност до: 05.05.2021 год.

Број: 7.0199

Издадено на: 05.05.2016 год.

Претседател на
Комората на овластени архитекти
и овластени инженери

Мр Блашко Димитров,
дипл.град.инж

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LIST OF ABBREVIATIONS:

SEETO	Southeastern European transport observatory
OCJE	Southeastern European traffic observatory
PEP	Pre-access economic programme
TEM	Trans-european motorway
TEN	Trans-european network
TSI	Technical specification on interoperability
Jaspers	Joint Assistance to Support Projects in European Regions
UIC	International regulations on train wagons
VHF	High frequency
GDP	Gross domestic income
PERI	Public enterprise Macedonian Railways-Infrastructure
DCFC	Department on central funding and contracting
EU	European Union
SEE	Southeastern Europe
SFRY	Socialist Federative Republic of Yugoslavia
EBRD	European Bank for Reconstruction and Development
ERTMS	European Railway Transport Management System
FS	Feasibility Study
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESAMP	Environmental and Social Aspects Management Plan
MTC	Ministry for Transport and Communication
AGTC	European agreement on international combined lines transport
BC	Bern Convention
EUNIS	EU National Information System
CITES	Convention on International Trade with Endangered Species
MEPP	Ministry of Environment and Physical Planning
PE	Public enterprise
ETCS	European Train Control System
GSM-R	Global System for Mobile Communications-Railway
UIC	International Railway Union
SIL	Security Integration Level
EC	European Commission
IPA	Instrument for Pre-Accession Assistance
NCEP/NCAR	National Center for Environmental Prediction/National Center for Atmospheric Research

GCM	Global Circulating Models
LV	Limit value
GHG	Greenhouse gasses
MIS	Mercalli Intensity Scale
SFB	Subsidiary Forest Business
HS	Hydrological Station
SSD	State Statistics Department
HD	Habitat Directive
IUCN	International Union for Conservation of Nature
RIMSYS	River Monitoring System
WHO	World Health Organization
PAHs	Polycyclic Aromatic Hydrocarbons
E&OHS	Environment and Occupational Health&Safety
CMP	Construction Site Management Plan
ESAMS	Environmental and Social Aspects Management System
SAIA	Social Aspects Impact Assessment
EARM	Employment Agency of the Republic of Macedonia
IFI	International Financial Institutions
IMCSWKP	Inter-Municipal Center for Social Work-Kriva Palanka
LRP	Livelihoods Rehabilitation Plan
EPP	Employment Plan for the purpose of the project
RPF	Resettlement Policy Framework
RAP	Resettlement Action Plan
SEP	Stakeholder Engagement Plan
OHSP	Occupational Health&Safety Plan
WAP	Worker Accomodation Plan
PPE	Personal Protective Equipment
WTA	Weekly Timeframe of Activities
SSAPC	Social Support Action Plan during the Construction

2 GENERAL INFORMATION

2.1 Introduction

The Republic of Macedonia is located at the crossroads in South-Eastern Europe, making it a strategical marchalignment in the land transportation system, connecting Central Europe, the Aegean Sea, the Black Sea and the Mediterranean Sea. The location of the country contributed to the development of the international transport in two transnational axes: North-South (Corridor X) and East-West (Corridor VIII), also known as Pan-European corridors, connected with the transeuropean transportation networks.

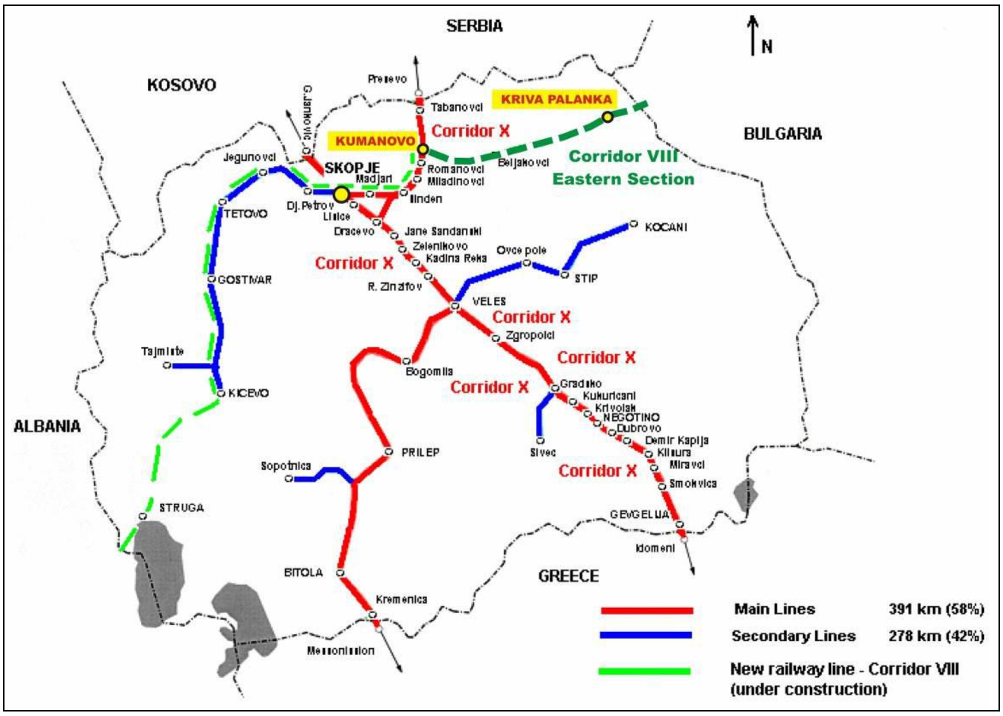


Figure 1 Railway corridors in the Republic of Macedonia

Corridor VIII is a multi-modal transportation network that includes sea and riverine ports, airports, roads and railways that are projected along the east-western axis, and it begins at the southern Italian ports of Bari and Brindisi, passes through Albania, Macedonia and Bulgaria, and leads to the Black Sea-the ports of Varna and Burgas.

Corridor VIII is an integral part of one of five new Trans-National European axles: the South-East axle. Also in the context of the Euro-Asiatic transport links, Corridor VIII was identified to connect Europe with Asia, the Middle and far East to the Balkans and Turkey with both railway and road infrastructure.

Along the length of its track, the Corridor VIII is connected to the Pan-European corridors IV, IX and X, as shown in the next figure.

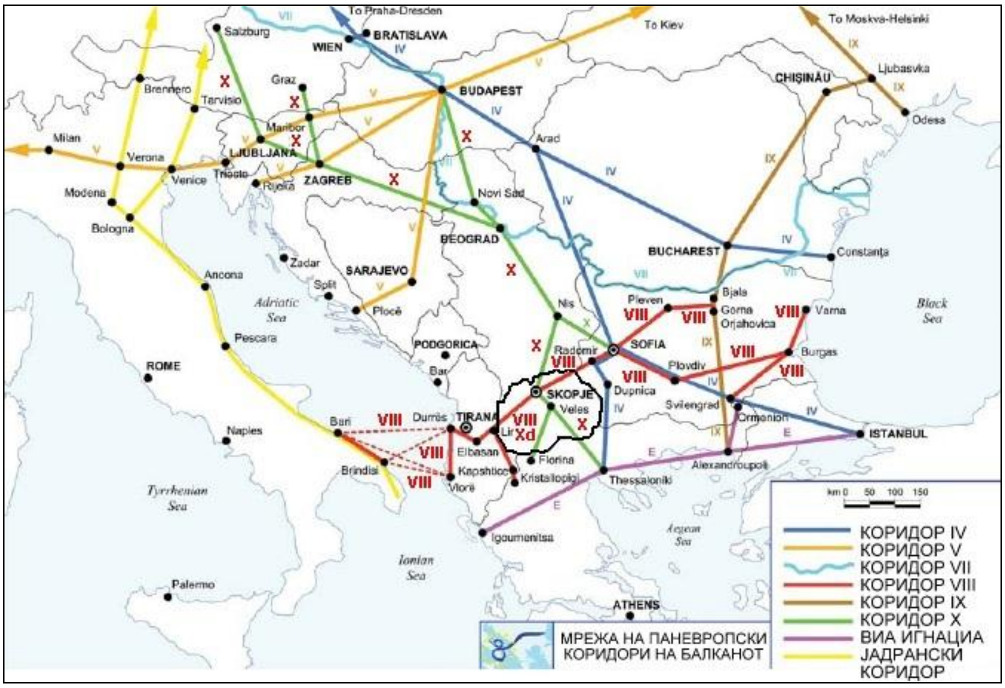


Figure 2 Pan-European corridors network in the Balkans

The railway line along the Corridor VIII is in total length of 315 km, only 50% of the railway line has been constructed so far.

The lack of these connections is an obstacle to international trade, not only between neighbouring countries, but also through this region in Eastern Europe.

In the Spatial Plan of the Republic of Macedonia, adopted in 2004, valid until 2020, the spatial arrangement for the transport and other types of infrastructure is mentioned as top priority for the country, and that's why the Corridor VIII is included as a very important transport corridor.

The national strategy for transport of the Republic of Macedonia (2007-2017) confirms the high priority of the Corridor VIII for the country.

The railway corridor VIII, i.e. the part that passes through Macedonia, is composed of two sections: the first, western section, is oriented towards Albania, and the eastern section is oriented towards Bulgaria.

At the moment, the Republic of Macedonia does not have railway links with the two neighbouring countries: Albania and Bulgaria.

For the development of the railway connection between the Republic of Macedonia and the Republic of Bulgaria through Corridor VIII, there is a bilateral agreement concluded between the two countries since 1993. More specifically, there is a protocol from a joint expert meeting to discuss the technical solutions for connecting the railway lines of the Republic of Macedonia and the Republic of Bulgaria (March 19, 1993). On May 26, 1999, the Law on Ratification of the Agreement[1] between the Government of the Republic of Macedonia and the Government of the Republic of Bulgaria for Connecting the Railway Networks of the two States (Official Gazette of the Republic of Macedonia No. 32/99) was adopted. These documents are enclosed in Annex 1 of the Study.

The plans and activities for the construction of the eastern part of the railway corridor from Kumanovo to the Bulgarian border are commenced at the beginning of the XIX century, and although with

[1] Signed on March 12, 1999

interruptions, they were implemented in continuity until 2004, when the activities that commenced in 1994, were inhibited, as the result of lack of funds.

The Eastern section of the Corridor VIII, between Kumanovo and the Bulgarian Border, includes 3 sub-sections:

a) Kumanovo - Beljakovce, was previously operational (1994) and reconstruction works of the existing line are under construction since 2014 (under EBRD financing).

b) Beljakovce - Kriva Palanka was under construction until 2004 when it stopped probably because of lack of funding. Macedonia's Public Enterprise for Railway Infrastructure plans to open two tenders for construction and reconstruction works on the Beljakovce – Kriva Palanka railway section.

c) Kriva Palanka - Bulgarian Border, new construction stretch subject to the new project and this ESIA Study.

Location of the section 3 of the Corridor VIII is presented in the following figures:

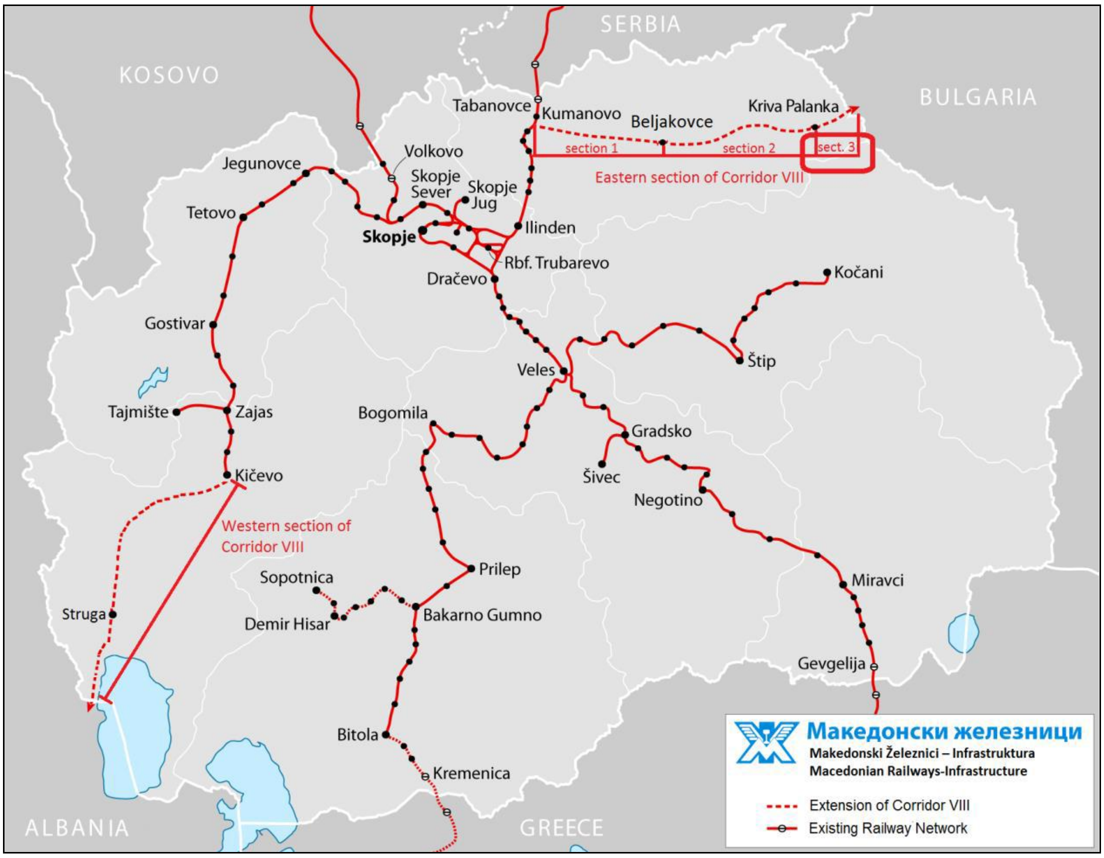


Figure 3 Eastern section of the Corridor VIII

Figure 4 Eastern section of the Corridor VIII

As a candidate country (from 2005), the Republic of Macedonia is using the pre-accession assistance, through the IPA, where transport infrastructure is defined as one of the priorities supported by the regional development component.

As was mentioned before, the Macedonian authorities intend to proceed with the development of the Section 3, with applying for EU IPA funding for the preparation of the detailed design. As part of the documentation that have to be prepared for the section Kriva Palanka border with Republic of Bulgaria, besides others is a new ESIA Study.

Subject of environmental and social assessment in the ESIA Study will be construction of the new railway line, i.e. section 3 Kriva Palanka-Border with the Republic of Bulgaria.

2.2 National legal framework requirements

The procedure for environmental impact assessment is defined in the Law on environment („Official Gazette of the Republic of Macedonia“ No. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 42/14, 44/15,129/15, 192/15 and 39/16) where the requirements of the EU Directive for EIA (85/337/EEК) are transponed.

In accordance with the Regulation on determining the projects and criteria by which the need for conducting an Environmental Impact Assessment is determined ("Official Gazette of the Republic of Macedonia" No. 74/05, 109/09, 164/12 and 202/16), the project for construction of a new railway line at the section Kriva Palanka-border with Bulgaria, as part of Corridor VIII, belongs to Appendix 1- Projects for which the need for conducting an Environmental Impact Assessment is mandatory, **section 7. Construction of: (a) railway lines at great distances and airports with a length of 2.100 m or more.**

In accordance with the established procedure, the Ministry of Transport and Communication, in the role of implementator of the Project, issued a Notice of intention for implementation of the project to the Ministry of environment and physical planning (MESP). In a procedure determined by the Law on environment and the Regulation on determining the projects and criteria by which the need for conducting an Environmental Impact Assessment is determined, MoEPP issued a Decision No. 11-5508/1 from 14.11.2017 (Annex 2) stating that an EIA procedure should be implemented.

Based on the scope determined in the aforementioned Decision, the current state in the project area, the descriptions in the Feasibility Study and part of the prepared project documentation, other relevant documents, reports and information, an ESIA Study is prepared for the section 3 Kriva Palanka-border with Bulgaria.

As a result of the envisaged activities for construction of the border tunnel that connects Macedonia and Bulgaria, a transboundary cooperation between the authorized ministries of both countries was carried out, in accordance with Article 3 of the Espoo Convention (Convention for assessment of impacts from individual projects in a transboundary context). Also a set of joint technical meetings have been organized. The information and documentation about the initiated Espoo communication are presented in Annex 3.

The ESIA Study for the construction of the new railway line-section 3 Kriva Palanka-Bulgaria, as part of the Corridor VIII, is prepared in accordance with the Regulation on the contents of the requirements that the EIA Study should fulfill („Official Gazette of the Republic of Macedonia“ No. 33/06), as well as according to the requirements listed in the EIA Directive (**2014/52/EU**), based on which the aforementioned Regulation is prepared.

Since this is a project for which an application for receiving financial aid from the IPA EU fund should be prepared, the Jaspers sectorial guideline for railway construction (Joint Assistance to Support Projects in European Regions), 2010, was used during the preparation of the study.

2.2.1 Activities for implementing the ESIA procedure

The activities for implementation of the ESIA procedure for the construction of the new railway for section 3 Kriva Palanka-Bulgaria, as part of Corridor VIII, are shown in the following table.

Table 1 Overview of the ESIA procedure

Phase	Documentation	Issued/Prepared	Date of submission/issuing/publishing	Comments
Scoping	Notification of the intention for the implementation of the project and scoping of the ESIA	Submitted to MoEPP	February 2017	Submitted by the Ministry of Transport and Communications
		Published on the MoEPP website	5.04.2017	Available to the public
		Published in daily newspaper	20.04.2017	Information was published in two daily newspapers “Vecher” and “Koha”
		Translated into English and Bulgarian lenguage and submitted to the eventually affected party-Republic of Bulgaria, under article 3 of the Espoo Convention	11-2504/3 from 1.08.2017	The Notification is submitted to the Bulgarian Ministry of environment and waters, through the Macedonian MoEPP, as a technical Focal point of the Espoo Convention through the Ministry of foreign affairs, as a political Focal point of Espoo Convention in the Republic of Macedonia

	Decision on the need for implementing an ESIA procedure and Opinion for the scope of the ESIA Study	MoEPP-No. 11-5508/2	16.11.2017 26.11.2017	Published on the web site of the MoEPP Published in one daily newspapers
		Submitted to the possible affected country, in accordance with the Espoo Convention	22.11.2017	Direct communication between Espoo focal points
Submission of the ESIA Study	ESIA Study (Article 83 from the Law on Environment)	Consultant	November, 2017	Ministry of Transport and Communications
Publishing of information relevant to the ESIA Study-Public consultation	Complete ESIA Study (Article 83 and 90 from the Law on Environment)	MoEPP	December, 2017	The Study will be published on the MEPP website and the Municipality of Kriva Palanka
	Submission of information to the Republic of Bulgaria (according to Article 93 from the Law on Environment)	MoEPP Ministry of transport and communication Republic of Bulgaria	November, 2017	MoEPP and the Ministry of Transport and Communication will submit information on the contents of the study to the Ministry of Environment and Physical Planning of the Republic of Bulgaria in order to implement the requirements of the Espoo Convention for transboundary assessment of the impacts, i.e. they will secure conditions for informing the public and for issuing Opinions and comments from the affected public, in accordance with the legal framework of the Republic of Macedonia.
	Information on the place and time for implementing the public hearing (Article 90 from the Law	MoEPP and the Ministry of Transport and Communication		Published on the websites of MoEPP, Ministry of Transport and Communication, and the Municipality of Kriva Palanka

	on Environment)			
	Public hearing implementation (Article 91 from the Law on Environment)	Consultant, MoEPP, Ministry of Transport and Communication		The public hearing will be held in the Municipality of Kriva Palanka
	Minutes from the public hearing (Article 91 from the Law on Environment)	MEPP		Preparation of minutes from the public hearing
Assessment of the compatibility of the ESIA Study	Preparation of Compatibility Report (Article 86 and 93 from the Law on Environment)	MEPP		The Minister of Environment establishes an expert committee for the assessment of the compatibility of the ESIA Study
	Publishing the Compatibility Report for the ESIA Study	MoEPP		Published on the MoEPP website and two daily newspapers
Consent for project implementation	Decision	MoEPP		Signing and publishing
	Decision	MoEPP		Published on the MoEPP website
Submission of the Study to the Republic of Bulgaria	Submission of the ESIA Study and the Decision on the Study	MoEPP		MoEPP will submit the Study and the Decision on the Study to the Republic of Bulgaria

2.3 Baseline in the National transport network

Traffic is one of the strengths of Europe. The performance of European transport systems can be compared with other developed regions of the world and constitute an essential component of the European economy. European countries differ in both the degree of development of traffic and the priorities of the development plans.

The development and gradual completion of the Trans-European Network, as an infrastructure basis for the flow of goods and the free movement of people in the internal market, remains a vital principled goal for the EU to bring the West closer to the eastern part of the Union, creating the future single European transport Area.

As for the Republic of Macedonia, transport plays a key role in economic development. Regional cooperation, within Southeast Europe, is more important today, in the period after the conflicts in the former SFRY, than it had two decades before. Political and economic ties between the EU member states and the Western Balkan countries are strengthening. From an economic point of view, the Union is the main trading partner of the Republic of Macedonia. Macedonia, so its business cooperation with the countries of the EU and SEE gets more importance.

National priorities for the development of the transport sector are defined in the following national and regional strategic documents:

- National Traffic Strategy 2007-2017;
- Public investment program 2011-2013;
- Five year program of the Public Enterprise for State Roads 2013-2017;
- Multi-Year Plan of the South East Europe Traffic Observatory (OSJE);
- Government Program 2014-2018;
- Pre-accession economic program 2014-2016 (PEP 2014-2016).

The transport of passengers and goods in the Republic of Macedonia is utilizing the following modes of transport: road transport, railway transport, air transport, inland waterway transport, urban transport.

In general terms the physical infrastructure consists of about:

1. 14,256 km public roads, of which 908 km are trunk roads, 3,778 km regional neighbours and further to the other European Countries are regional, and 9,570 km are local roads.
2. 699 km railways, and
3. 3. two (2) international airports.

The two Trans National Axes (Corridors VIII and X) that cross the country are important because they support the easy movement of people and goods within the country and also provide connections to the neighbouring countries. The EU policy regarding the extension of the major Trans-European Transport Axes to the EU neighbouring countries is confirmed and the orientation is already given in the Memorandum of Understanding (MoU) on the Development of the South East Europe Core Regional Transport Network. The SEETO Comprehensive network is established by the technical secretariat of the South East Europe Transport Observatory (SEETO).

The development of the transport infrastructure has achieved good results in the recent period.

However, it does not have all the features and characteristics of a fully functional, well developed and modern transport infrastructure system. In order to achieve the objectives of the Sector Operational Programme for Transport 2014-2020, modernisation and extension of the infrastructures on Corridors X and VIII to enable transport service delivery to be improved both in qualitative and quantitative terms is foreseen.

2.3.1 Road transport

The national road network is of a high density with the exception of the highways. Today, the overall road network of the country has a total length of 14,159 km. The network itself is a good starting basis for further development.

Major part of national roads or 553 km are included in the European roads "E" system, while only 251 km of motorways may be included in the TEM TEM (Trans-Europe Motorway) system of roads, these being: Border R.Serbia-Kumanovo-Petrove-Veles-Gradsko-Negotino-(to Demir Kapija); Skopje-Petrovec; Hipodrom-Miladinovci; Skopje (Saraj)-Tetovo; Tetovo-Gostivar. Out of the total length of categorized national and regional road network, 236 km (4.7%) are at motorway level, 341 km (7.9%) are with tracks width of 7 meters or more, 297 km (6.9%) are of tracks width of 7 meters and less, 1,523 km (35.3%) have width bigger than 5.5 meters, 306 km (7.0%) are of width ranging from 4.5 and 5.5 meters, 872 km (20.2%) with width less than 4.5 meters and 774 km (17.9%) are with earth tracks.

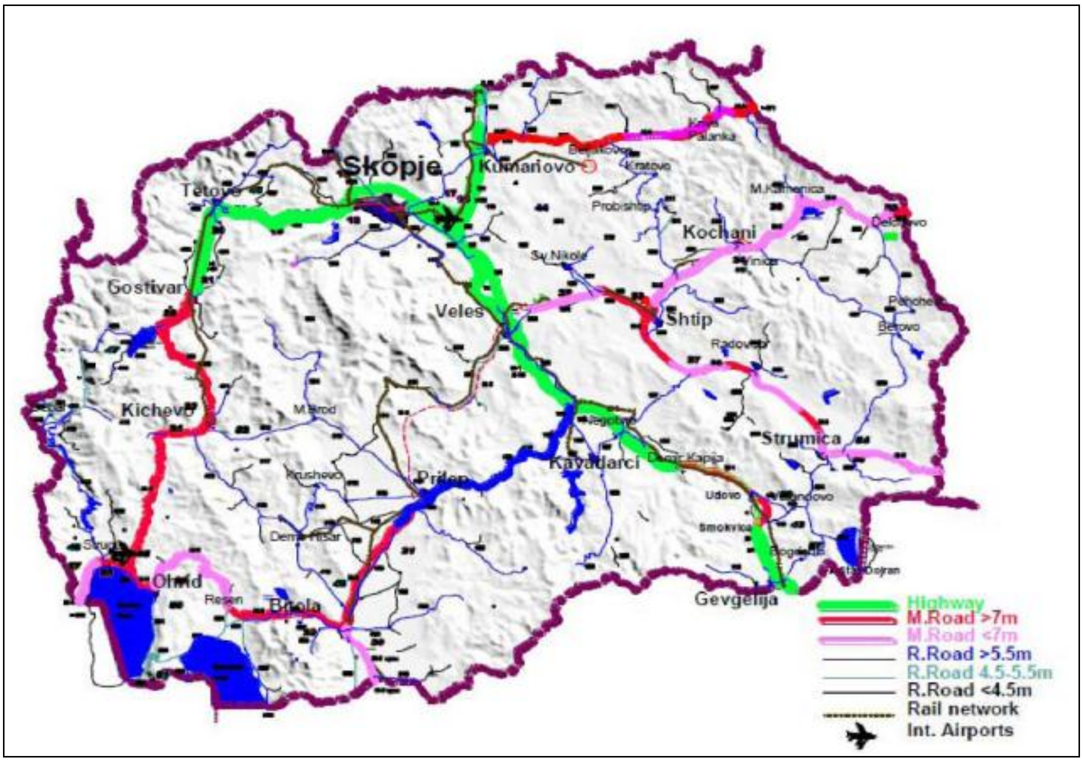


Figure 5 Road network in Macedonia

The overall condition of the road structure (main and important regional roads) is lower in comparison to European and some Neighbouring Countries Standards. The existing constructions are in fact generally strong and of a good quality. The magisterial roads, and in particular the highways, which have to carry the higher portion of traffic are in a better condition than those of second importance. The worst conditions can be assessed on low-traffic regional roads; most of them with dead ends. Many of them do not present neither geometric, structural, nor traffic characteristics and not justifying their classification into the regional road network.

2.3.2 Railway sector in the Republic of Macedonia

The Railway Infrastructure in the Republic of Macedonia was constructed in 1873 with the first Railway Track from Skopje to Thessaloniki in Greece. Today the railways network is about 699 km in single track lines and normal gauge of 1435mm. Additionally, the railway network is comprised by 226 km station and 102 km industrial rail tracks.

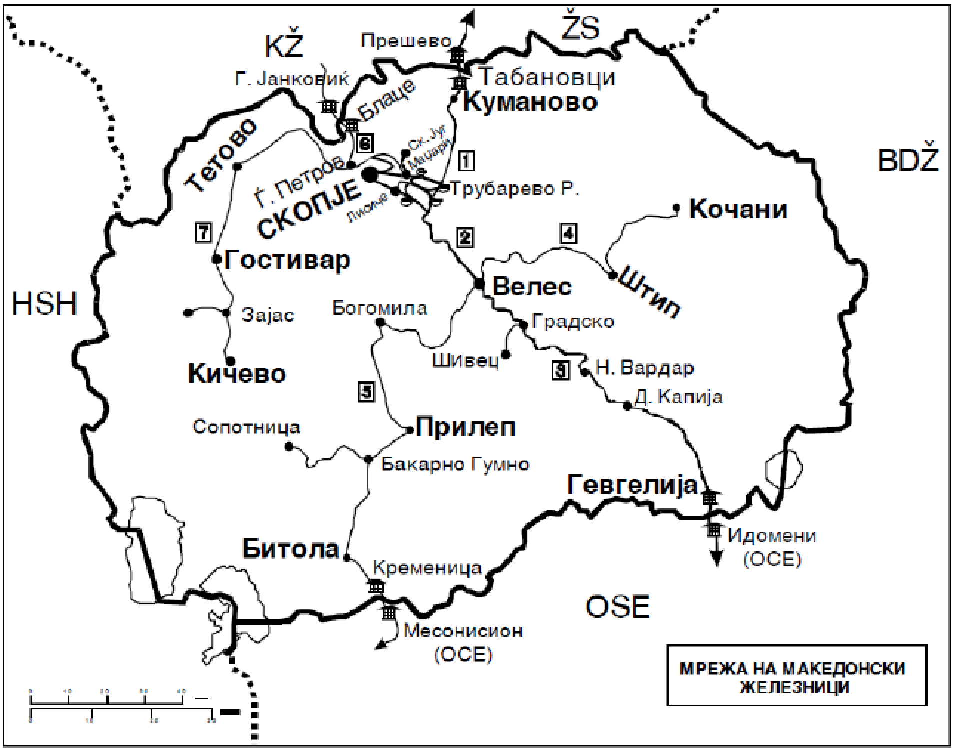


Figure 6 Railway network in Macedonia

Railway network has 68 railway stations (32 regulated by modern SS and TK devices, and the rest regulated by electric and mechanical devices), one shunt station, six depots and 62 standing points. Stations are mainly passengers and goods transport.

The main line on Corridor X from Tabanovci to Gevgelija-via Skopje and Veles is a single-track line, electrified (25Kv, 50Hz). The last renovation on most sections has taken place 30 years ago.

The total length of the railway infrastructure in Corridor VIII is about 307 km on the territory of Macedonia and 152 km (or 49%) are constructed and operational. About 89 km or 25% of the total length are remaining to be constructed on the link with Bulgaria and 66 km or 20% of the total length on the link with Albania subject to construction.

The railway system suffers from a chronic lack of maintenance that has been evidenced for many years and the rehabilitation that will be required to recover the position to achieve acceptable levels of safety at speed are difficult to quantify with any accuracy at this time. Besides incomplete basic infrastructure network: the missing part of Corridor VIII and still no electricity on part of Corridor VIII, which is in function, and branch Xd of Corridor X, there are several factors that explain the relatively small role of railways in the transport system of the country. All major issues related to geographical features of the state, i.e. the short distance among urban centres in the country especially between Skopje-Veles, Skopje-Kumanovo and Skopje-Tetovo are currently limiting factor for the low level of technical and technological development.

In 2007 Macedonian Railways (Makedonski Železnici-MŽ) was reorganized into two separate joint stock companies-a public enterprise in charge of infrastructure management.

Macedonian Railways Infrastructure (MŽ-I) and a transport company in charge of passenger and freight operations, Macedonian Railways Transport (MŽ-T). Republic of Macedonia adopted a new railway law and rail safety law in 2010, both of which entered into force on April 17, 2010. Since 2007, there are two independent rail companies as successors to Macedonian Railways-Public Enterprise

Macedonian Railways Infrastructure (MZ-I) and the joint-stock company Macedonian Railways Transport (MZ-T). This change was part of a broader railway reform program aimed at making the Macedonian rail sector comply with EU directives and the EU rail acquis, and by doing so, increase the commercial orientation of activities in order to allow the rail system to operate successfully and in competition with other operators.

In 2015 the railway carried 1,022,000 passengers, equating to 178 million passengers-km. As for cargo, the railway has carried 1,566,000 tons, equating to 278 million ton-km of cargo, being more than 97% for international transportation.

The railway carries selected bulk commodities including fuels, coals, cokes, steel products and clinker/cement. According to the data published in 2015, the composition of the transported freight is 25% container and 75% general cargo, with important presence of material for industry, being 13% gasoil, petrol and gas; and 34% ferrous and metallurgy products.

In the last 5 years, freight and passenger rail traffic declined in Macedonia by 43% and 28% respectively.

Even though the total number of passenger has decreased, the Passenger traffic in terms of passenger-km has increased from 145 million passenger-km in 2011 to 178 million passenger km in 2015, being less than 12% of the total performance.

Freight traffic grew strongly over 2000-2007, rising by 48 percent to 778 million ton-km, before declining sharply, particularly in 2009. As a result, overall freight traffic declined by 48% over 2000-2015 until 278 million ton-km.

The sharp decline in freight transport starting in the second half of 2008 reflects the impact of the crisis on the metals sector, which accounts for 44.5 percent of transported goods, measured in tons; some of the large clients of MŽ-T include Mittal Steel, Fenimak, the nickel mine company, and Makstil, a steel company.

Freight transport is dominated by international transport, with transit and import traffic almost 50% of total freight traffic in 2015 (transit equals to 46% and import equals to 49%).

- ***Planned projects in short-term affecting the performance of the project***

The track from Bitola to Kremenica will be reconstructed as part of project with the IPA I-OPRD 2007-2013.

There are currently projects for improvement of the rail infrastructure in the Republic of Macedonia such as rehabilitation of railway stations, rehabilitation of rail sections, projects for increasing the speed, electrification and operational aspects of the rail but still there is still room for improvement.

There are investments along the Corridor X in the period from 2012-2014 with an overhaul of a total length of 54 km of three sections: Tabanovce-Kumanovo, Miravci-Smokvica, and until the end of 2014 will be completed an overhaul for the section Nogaevci-Negotino.

2.4 Project goals and project-implementation benefits

The railway transport had and continues to have an important role in the economic and social development of the world regions, due to its ability to transport large quantities of goods and significant number of people at long distances and for a reasonable travelling time. It represents a highly competitive energy-efficient mean of land transportation, since the energy consumption per unit of load per km is less than the one for the road transportation. Also, the CO_2 emissions originating from road transport, will be significantly reduced using the railway transport. Hence, the railway will show an important role in combating climate change.

Also, the unstoppable enlargement of the energy costs that have tendention to hinder the transport with private vehicles and trucks makes the railway even more significant. The newly opened markets in the region, and its integration within the European market, makes the necessity for an efficient railway system to be a crucial topic for the socio-economical development of the Northeastern region of Macedonia, Macedonia as a whole, and Southeastern Europe, bringing sustainable benefits for the inhabitants, the business and the economy as a whole.

The strategic goals of the Government of the Republic of Macedonia within the railway transportation are:

- Attractive railway transportation of passengers, by securing high quality of passenger services, safe transport and guarantee that the choice on the type of the transport made by the passenger has taken into consideration the environmental aspects, including air quality and noise emissions;
- Support of the heavy freight trains that transport a large number of different products with an effective transition from railway to road transportation and vice versa;
- Support of the national industry in securing the effective and efficient mass transporatation regime.

The integrated transportation system has a key role in the support of the economic growth and increasing the competitiveness of the national and local economies, by securing an access to fast, efficient and trustworthy transportation services, as well as securing an individual mobility via the offered transportation services.

Working, management, maintenance and construction of the transportation networks directly contributes to the economic development, connection of the people with their workplaces and other activities related to recruitment promotion as key social element that supports the economic growth of the country.

The main purpose of the Project for construction of the railway Kriva Palanka-Republic of Bulgaria-Section 3 from the railway Corridor VIII-Eastern part, is promotion of the Balkan regional economic development, with an opportunity to use the significant potential for national and regional economic growth that the Corridor offers and creating new opportunities.

Currently the Corridor VIII within the Republic of Macedonia is operable along the section between Kumanovo and Kichevo, while the section Kumanovo-Beljakovce is under construction and the section Beljakovce-Kriva Palanka is currently in phase of choosing the best Contractor for the construction activities.

The completion of the rest of the railway links from the Corridor VIII will contribute to:

- Attracting larger national passenger and freight transport that is currently carried out mostly on roads, or it is not occurring at all;
- Boost of the international passenger transport;
- Boost of the usage of the railway for the purpose of import of materials;
- Boost of the usage of the railway for the purpose of export of materials;
- Boost of the usage of the railway by the international transit traffic.

The major goals that will be achieved with the implementation of the new infrastructure are:

- Improved accessibility for the road traffic and freight traffic;
- Improved interoperability;
- Strengthened capacity;
- Improved energy efficiency;
- Minimising the environmental impact;

- Mitigation of the impact of climate change: reduction of the greenhouse gas emissions, reduction of the pollution and the environmental impact (important examples are the projects that support the transfer from individual, i.e. automobile to collective transportation);
- Climate change adaptation;
- Improvement of LOS for the passengers at the railway stations;
- Improvement of intermodality;
- Improvement of safety.

The major results that are expected from the investment in the railway-Section 3 are:

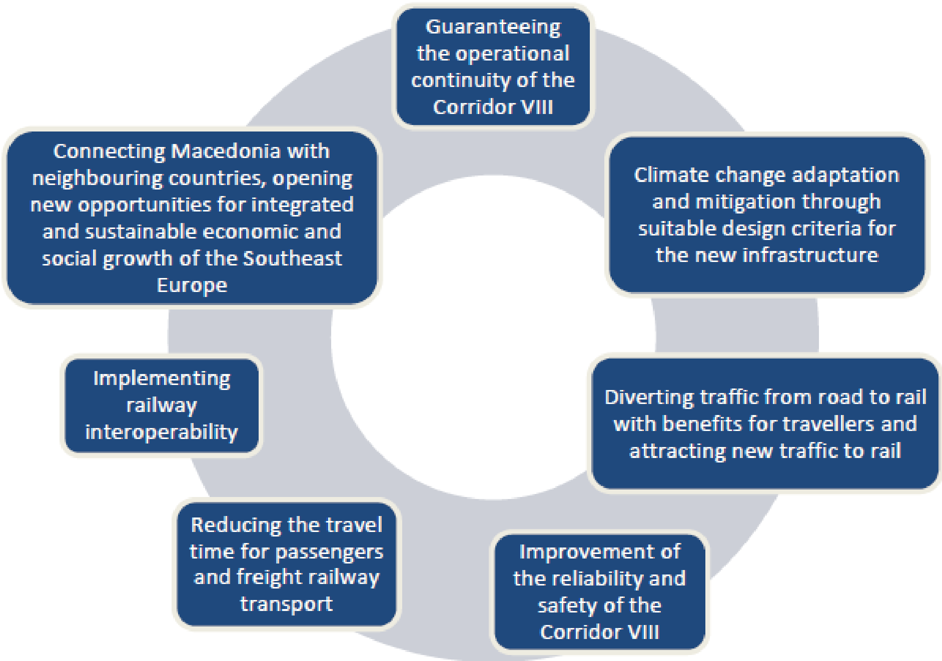


Figure 7 Main results of investment in Secton 3

3 LEGAL AND ADMINISTRATIVE ENVIRONMENTAL AND SOCIAL ASPECTS FRAMEWORK

The basic principles for environment protection are set in the **Constitution of the Republic of Macedonia** ("Official Gazette of the Republic of Macedonia" no. 52/91, 1/92 (Amendment XIX); no. 107/05 (Amendment III); no. 91/01 (Amendment IV-XVIII); no. 84/03 (Amendment XIX); no. 107/05 (Amendment XX-XXX), no. 3/09 (Amendment XXXI); no. 49/11 (Amendment XXXII) as the supreme legal document in the country. The Constitution prescribes that one of the basic principles of the fundamental values is regulation and humanization of the landscape and protection and improvement of the environment and nature. Also, one of the basic freedoms and human rights is the right of clean and healthy environment, but it is also an obligation of citizens to improve and protect the environment, while the country is obliged to secure conditions that allow for the realization of this guaranteed citizen right. (Article 43).

In 2005, the Republic of Macedonia was granted a candidate status for full membership in the EU. Since then, the Republic of Macedonia made significant progress in the area of law, politics, national strategies and plans, many international standards were adopted, but the activities should continue in the future.

The EIA procedure is enforced pursuant to Chapter XI of the Law on environment ("Official Gazette of the Republic of Macedonia" no. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 187/13, 42/14, 44/15, 129/15, 192/15, 39/16) and the appropriate bylaws. The purpose of the EIA procedure is to identify, describe and assess the impacts that a certain project (due to its character, scope or location) have or could have during its construction, operation and decommission upon: people and biodiversity, soil, water, air, and other natural resources, as well as the climate; the historical and cultural heritage and the interactions of these elements.

In accordance with the Regulation on determination of the projects and criteria pursuant to whom the requirement for the enforcement of an EIA procedure is laid down ("Official Gazette of the Republic of Macedonia" no. 74/05, 109/09, 164/12 and 202/16), the project for the construction of a new railway at the Section Kriva Palanka-border with the Republic of Bulgaria fits into Annex I-Projects that are mandatory subject to an impact assessment, item 7. Construction of: (a) lines for long-distance railway traffic and of airports with a basic runway length of 2 100 m or more.

During the implementation of the Project "Preparation of Detailed Design and tender documentation for the construction of the railway Corridor VIII", the EIA Directive (85/337/EEC), which is transposed in the national legislation, shall be considered together with its amendments.

Since it is a project for which an application for EU IPA (Instrument for Pre-Accession Assistance) funding should be prepared, the EIA JASPERS (Joint Assistance to Support Projects in European Regions) sectorial guideline on railway construction projects (2010) is followed. The following table presents the correspondence of the contents of both aforementioned documents.

NATIONAL LEGISLATION	EU EIA GUIDELINE[2]
Project description, along with information on project location, the character and scope of the project and the necessary land area Description of characteristics of the technology that will be used	Project description [Chapter 2.1]: a) physical characteristics of the project and land use during construction and operation (detailed maps of the location, borders of the location where major project activities will be performed must be obtained); b) description of the major characteristics of the design (for each section and for each structural component, number of

[2] (JASPERS, example from the Republic of Romania, 2010)

<table>
<tr><td></td><td>locations with precise data for identification);</td></tr>
<tr><td>Description of the environment and its media at the project location</td><td rowspan="2">Description of the environment [Chapter 3]:
- Soils and geology, surface and groundwater, air quality, human beings, noise and vibrations, climate, flora and fauna, proposed Natura 2000 sites, landscape, population, material assets and cultural heritage (archaeological and historical heritage);
Significance and sensitivity
Regulatory framework</td></tr>
<tr><td>Description of the natural, cultural and historical heritage and the landscape</td></tr>
<tr><td>Description of the type and quantities of expected emissions, especially air emissions and wastewater, solid waste, as well as other relevant information necessary for evaluation of the major project impacts on the environment</td><td rowspan="2">Description of the major processes [Chapter 2.2]:
a) description of activities and expected emissions (type and quantity) during construction;
b) description of activities and expected emissions (type and quantity) during operation;
c) description of changes in the project</td></tr>
<tr><td>Proposition of the magnitude and the characteristics of the change that imposes the need to update the Study on EIA</td></tr>
<tr><td>Description of the project impacts on the environment on the basis of scientific knowledge and the adopted evaluation methods</td><td>Description of the probable significant impacts (from the project itself, the use of natural resources);
Description of methods used to predict the environmental impacts [Chapter 4]</td></tr>
<tr><td>Description of the measures for prevention, mitigation and elimination of the environmental impact, as well as the restoration measures</td><td>Description of the measures for prevention, mitigation and elimination of the negative environmental impacts [Chapter 4]
-Possible impacts during construction and operation, as well as mitigation measures for the impacts during construction and operation concerning soils, surface and groundwater, air, noise and vibrations, climate, flora, fauna, protected areas-Natura 2000, population, landscape, cultural heritage, material assets;
- Cumulative impacts and interaction between all the elements;
- Short summary of impacts, measures, residual impacts</td></tr>
<tr><td>Description of the alternative solutions for realization of the project that the Investor has taken into consideration and the major reasons for choosing the preferred alternative; the zero alternative is always included</td><td>Description of the alternatives [Chapter 2.3]
a) description of the alternative locations, including assessment as prescribed in Article 6 of the Habitat Directive;
b) description of the design of the alternatives and processes, taking into consideration the environmental protection aspects;
c) Choice of alternative (short summary of the elements of the different alternatives, including the zero alternative)</td></tr>
<tr><td>Summary of the submitted Study without technical details</td><td>Non-technical summary (what is the reason for enforcing the EIA procedure; contents of the Study; written in style and language that is understandible for the broader public)</td></tr>
</table>

	[Chapter 6]
Gap analysis (technical problems or insufficient knowledge) of the difficulties that the Investor or the Expert have come upon during the preparation of the Study on EIA	Access to data (whether the available information is sufficient to identify the major impacts? Is the information focused on impacts that are probable and significant?) Lack of information [Chapter 3.5]
The need for elaboration of the regulatory framework within the scope of the Study on EIA is not a requirement of the national legislation, but the experiences and guidelines from the EU member states are being followed in practice, hence this chapter is included in the Study on EIA	Introduction, regulatory framework (summary of the national and EU legislation) [Chapter 1 and 3.6]
The need for preparation of Environmental Management Plan is not a requirement of the national legislation, but the experiences and guidelines from the EU member states are being followed in practice, hence this chapter is included in the Study on EIA	Environmental Management Plan [Chapter 5] -Major goals and scope of the Plan; -Contents and form of the Plan (overview of the proposed activity and local characteristics); summary of the impacts from the proposed activity; policies that are set by the Plan; institutional and regulatory framework; implementation program; assessment of the expenditures and financial resources

Annex 4 gives a detailed description of the EIA procedure and the relevant national legislation, as well as other relevant documents.

4 PROJECT DESCRIPTION

4.1 Overview of the project

At the end of the 19th century it was envisaged that the railway corridor should connect the Black Sea and the Adriatic Sea through Sofia and Skopje, via the railway from Kumanovo to Bulgaria. Works on the railway were initiated in 1873 between Sofia and Kumanovo. One year later, due to the Balkan Wars, the activities stopped. The railway between Sofia and Gyueshevo (Macedonian border) was finished in 1910 by Bulgarian railways. During the First World War, when Macedonia was occupied by Bulgaria, the Bulgarian railways analyzed the section that was missing at the railway that connected Kumanovo and in 1930 Bulgaria and Yugoslavia agreed to build several railway links, including the section Kumanovo-Gyueshevo. From 1941 to 1944, the Bulgarian army designed and initiated the activities on the railway line Kumanovo-Gyueshevo; they included the construction of 43 bridges and excavation of 26 tunnels. After the Second World War, Yugoslav railways have finished the works from Kumanovo to Beljakovce, in accordance with the Bulgarian project. This section was functional between 1956-1994. On 28 December, 1994, the Law on adoption and providing funding for the program for construction of the railway Kumanovo-Beljakovce-Kriva Palanka-Deve Bair (Bulgarian border) in 1994, 1995 and 1996 was adopted by the Macedonian parliament. 120 millions of USD were approved for the implementation of the program for the construction of the railway to the border with Bulgaria. The funds for the program were provided from the state budget, by the Public Enterprise for railway transport from Skopje, and partly from foreign funds. The design together with the construction works for the reconstruction of the section between Kumanovo and Beljakovce, and the construction of the section between Beljakovce and the border tunnel at Deve Bair started in 1994. The track of the section that needs to be built has remained almost the same as it was designed 50 years earlier. Still, the longitudinal profile is different because the proposed project for a dam near Kratovo is taken into consideration. At the end of 2004, the Government of the Republic of Macedonia decided to stop the works due to lack of funding. Up until this time, several bridges and tunnels were partly build between Beljakovce and the area located about 5.5 m west of Kriva Palanka.

At the end of the track there is a border tunnel. The construction works for the tunnel have begun before 1945 and were never completed.

In order to complete the construction activities, as well as to provide continuity in the construction of the sections that comprise the Corridor that will provide connection with the Republic of Bulgaria, a new railway line is envisaged to be constructed – Kriva Palaka-border with Bulgaria, section 3.

4.2 Project area location

The project area is placed in the Municipality of Kriva Palanka, which belong to Northeast Region of the Republic of Macedonia. The railway line runs from location before the town of Kriva Palanka (village Dlabocica) to Deve Bair at the Bulgarian border. The adopted Main Design for the alignment of Section 3 concerns the alignment of 23.4 km length. This stretch begins at approximately K.P. 64+942.01 and continues on the northern side of the Kriva valley. At K.P. 72.3 it reaches the town of Kriva Palanka. The line will cross the city by means of a tunnel. The alignment continues to move parallel to Kriva Reka until the entrance of the existing border tunnel connecting the two countries, the Republic of Macedonia and the Republic of Bulgaria. The project includes an actuation on Deve Bair border crossing between the Republics of Macedonia and Bulgaria.

The railway alignment of Section 3 inside the Bulgarian territory starts from km 88+364.65 (reference chainage of the territory of the Republic of Bulgaria: km 138+325.40) and ends 100 m after the portal of tunnel Deve Bair at km 89+658.47 (reference chainage of the territory of the Republic of Bulgaria: km 137+031.58).

The railway alignment design between km 89+658.47 and km 90+555.67 (Gyueschevo station) is out of scope of works of the Project Kriva Palanka – Bulgarian Border.

Figure 8 Project area

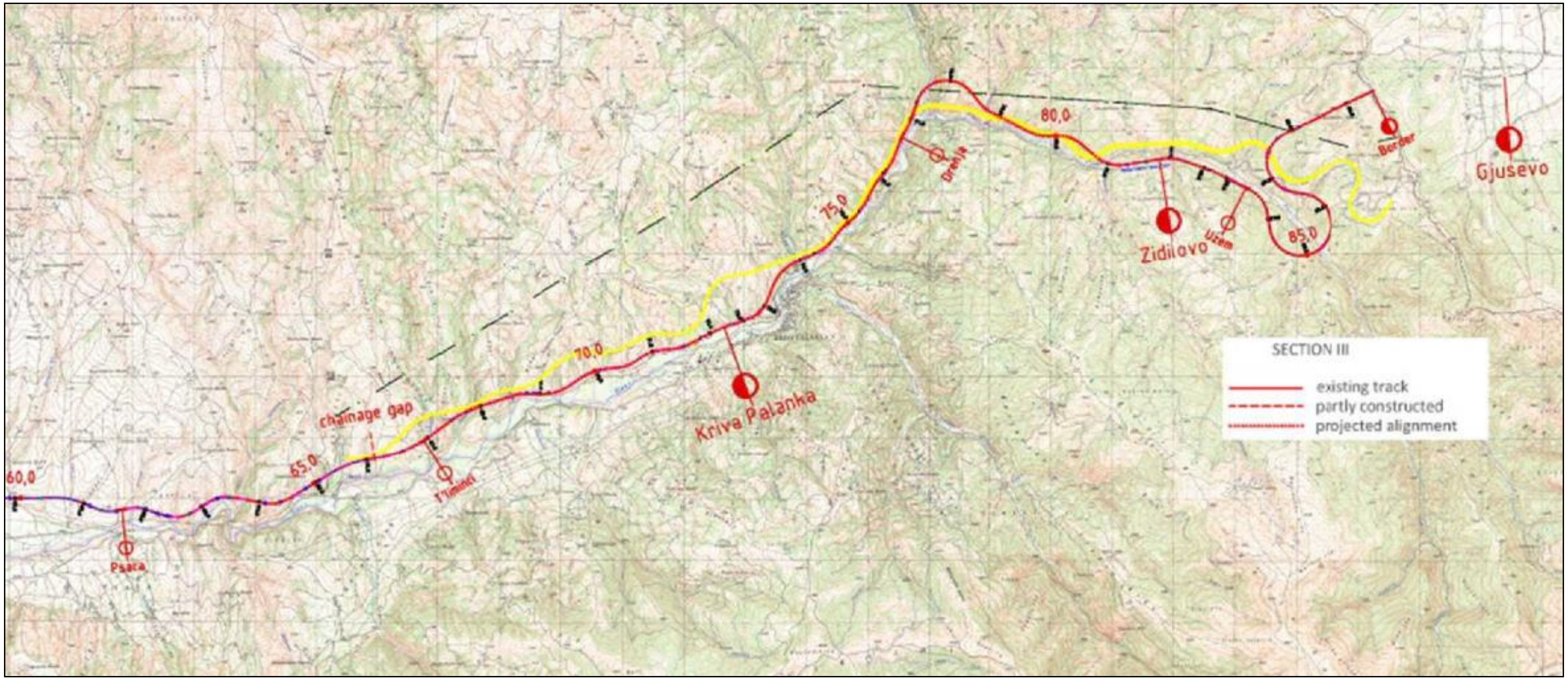


Figure 9 Project area

4.3 Land use in the project area (site visit conclusions)

At the beginning of the section 3 to the town of Kriva Palanka, the topography of the terrain corresponds to a widely open valley. The maximal altitude is c. 800 m. Towards Kriva Palanka, up to the Bulgarian border, the railway Corridor enters a mountainous region with a maximal altitude of 1.125 m.

At the start of the section, the land use corresponds to hilly pastures and conifer forests. There are also landscapes where the land is used for agriculture or orchards, especially in the lowlands near the river of Kriva Reka.

In the middle part of the section 3, the railway passes the town of Kriva Palanka, where the dominant use of land is housing. In the last part of the section, in the higher mountainous places, there are more types of natural deciduous forests that dominate the area. These forests are composed of oaks and birches. Agricultural land can be found along the river Kriva. The uncultivated land and pastures are gradually being replaced with forests over the slopes of the hills and mountains. Near the Bulgarian border the land is covered with forests, and part of it is used for mining activities.

The following text is a description of the locations where the railway line is envisaged to pass, as well as a description for the land use.

The starting point of the railway track is located before the village of Dlabochica and it represents a starting point of the newly envisaged railway. There is an already built bridge here that is the end of section 2. The houses from the village are located at around 500 m air distance. The land is covered with low-growing and high-growing vegetation.

Figure 10 Location of the strating point of section 3

Near the village of Dlabochica, at the beggining of the track, the village of T'lminci is also located. The houses from the village are situated right under the road that leads to the river of Gabarska (Dlabochichka).

Figure 11 View towards the village of T'lminci and the river Gabarska (Dlabochichka)

At the beginning of the track, the land is hilly, covered with bushes, after which a land covered with forests follows. These forests are mainly composed of oak and pine.

Figure 12 Vegetation at the location where the railway will be built

The track then passes again through a forested area and in the vicinity of the houses from the village of Gradec or Stamboliski Maala.

Figure 13 View towards Stamboliski Maala

Further on, the track continues towards the village of Konopnica and passes through a lowland and a slightly hilly landscape, i.e. cultivated and non-cultivated land. From here on to Kriva Palanka, the track is situated on a hill, above low-growing pine forests, left of the road that leads to Kriva Palanka.

At one point the track passes near houses and auxilliary objects.

Figure 14 Location of the track before Kriva Palanka

Then the track continues on a hilly landscape above the housing objects. In this part, a bridge is supposed to be build over a housing object-an individual house.

Figure 15 Part of the location of the track in Kriva Palanka

The railway station in Kriva Palanka starts at a location which was previously planned for construction of a railway station. There are houses situated below the access road.


Figure 16 Location which was envisaged for the construction of the station in Kriva Palanka (starting point of the station)

Then the track continues towards the locality called Kukov Dol. It will enter a tunnel and bridges. Part of the bridge will pass over the houses. In the rocky area where the houses are situated, a tunnel is planned to be build.



Figure 17 Location of the track at the locality of Kukov Dol in Kriva Palanka

After the station and the large tunnels that will pass under the houses, the track continues towards the locality of Osichki Maala or Domachki Dol. Here the exit from the tunnel is located, and the track continues on a bridge. Here several houses are planned to be demolished (shown in figures below) in order to make a clear area for the envisaged tunnel.

Figure 18 Some of the houses that need to be demolished for the purpose of railway construction

After this, the track continues in the settlement of Drenje, in the hilly part above the housing objects. There are newly built houses here, above which the railway line should pass (few meters above the houses).

Figure 19 Housing objects in Drenje

Then the track leaves Kriva Palanka and it stretches on the hill, near the road to Zhidilovo and near Kriva Reka. Several houses are envisaged to be removed for the puropse of railway construction. Agricultural land can be seen along the banks of the river Kriva.

Figure 20 The railway track at the exit of Kriva Palanka

The track continues towards Zhidilovo, on the left side of the road, and then through a tunnel, and then across a bridge will pass over Kriva Reka towards the right side of the road that leads to Bulgaria. In Zhidilovo a halt is envisaged to be build. There is a fishpond near the track and a restaurant, houses, as well as the river Kriva. Agricultural cultivated land is present here, as well as a hilly landscape covered with vegetation.

Figure 21 The railway track at Zhidilovo

After Zhidilovo the track continues on a mountainous terrain towards the villages of Uzem and Kostur. A tunnel will pass under the houses located on the hill (from the v.Uzem) and from here the track stretches towards the border crossing of „Deve Bair". The track passes in the vicinity of the tailings dump of Toranica. At the last part of the track, in the higher mountainous areas, there are dominant natural decidouous forests, i.e. oak and birch forests.

Figure 22 Track location at Uzem-Kostur

The track then passes through the place called Mandelci (Mandalska Maala), which is part of the village of Uzem. There is an old tunnel here, whose construction begun during the Second World War. This tunnel should be completed to the border with Bulgaria and to continue from the Bulgarian side. The tunnel should emerge at the border crossing „Ramna Niva“. There are houses at the location, barns, auxiliary objects etc. The land is covered with forests.

Figure 23 Location of the part of the track that ends in the border tunnel that leads to Bulgaria

- **Land use during the construction of the railway**

During the construction, there will be a need for temporary land expropriation for the process of construction, as well as for storage space, workers camps, and offices. There will also be a need for land that will be used as borrow pit, landfill, concrete batching plants, objects for aggregate crushing, access roads etc. The locations of the construction objects should be additionally defined, prior to the commencement of the construction works. This activity will be implemented according to the legal requirements, which will also require concluding Contracts with the affected landowners.

In the newly prepared Feasibility Study for the section Kriva Palanka-border with Bulgaria from December, 2016 and in the other available documentation, the future use and land acquiring is not analyzed.

In accordance with the data from the ESIA Study for Corridor VIII (section Kumanovo-Bulgarian border), prepared in 2012, a Study for Expropriation was prepared by Macedonian Railways-infrastructure for the section 3. It is assessed in the study that around 25 houses should be demolished and agricultural land should be expropriated. The total number of houses that will be affected in the town of Kriva Palanka is 19. Additionally, 1 house will be affected in the village of Gradec and 5 houses in the village of Uzem.The new station in Kriva Palanka is expected to be located after the gas station. The access road to the station will pass through the yard of a house, and through another house; these houses should be demolished (2 affected houses). The track will also stretch through the yards of three more houses and will be located at less than two meters from one of these houses. Starting from the west side of the town, the railway will continue for 900 m, and then a bridge will follow with a length of 40 m. Then the railway will enter a tunnel with a length of 100 m, and after that it will pass through an open terrain again, prior passing into the 960 m long tunnel. The railway will then pass a bridge with a length of 130 m (around 14 houses will be affected). It is expected that the procedures for land expropriation for this section to be completed prior contracting the construction activities.

Besides the 25 houses that will be demolished, it is estimated that 424.379 m^2 of land should be expropriated, of which the majority is agricultural land. Small portion of this land (20.805 m^2) are yards. Most of the yards belong to the affected houses, but they also belong to other houses that fall under expropriation. All of the houses that need to be demolished are two-storeyed and have an average ground floor surface of 52.5 m^2. The permanent land acquisition will directly affect around 465 land owners (families). Taking into account the total number of family members whose land and property will be confiscated, the number of individuals that will be affected is 1960. The houses that will be demolished and the land that will be expropriated are located in the Municipality of Kriva Palanka. The settlements where these houses and land are located are shown in the following table.

Table 2 Overview of the expropriation needs

Settlements along Section 3	Area, m^2	Houses/ground floor, m^2	Number of houses
T'lminci	33,760		
Gradec	70,041	35	1
Lozanovo	10,349		
Kriva Palanka	68,602	801	19
Drenje	24,943		
Trnovo	3,289		
Kiselica	18,451		
Zhidilovo	29,440		
Krklja	64,711		
Kostur	3,590		
Uzem	97,203	214	5
Total	**424,379**	**1,050**	**25**

4.4 Technical project description, including size or scope

The technical solutions for construction of the new railway (Reference Alternative), Kriva Palanka, Border with the Republic of Bulgaria are presented in the following chapters (in accordance to the ToR the following main design criteria have been considered and shall be respected).

Table 3 Main design criteria according to ToR

Parameter	Value
No. of tracks on the open line	One
No. of tracks in the station (halt)	In accordance with the specific requirements of the site that are elaborated in the alignment from the Detailed Design
Minimum distance between axes of main tracks in station (halt)	Min. 4,75 m
Speed which should be attained of each section (designed speed)	100 km/h
Minimum radius	R_{min}=500 m
Maximum cant value	150 mm
Transition curve	Cubic parabola
Maximum gradient	25,0 mm/m on the open line и 1,5 mm/m in the station (halt)
Maximum radius of vertical curve	R_{Vmax}=25,000 m
Minimum radius of vertical curve	R_{Vmin}=2,500 m
Traffic	Mixed traffic – passengers and freight
Clearance gauge	European GC
Usable length of main track in railway stations	750 m (depending on the local geographical conditions and final lengths to be defined according to the instruction from “MZ-I”)
Length of platforms in main stations	400 m (220 m for the halt)
Track bed width	Designed lower bed shall be minimum 6.0 m wide for the single track on straight, except where the track is on/in civil engineering structure and/or in curve
Maximal axle load	250 KN and 8,0 KN/m (group D4, UIC leaflet 700)
Crossings	In two levels – the railway line should be built without any road level crossing
Sub-ballast	Where appropriate
Traction	Electrification, mono-phase system of 25 kV/50 Hz
Signalling and communication equipment	Interlocking ETCS-Level 1, (European Train Control System – signaling, control and train protection system), GTC and GSM-R Global System for Mobile Communications – Railway (international wireless communication Standard for railway communication and applications)

The following is adopted:

- ✓ Length of platforms:
- Length of platforms in Kriva Palanka station: 170 m
- Length of platforms in Zidilovo halt: 100 m
- ✓ At the beginning of bridge B21 and due to the relocation of the bridge abutment to KM 71+569 there was a conflict with the two auxiliary Railway lines at this area.This issue

have been discussed with MZ-I and a reduction of 5.0 m in these two tracks have been approved allowing to eliminate the interference.

- ✓ The Main Design of Electrification belonging to Section: Kumanovo-Beljakovce, considered two substations, in Kratovo and Kriva Palanka. MZ-I have decided not to build a second Traction Power Substation at Kriva Palanka, due to MZ-I expects light traffic on Corridor VIII (Eastern Section) at least for the initial 10-15 years of its operation. The Preliminary Design includes a design without substation at Kriva Palanka and with the parallel feeders.
- ✓ At the area of Tunnel T06 at Kriva Palanka Station where there are 2 tracks, the distance between their axes is 6.00m according to the preliminary design.The Consortium proposed the reduction of these distance up to 4.50 m, which fulfils requirements of TSI Infrastructure, in order to design a narrower tunnel section with the relevant cost benefit. MZ-I allowed the reduction of the distance up to 4.75 m, that is the minimum distance of track centres in stations according to the requirements of ToR.
- ✓ Using the GSM-R system to establish a radio link between locomotives and trains management centers.

The parameters for the design of the railway are shown in Annex 5.

- **Alignment**

Section 3 of the Eastern Section of Corridor VIII (Kriva Palanka-Bulgarian border) concerns the alignment of 23.4 km length of single track line and it includes also one station in Kriva Palanka and one halt in Zidilovo.[3] Along this alignment there are 22 tunnels with total length of about 9 km, and 52 bridges (viaducts) with total length of about 5 km.

Section 3 stretches from Kriva Palanka (at K.P. 64+942.01) to the Bulgarian border (at K.P. 88+364.65). The projected alignment continues from K.P. 64+942.01 on the northern side of the Kriva valley. At K.P. 71.0 it reaches the town of Kriva Palanka, where a station will be located.

Since the valley and the neighbouring hill sides of Kriva Palanka are densely covered with buildings, the line will cross the city by means of a 966 m-long tunnel in order to avoid major demolitions.

From the end of the tunnel up to K.P. 76.0, the line runs between the Kriva River and the planned future motorway. At K.P. 76.0, the river valley makes a 90° curve, shifting from the North-East to the South-East direction. The line follows this bending with a wide curve in order to gain length and subsequently height. Three kilometres further upstream, the line crosses to the South side of the valley. At K.P. 82.3 a horseshoe curve has been planned in order to gain length and climb up to the entrance of the existing border tunnel. The horseshoe curve is on the approach to the tunnel.

The cross-border tunnel “Deve Bair” tunnel has a design length of 2,383 m, of which 1,193.70 m are on the territory of the Republic of Bulgaria (reference chainage of the territory of the Republic of Bulgaria: km 137+131.70 to km 138+325.4). Construction of the tunnel from the Bulgarian side was commenced in 1941. Fully completed is a section of 550 m of the tunnel, performed with single-layer lining comprised of concrete blocks in the vault and in-situ cast concrete in the walls. The tunnel, in its finished part, provides a clear opening of b/h – 5.2/6.0 m (following the reconstruction of the existing

[3] The cross-border tunnel “Deve Bair” tunnel has a design length of 2.383 m, of which 1.193,70 m are on the territory of the Republic of Bulgaria (reference chainage of the territory of the Republic of Bulgaria: km 137+131,70 to km 138+325,4)].
The Alignment design team modified the mentioned features in order to be consistent with the previous section 2, Beljakovce – Kriva Palanka. So, according to the alignment design, the section begins at km 64+942,01 and ends at km 88+364,65 Bulgarian border).

bottom). Up to km 138+158, there follows a partially excavated and unfinished part of the tunnel – main galleries, etc. The length drilled from the Macedonian side is 250 m. The tunnel entrance has partly collapsed at the Macedonian side. The first 250 m of the tunnel are known to be in difficult and unstable soil with the rest of the tunnel being in more stable rock. Annex 6 shows the alignment of the railway line Kriva Palanka-Border with the Republic of Bulgaria

From Kriva Palanka to the Bulgarian border most of the railway alignment has a gradient ranging from 20 to 25 ‰. Therefore, freight trains will have to be pushed by a second locomotive.

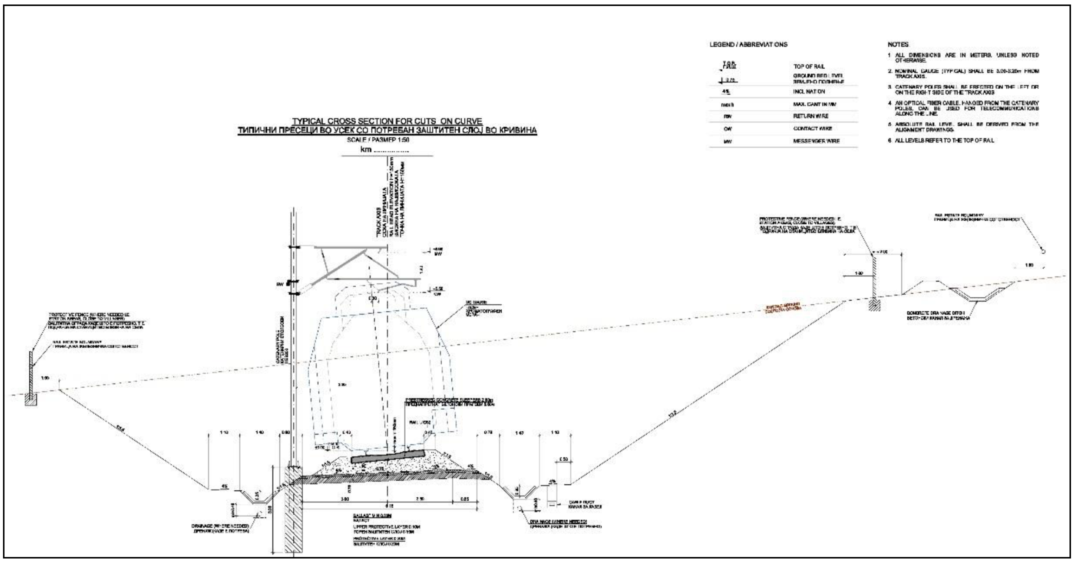


Figure 24 Typical cross section for cuts on curve

- **Track**

The design of the railway track and its interface with other components of the rail system will have the primary considerations of safety, economy, ease of maintenance, and constructability.

This is one of the reasons that implies that for construction of a new railway line, it is important to ensure that the track bed layers have the appropriate mechanical characteristics and are of adequate thickness.

The track bed layers play an important part in track performance with respect to track support stiffness, maintenance of track geometry and drainage.

In addition, the track structure includes ties, fastening system and rail. These elements are interconnected to provide a continuous surface for running trains and an electrical conductive medium for transmitting railroad signals.

On the other hand, the track structure requires an effective drainage system in order to keep the subgrade well drained and stable. A well-drained and stable subgrade means absence of standing water therefore preventing pumping phenomena.

Additionally, any standing water may shunt the signal circuits causing signal failures.

The permanent way components are summarized below:

- Rails: CWR rails welded in continuous railway track.
- Fastening: elastic fastening system.
- Sleeper: pre-stressed mono-block concrete sleepers.

- Ballast: the minimum ballast thickness under the sleeper edge (measured at the lower rail) is 30 cm for main tracks and 20 cm for station tracks. The minimum width at the sleeper head is 40 cm.
- Protection layer: the proposed thickness of the protective layer is 40-60 cm for new lines, but these vale must be verified with geotechnical investigations.

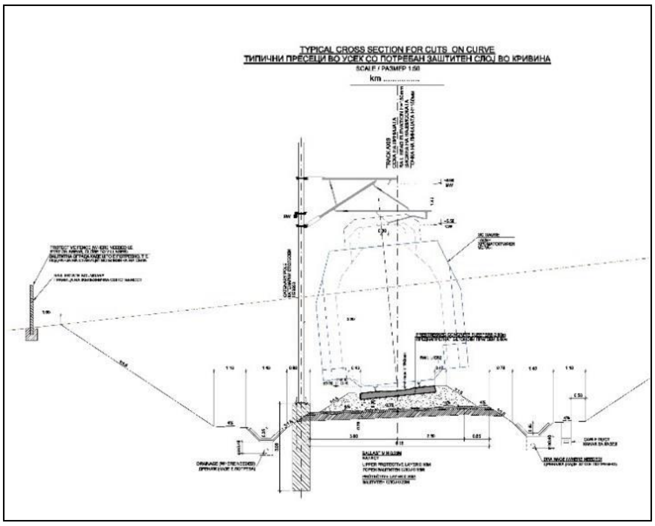


Figure 25 Typical cross section for cuts on curve

In the following text is presented a brief description of the different elements.

- **Rail**

The rail characterizes and distinguishes the rail system, being a fundamental element of the track line.

It must have a number of features that allow it to withstand a complex set of efforts (its profile, its length and its metallurgical composition).

According to the ToR, the rails to be used will be UIC-60/or 60E1, required quality of steel 900A (R260), CWR-rails welded in continuous railway track. Higher steel grade may be used (e.g.: in sharp curves) if deemed necessary.

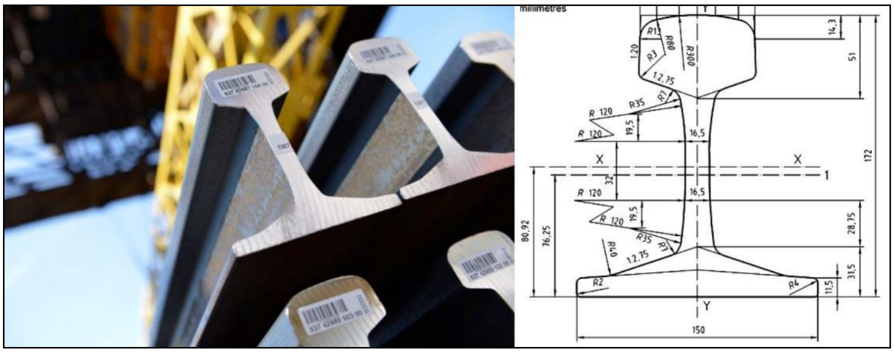


Figure 26 Example of rail profile 60E1

- **Fastening**

The rail elastic fastening systems must keep the track gauge within predetermined tolerances, retain sudden relative movements between the rail and the sleeper, protect the rail against torsion forces, avoid turning of rail and keep it in a transversal direction. Fundamentally, the elastic fastening systems must provide a permanent contact without gaps that may occur between different systems described and the support system.

These systems include elastic absorbing elements of the impacts and vibrations, and insulating elements to ensure electrical insulation between the rails, necessary for the proper operation of the track circuits. Generally, the elastic rail fastening systems complement the concrete sleeper in its appropriate behaviour, in what concerns to the vertical elasticity and electrical insulation. On the other hand, the fastening systems are designed to ensure smooth operating during the life of the whole line.

According to the ToR, fastening system will be elastic, contemporary and adapted to approved pre-stressed concrete sleeper supplied with elastic (rubber) rail pad and adequate elastic spring.

- **Concrete Monoblock Sleepers**

The sleepers are the elements placed under the rails and perpendicular to these, their function is to ensure the transmission of loads to the ballast and maintain the gauge and the inclination of the two rails without changes.

The monoblock sleepers with the International gauge are formed by a single piece of prestressed concrete and fixed with elastic fastening to the rail. The tracks must laid with a nominal gauge of 1,435 mm and with a minimum of 1,666 sleepers per kilometre.

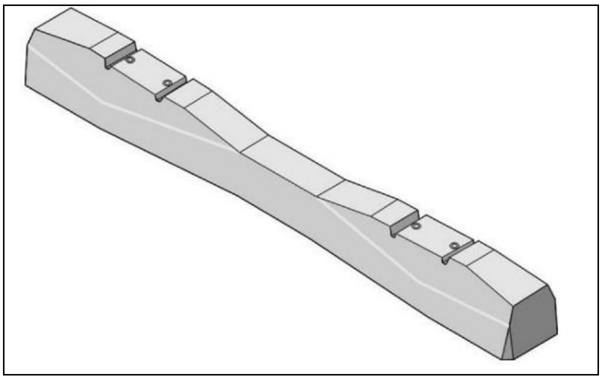


Figure 27 Example of concrete monoblock sleeper

It will be provided an assessment to choose the suitable sleeper to be used in the line, according to the rolling stock loads. Also, possible materials and other sleeper’s elements (sleeper pads) will be analysed with the aim of ensuring optimal performance of the track.

The sleeper shall be one-piece compliant with UIC recommendations and local regulations.

Wooden sleepers may be foreseen on bridges and viaducts, in tunnels and on turnouts, if found technically unavoidable or justifiable, but as an exception only.

- **Turnouts and Crossings**

The demand for the track equipment to be installed in a line is determined by different factors such as the definition of the infrastructure and superstructure geometry and material properties selected for its construction, the needs generated by the planned operation, planning maintenance work, and the characteristics of the execution of the works.

According to the ToR, all turnouts will be in accordance with designed rail profile, in compliant with the Europeans standards of construction and also be welded and incorporated in the CWR and secured with devices against longitudinal displacement.

It will be necessary to foreseen installing of the adequate hydraulic devices and electric heaters where required by the climate.

The turnouts have been designed on some sections with gradient i≤10‰. The geometric characteristics allow the calculation of the values of travel speeds, gauge, acceleration, etc. defining the type of point switch to be used in each case.

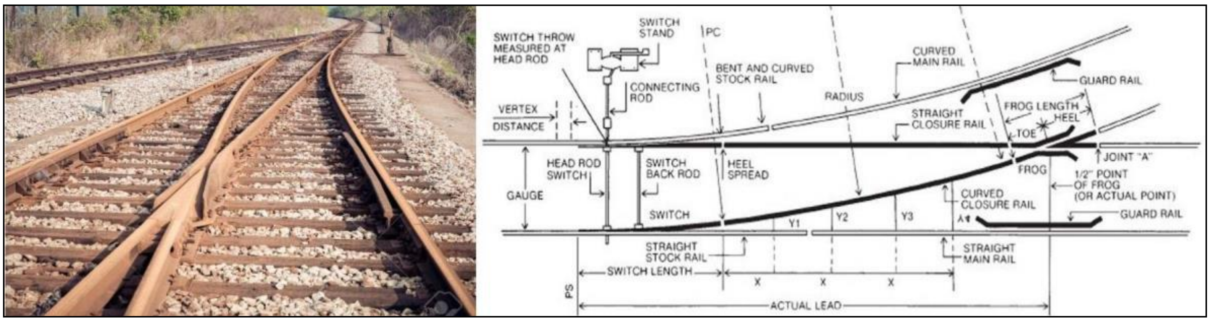


Figure 28 Example of turnout

- **Ballast**

The ballast shall be quarried hard rock consisting of granite, basalt or other igneous rock capable of being crushed into sharply faceted surfaces. It shall be selected from source rock such that the feed to the primary crusher is fresh, hard, durable and free from clay, organic matter, weathered or friable material.

Referring to the shape, it must be angular in shape with all dimensions approximately equally proportioned, free from dust, chemical contamination and cohesive particles.

A geological report identifying the geological characteristics of the parent material shall be submitted to the Final Beneficiary for approval prior to ballast production commencing.

According to the ToR, ballast will be crushed stone in accordance with EN13450. The ballast prism have a minimum depth of 33 cm under lower plane of sleepers.

- **Stations and halts**

This section has one station and one halt as summarized below:

- Kriva Palanka station at K.P. 71.03 with 2 sidings and 3 tracks for maintenance and stabling;
- Zidilovo halt at K.P. 80.8 with 2 sidings;

For both cases, passenger building and railway maintenance building have been considered included in the works. Several new buildings are proposed:

<u>In Kriva Palanka station (5):</u>

- passenger building, railway maintenance and electrical operations building, train traction facility, train traction building, train inspection facility

<u>In Zidilovo halt (2):</u>

- passenger building, railway maintenance

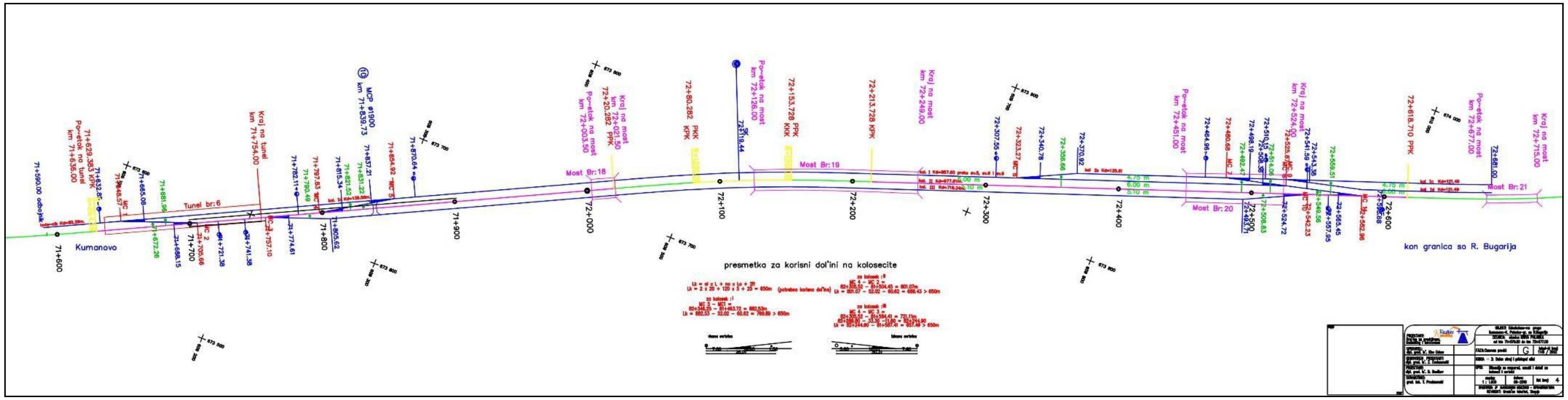


Figure 29 Layout Kriva Palanka Station

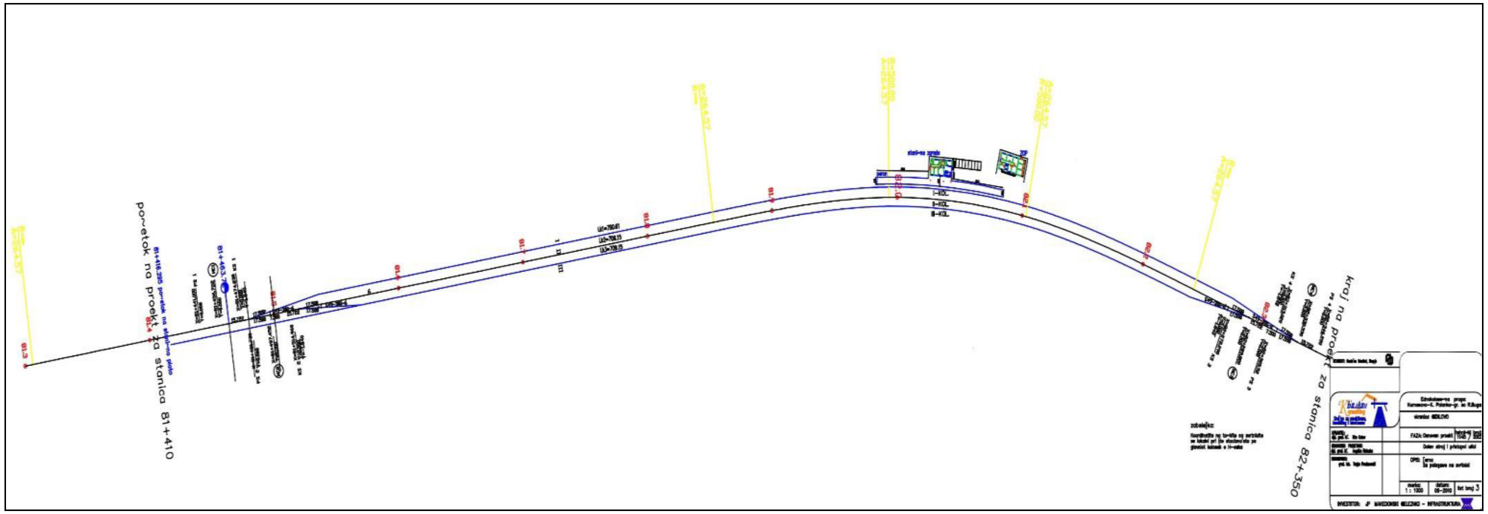


Figure 30 Layout Zidilovo Halt

- **Crossing**

Along the stretch Kriva Palanka-Border with Republic of Bulgaria, there are several crossings with roads and alignments:

- Some of them are located in areas of bridges or tunnels and have no interference with the future railway line.
- Other crossings are solved through an underpass.
- In the rest of crossings, an overpass is designed.

The list of crossings with existing roads is the following:

Table 4 Crossing with roads and alignments

	Chainage	Facility
Crossing 1	65+940.000	Bridge 3
Crossing 2	67+185.000	Tunnel 3
Crossing 3	68+234.000	Bridge 9
Crossing 4	69+085.000	Bridge 12
Crossing 5	70+022.000	Bridge 16
Crossing 6	71+364.000	Bridge 20
Crossing 7	71+592.000	Bridge 21
Crossing 9	72+822.000	Bridge 23
Crossing 10	72+930.000	Bridge 23
Crossing 12	76+480.670	Bridge 32
Crossing 13	79+850.600	Bridge 37
Crossing 14	82+122.000	Bridge 42
Crossing 15	84+149.440	Bridge 44
Crossing 16	85+607.000	Bridge 45
Crossing 17	85+838.200	Bridge 46
Crossing 18	86+338.966	Bridge 48
Crossing 19	86+379.733	Bridge 49

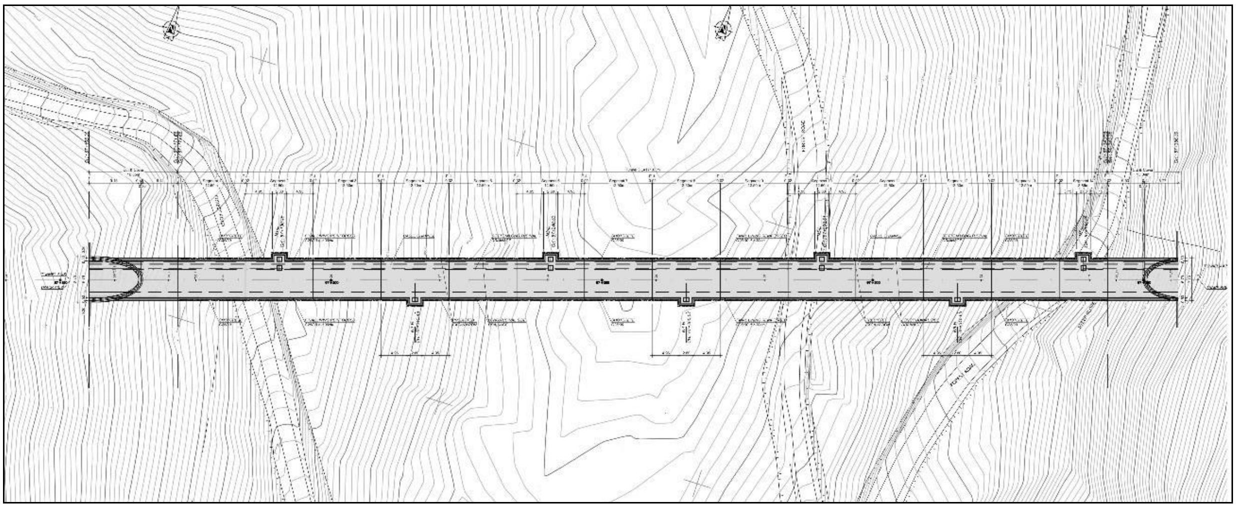


Figure 31 Example of crossing with forest roads. Preliminary Design of Tunnel 03

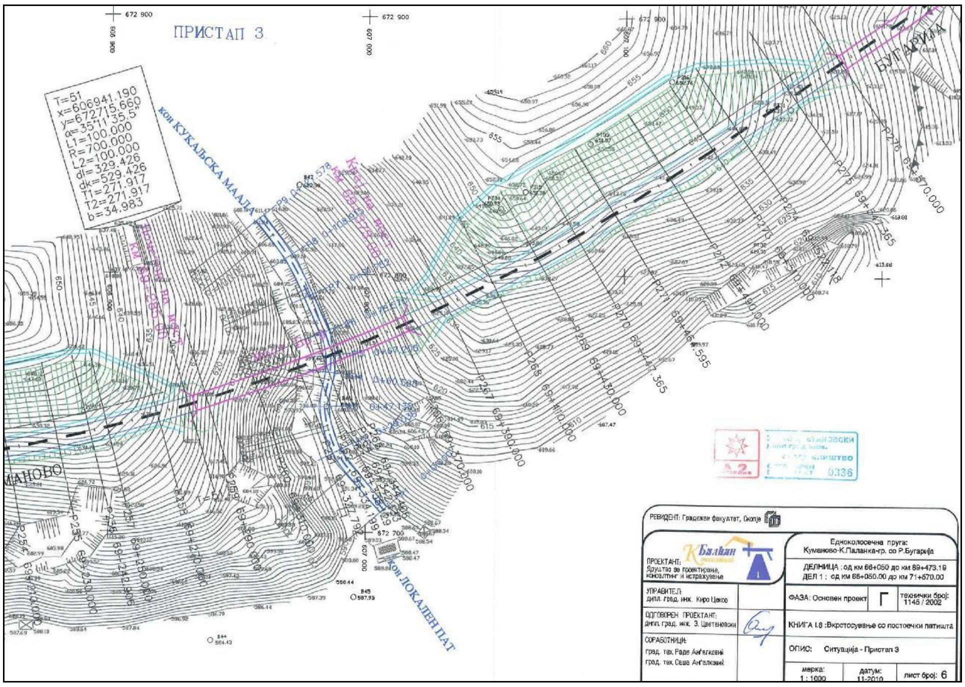


Figure 32 Example of crossing with dirty road. Bridge 09 included in previous Preliminary Design

- **Tunnels**

Along the railway aligment will be constructed tunnels. The tunnel cross-section will be defined with regard to the space requirements of: clearance UIC GC, overhead catenary system and related installation (circuit breaker, tensioning devices), power supply feeding lines, electrical clearance, height and width of permanent way, emergency exits, space signalling and telecommunication equipment, cable ducts, construction space including temporary scaffold and additional reinforcement of lining, aerodynamic clearance.

- **<u>Construction method for Border Tunnel 22</u>**

Border Tunnel 22 is a long tunnel with one track. The total length of the alignment of the tunnel, where construction activities will be executed, is 2366.05 m. Due to length and dimensions of tunnel 22, foreseen construction method will be NATM.

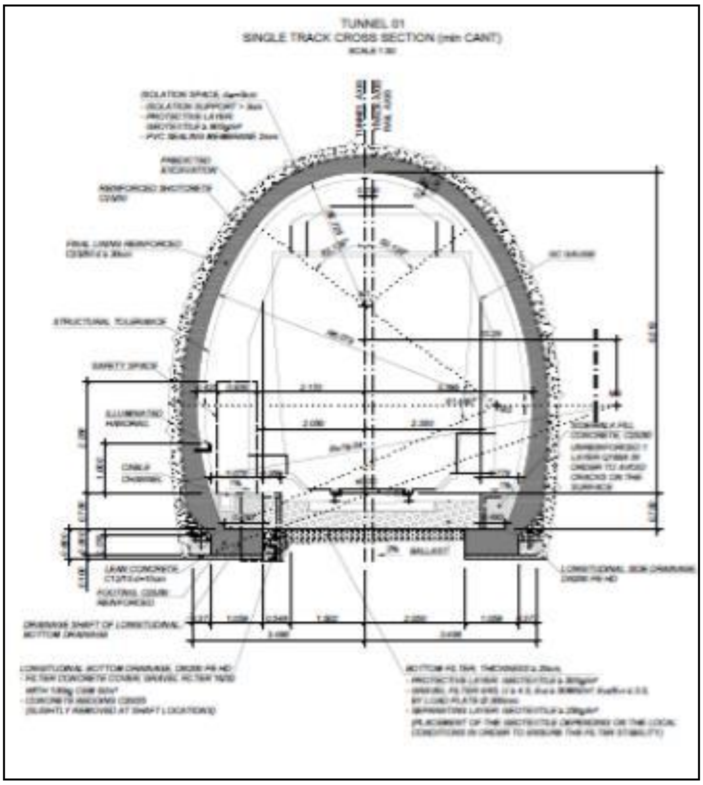
Regarding the construction of Border Tunnel 22, it can be said that from km 87+192.3 to km 87+280 (87.7 m) cut&cover will be carried out, while from km 87+280 to km 89+558.4 (2278.4 m) drill and blast will take place.

In a rocky substrate, the excavation can be done by drill and blast, while in faults it can be done mechanically. Road headers might be used, but the small section of the tunnel would limit the use of such equipment; also, due to the already constructed parts of the tunnel (250 m in Macedonia and 1100 m in Bulgaria) which have different dimensions and support on the Bulgarian part, the use of such equipment would be impossible.

- **<u>Construction method for the Emergency Gallery</u>**

Since the length of the border tunnel is greater than 1 km, an emergency gallery is envisaged which will serve as emergency exit (according to TSI). Connections to the gallery will be constructed at every 500 m, and at the connection points within the tunnel there will be enlargements.

The gallery will be constructed based upon the NATM method, with the use of drill and blast technique.



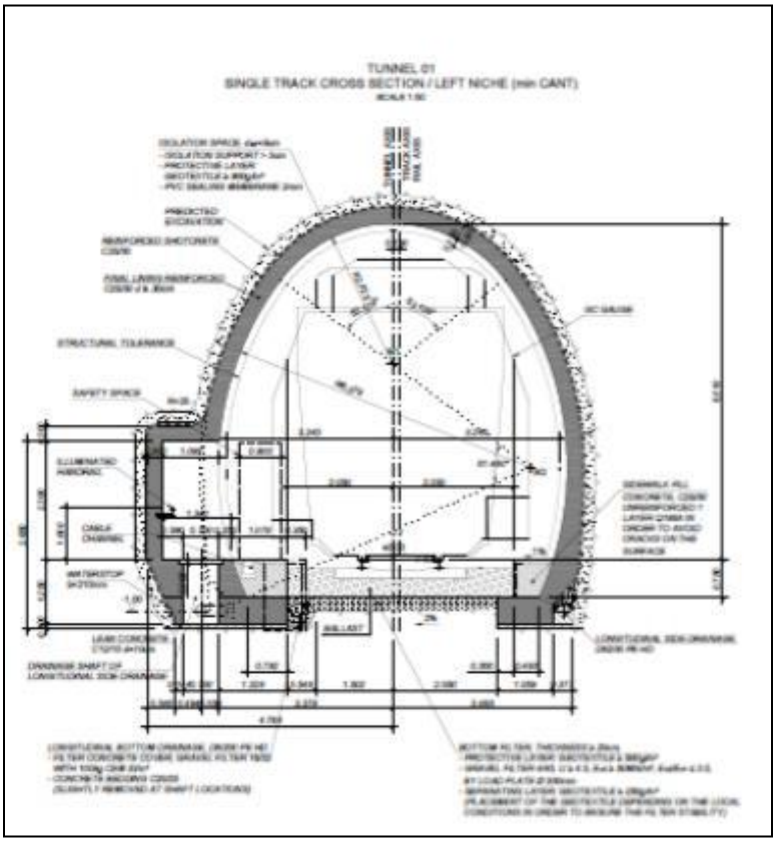


Figure 33 Example for single track tunnel (tunnel 1)

In the following table are presented the envisaged tunnels along the aligment.

Table 5 Tunnles along the alignment

TUNNELS					
Nº	Start point	End point	Lenght (m)	Total lenght included C&C (m)	Type (*)
1	66+126,00	66+352,70	226,70	226,70	Single track tunnel (good underground conditions)
2	66+895,35	67+039,41	144,06	144,06	Single track tunnel (good underground conditions)
3	67+155,30	67+356,39	201,09	201,09	Single track tunnel (good underground conditions)
4	67+464,66	67+579,90	115,24	115,24	Single track tunnel (good underground conditions)
5	68+821,56	68+957,23	135,67	135,67	Single track tunnel (good underground conditions)
6	70+528,00	70+646,00	118,00	118,00	Double track tunnel (good underground conditions)
7	71+636,02	71+758,63	122,61	122,61	Single track tunnel urban area
8	71+793,14	72+789,87	996,73	996,73	Single track tunnel urban area
9	73+824,63	74+040,55	215,92	215,92	Single track tunnel (good underground conditions)
10+11	74+423,70	74+759,77	336,07	336,07	Single track tunnel (good underground conditions)
11a	74+989,95	75+171,26	181,31	181,31	Single track tunnel (good underground conditions)
12	75+968,75	76+156,68	187,93	187,93	Single track tunnel (good underground conditions)
13	76+622,00	77+678,00	1056,00	1056,00	Large tunnel
14	77+799,89	78+058,80	258,91	258,91	Single track tunnel (good underground conditions)

15	78+851,77	79+092,00	240,23	240,23	Single track tunnel (good underground conditions)
16	79+092,00	79+720,00	628,00	644,00	Large tunnel
17	80+571,00	80+639,00	68,00	68,00	Triple track tunnel (C&C)
18	80+792,00	80+842,00	50,00	50,00	Triple track tunnel (C&C)
18a	80+842,00	80+916,00	74,00	74,00	Triple track tunnel (C&C)
19	82+670,00	84+070,00	1400,00	1407,00	Large tunnel
20	84+300,00	85+564,00	1264,00	1313,00	Large tunnel
21	85+982,00	86+119,00	137,00	257,00	Single track tunnel (bad underground conditions)
22	87+280,00	89+560,00	2280,00	2350,00	Large tunnel

The chainage data, underground sections and locations of the tunnels on the Google maps are presented in Annex 7.

- **Hydraulic Structures**

Along this part, the railway line crosses a number of streams, most of which have small catchment areas. The main stream in the project area is the Kriva River and all the other streams flow to this main stream. According to the watersheds' area having been determined there are: 48 very small basins, 3 small basins, 4 moderate basins, 5 big basins.

The catchment area of the Kriva River, until bridge B37 (~79+927.32), is estimated to cover approximately 66.29 km^2. Its highest point is approximately 2,084 m above the sea level, and the control point at the railway bridge reaches 780 m above the sea level. The length of the stream until the bridge is estimated to 14,175 km. The biggest part of the basin is on the mountainous areas, covered by rich forests and only close to the riversides there is some agricultural activity.

Most of the streams cross the railway line through bridges and some of them through culverts (more detail are presented in Annex 9).

In the following figures are presented bridges and culverts envisaged for the identifited water bodies.

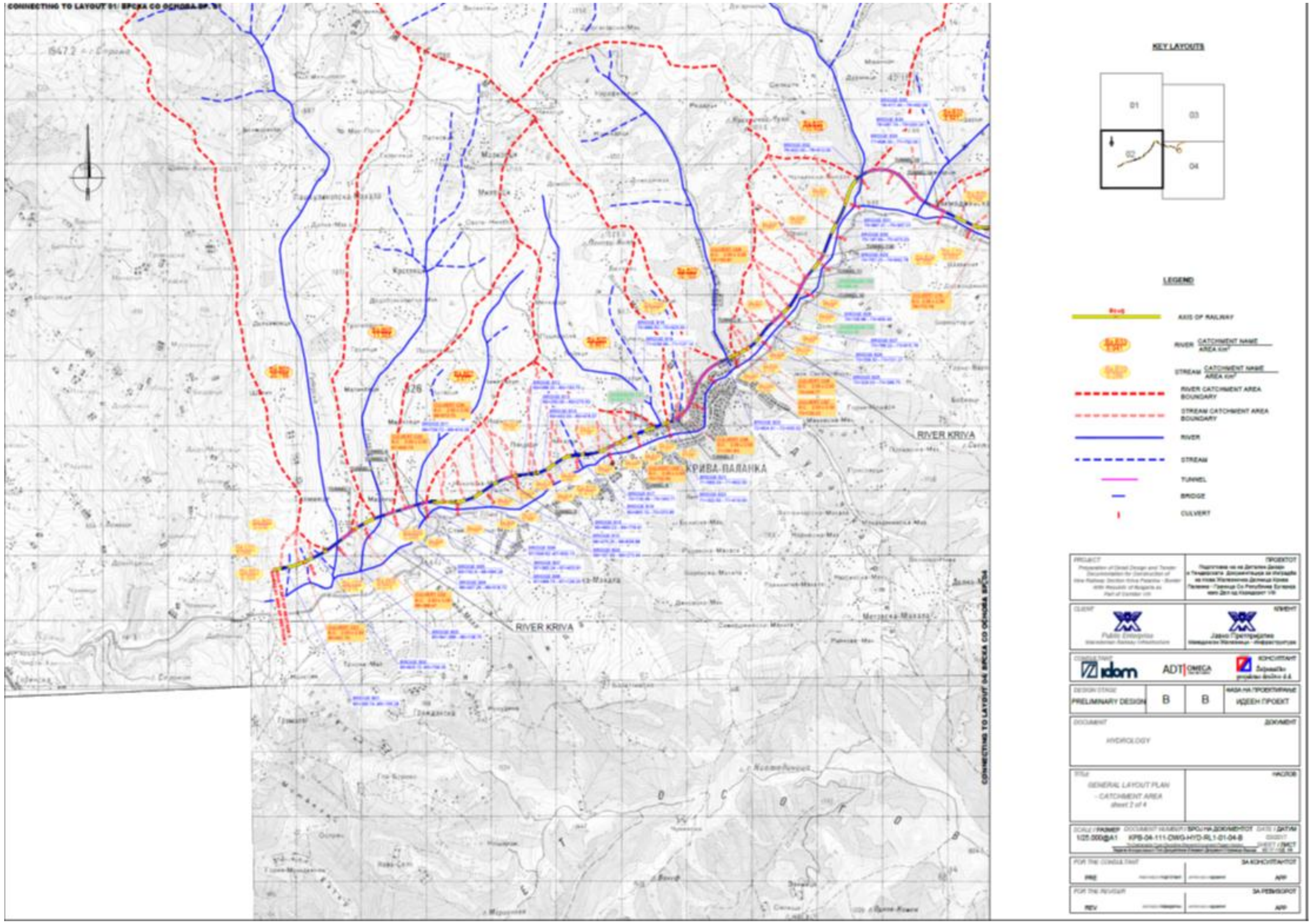


Figure 34 Drainage structure desing

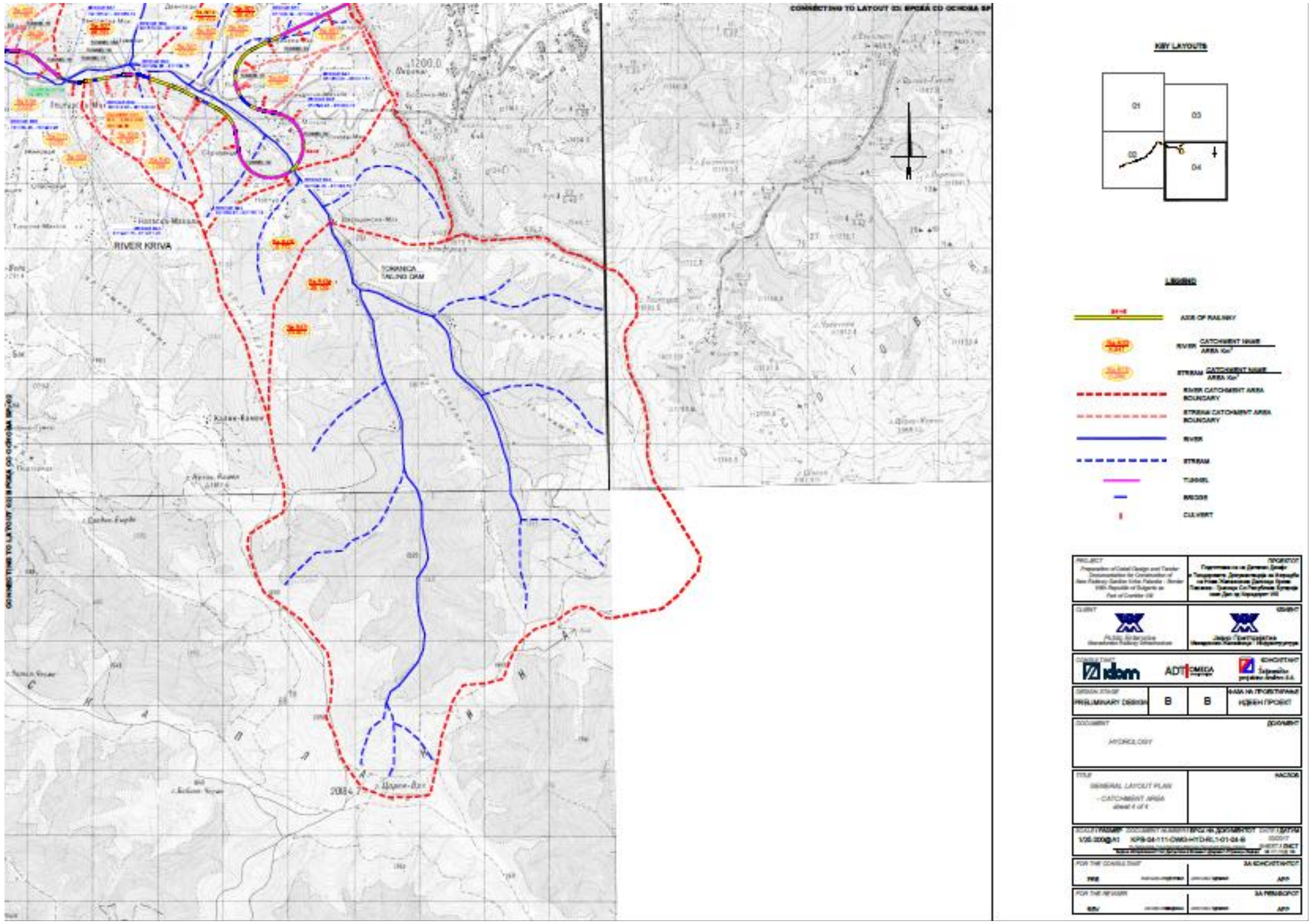
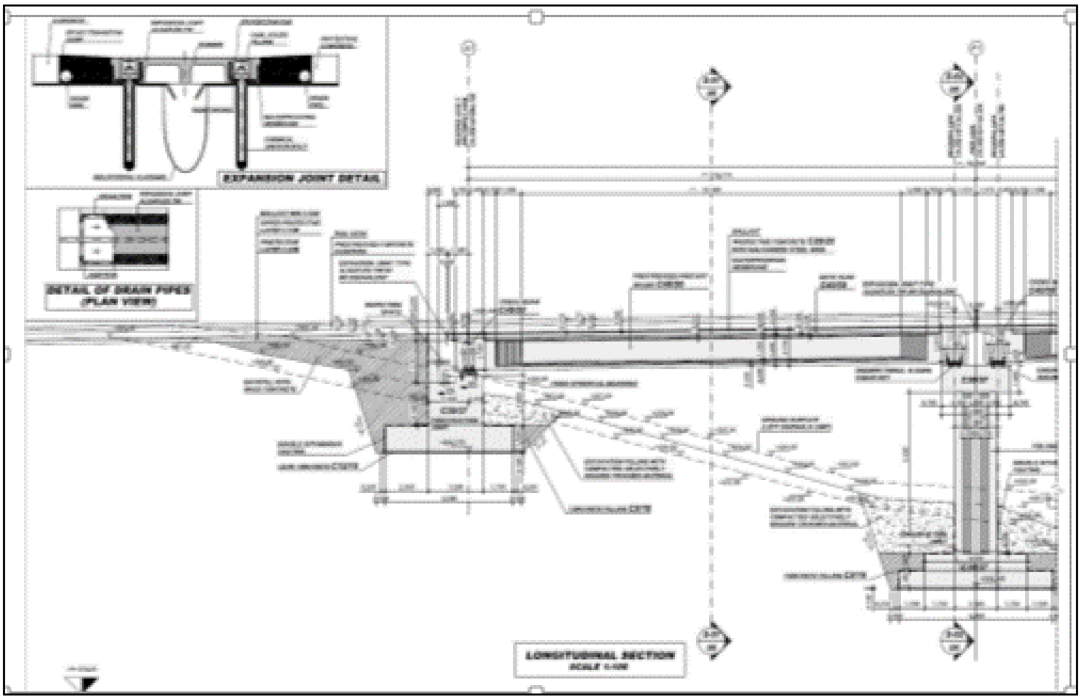


Figure 35 Drainage structure desing

- **Bridges**

Along the railway there are 51 proposed bridges, from which 44 are hydraulic (or serve also as hydraulic) and one culvert . The bridge 24 is replaced by Culvert C08 (2x2).

The typical bridge use for the project is as follows:



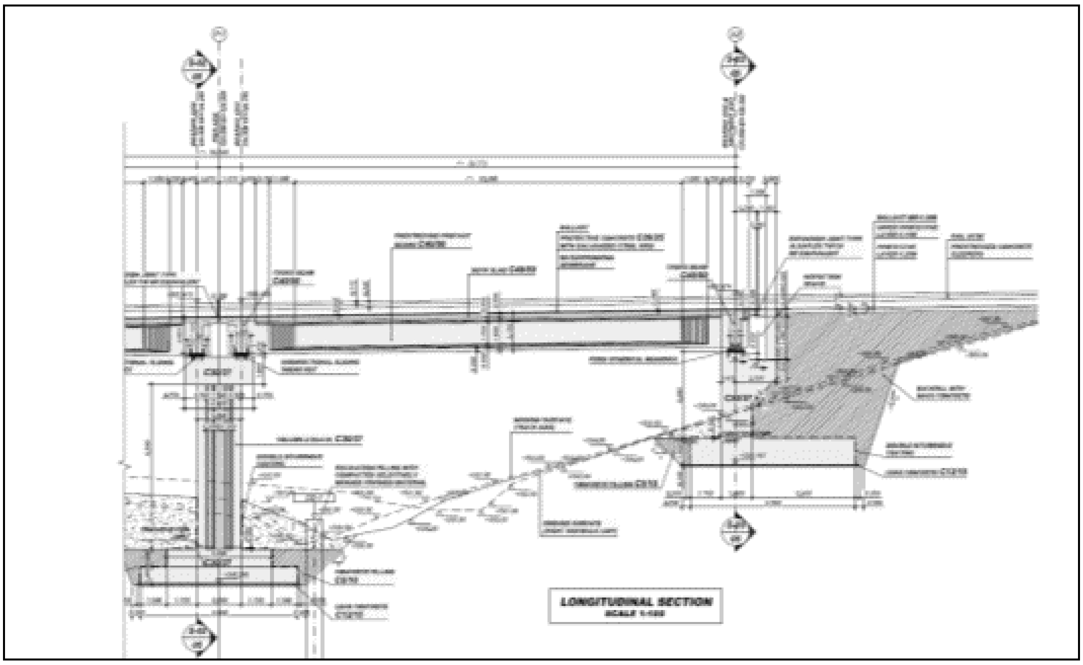


Figure 36 Typical bridge cross section

These bridges are predicted at the chainage locations that are shown at the table below:

Table 6 Bridges along the aligment

BRIDGES					
Nº	**Start point**	**End point**	**Lenght (m)**	**Number/length spans**	**Type (*)**
1	65+095,735	65+155,280	59,545	2*28.5	Single track viaduct
2	65+605,724	65+758,346	152,622	5*28.5	Single track viaduct
3	65+841,065	66+106,750	265,685	3*28.5-4*33.5-28.5	Single track viaduct
4	66+447,279	66+516,721	69,442	2*33.5	Single track viaduct
5	66+742,660	66+884,280	141,620	4*33.5	Single track viaduct
6	67+068,750	67+128,250	59,500	2*28.5	Single track viaduct
7	67+360,246	67+455,813	95,567	3*28.5	Single track viaduct
8	67+596,622	67+630,125	33,503	33,5	Single track viaduct
9	68+167,685	68+273,442	105,757	3*33.5	Single track viaduct
10	68+457,248	68+636,856	179,608	7*23.5	Single track viaduct
11	68+738,717	68+814,348	75,631	3*23.5	Single track viaduct
12	69+066,200	69+193,750	127,550	5*23.5	Single track viaduct
13	69+250,000	69+273,500	23,500	23,5	Single track viaduct
14	69+402,142	69+478,073	75,931	3*23.5	Single track viaduct
15	69+683,217	69+778,911	95,694	33.5-23.5-33.5	Single track viaduct
16	69+965,189	70+070,852	105,663	3*33.5	Single track viaduct
17	70+159,478	70+343,707	184,229	6*28.5	Single track viaduct
18	70+889,500	70+923,000	33,500	33,5	Triple track viaduct
19	71+038,977	71+127,140	88,163	2*33.5-16.00	Triple track viaduct
20	71+323.500	71+419.000	95,500	28.5-33.5-28.5	Viaduct with 4 tracks
21	71+569,000	71+602,502	33,502	33,5	Single track viaduct
22	71+760,00	71+768,00	8	8,00	Underpass
23	72+804,013	72+935,520	131,507	28.5-2*33.5-28.5	Single track viaduct
24	Replaced by Culvert C08 (2x2)				
25	73+329,000	73+398,753	69,753	2*33.5	Single track viaduct
26	73+558,500	73+721,265	162,765	33.5-3*28.5-33.5	Single track viaduct
27	73+766,218	73+815,775	49,557	2*23.5	Single track viaduct
28	74+195,656	74+409,944	214,288	6*33.5	Single track viaduct
29	74+767,234	74+842,762	75,528	3*23.5	Single track viaduct
30	75+187,692	75+473,294	285,602	8*33.5	Single track viaduct
31	75+667,100	75+952,510	285,41	34,75-6*36-34,75	Single track viaduct
32	76+402,00	76+611,500	209,50	29,88+5*31,254+24,42	Single track viaduct
33	77+698,75	77+789,25	90,50	29,56+30,88+29,69	Single track viaduct
34	78+078.739	78+200.239	121,50	4*30m	Single track viaduct
35	78+417.444	78+492.991	75,55	3*25m	Single track viaduct
36	78+783.458	78+842.958	59,50	2*30m	Single track viaduct
37	79+785.906	80+068.737	282,83	2*30m+5*35m+2*25m	Large viaduct

38	80+314.800	80+338.300	23,50	1*25m	Single track viaduct
39	80+670.300	80+745.800	75,50	3*25m	Triple track viaduct
40	80+959.858	81+164.750	204,89	1*25m+5*35m	Triple track viaduct
41	81+947.750	81+971.250	23,50	1*25m	Single track viaduct
42	82+056.250	82+177.750	121,50	4*30m	Single track viaduct
43	84+094.529	84+107.459	12,93	1*12m	Single track viaduct
44	84+145.800	84+154.600	8,8	1*8.8m	Alignment underpass
45	85+607.648	85+628.578	20,93	1*20.93m	Road overpass
46	85+698.471	85+882.732	184,26	6*30m	Single track viaduct
47	86+262.000	86+311.614	49,61	2*25m	Single track viaduct
48	86+345.870	86+384.870	39,00	2*12m+1*15m	Motorway crossing
49	86+373.630	86+412.630	39,00	2*12m+1*15m	Motorway crossing
50	86+594.830	86+633.830	39,00	3*13m	Alignment overpass
51	87+023.890	87+032.970	9,08	1*9.09m	Overpass
52	0+045,26	0+069,24	48,00	48 m	Overpass

If the flow of the stream or river under the bridge interferes with the bridge piers, then protection works are proposed. These works are either protection with mattresses locally around piers, or regulation works with gabions and mattresses in order to control the width and velocity of the flow. All proposed works are drawn both in plan and profile view. Details about protection works in bridges can be found in the following table.

Table 7 Protection works in bridges

Bridge	Works	Details
B01	Matresses	
B03	Matresses	
B05	Matresses	
B07	Matresses	
B18	Matresses	
B23	Trapezoidal regulation with matresses	H=1,50 m B=4,00 m z=1,0 L=15,00 m
B27	Trapezoidal regulation with gabions	H=1,00 m B=1,50 m z=1,0 L=13,50 m
B28	Matresses	
B32	Matresses	
B37	Gabions	
B40	Trapezoidal regulation with matresses	H=1,00 m B=1,00 m z=1,0 L=52,00 m
SO1 (at Kriva Reka, parallel with the alignment)	Trapezoidal regulation with gabions	H=2,00 m B=9,00 m z=1,5 L=130,00 m
B41	Matresses	
B43	Trapezoidal regulation with gabions	H=2,00 m B=6,00 m z=1,5 L=90,00 m
B51	Matresses	

At bridge B23 water can flow outside the regular riverbed and cause erosion problems to piers. Therefore lining mattresses is proposed (trapezoidal section H= 1,00 m B=1,50 m z=1,0). At bridge B27 the pier is practically inside the stream, therefore in order to avoid erosion problems construction of a trapezoidal section is proposed (gabions H= 1,00 m B=1,50 m z=1,0).

Kriva River crosses bridge B37. For the protection of the piers, gabions and mattresses are also proposed, since for the return period of 100 years, it seems that water can flood from the regular riverbed.

Kriva River also flows close to bridge B40 (parallel to the alignment), where regulation (S01) of the riverbed is proposed so that water does not affect the bridge's piers (with gabions, trapezoidal crosssection B=9.0, H=2.0, z=1.50). A small stream also crosses bridge B40, where a diversion is proposed (with mattresses, trapezoidal cross-section B=1.0, H=1.0, z=1.50).

River Kozja, one of the main tributaries of Kriva River, crosses the railway at bridge B43. A trapezoidal cross-section lined with gabions (B=6.0, H=2.0, z=1.50) is proposed for the protection of the bridge and the surrounding area.

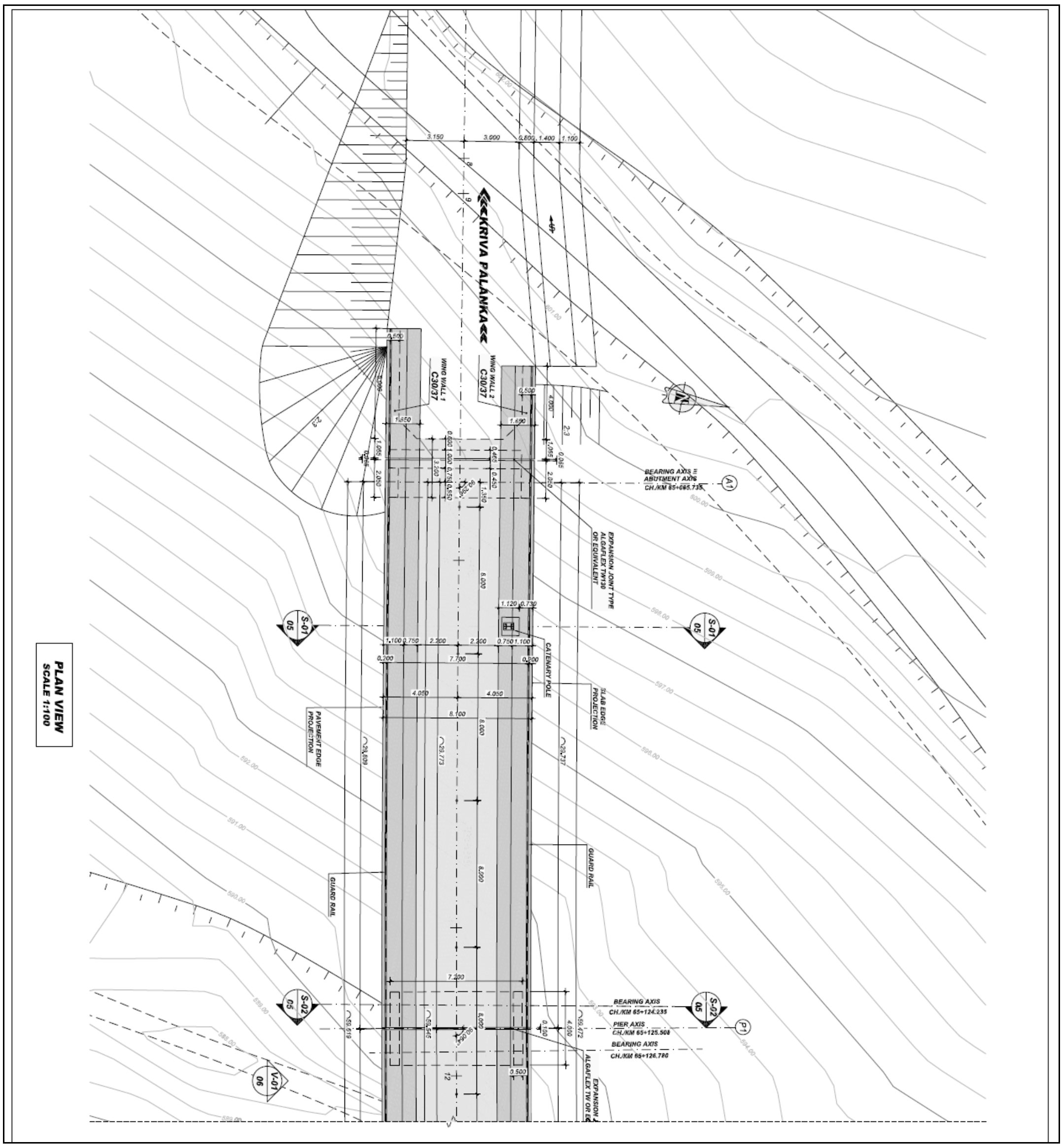


Figure 37 Predicted desing of the bridge No 1

- **Culverts**

Reinforced concrete culverts are required along the railway at locations where the railway alignment interrupts the natural flow of a formed stream or at locations where, due to local topography, it forms a deep line which becomes a natural receiver of surface water.

The typical drawings of culvert sections, inlet and outlet works have been attached with this report All proposed culverts are presented in the following table.

Table 8 Culverts along aligment

Culvert	Chainage	Type	Dimensions
C01	65+421,50	Box	B=2,00 m H=2,00 m
C02	66+366,47	Box	B=2,00 m H=2,00 m
C03	67+835,75	Box	B=2,00 m H=2,00 m
C04	68+970,75	Box	B=2,00 m H=2,00 m
C05	70+732,00	Box	B=2,00 m H=2,00 m
C06	71+781,63	Box	B=2,00 m H=2,00 m
C07	73+129,22	Box	B=2,00 m H=2,00 m
C08	73+248,77	Box	B=2,00 m H=2,00 m
C09	74+150,87	Box	B=2,00 m H=2,00 m
C10	78+772,78	Box	B=2,00 m H=2,00 m
C11	80+198,00	Box	B=2,00 m H=2,00 m

The envisaged culverts are designed with dimensions 2x2 m. As the flow of water passing through the slopes is relatively small, it is recommended to use pipe culverts (with a minimum diameter of the culverts of 1000 mm).

- **Stream Diversion**

In cases where a natural stream is flowing towards a deep cut, or towards a “cut and cover” structure then the flow is diverted. In cases of deep cuts the diversion is permanent and the stream crosses the alignment in tunnel position, while in cases of “cut and cover” the diversion is temporary only for the phase of construction. Such diversions are proposed in the following chainages:

Table 9 Stream Diversion

Diversion	Chainage	Permanent diversion	Cross section Construction phase	Cross section Operation phase
T01	70+521.72	Yes	Trapezoidal b=0,50 m h=0,50 m z=1:1	Same as during construction
T02	74+012.35	No	Trapezoidal b=0,50 m h=0,50 m z=1:1	Trapezoidal b=0,50 m h=0,50 m z=1:1
T03	74+585.44	No	Trapezoidal b=0,50 m h=1,00 m z=1:1	Trapezoidal b=0,50 m h=1,00 m z=1:1
T04	79+088.78	Yes	Trapezoidal b=0,50 m h=0,50 m z=1:1	Same as during construction

- **Signalisation and telecommunication**

The design defines the security equipment to be installed in the section taking into account the requirements for interoperability of the trans-European conventional railway system, interoperability of the trans-European high-speed trains and AGC and AGTC standards for international corridors.

The new railway section between Kriva Palanka and the border with the Republic of Bulgaria will be equipped with an ERTMS/ETCS Level 1 train control system with “in-fill” function through Eurobalises (Safety level SIL4).

The line will be equipped with automatic interlocking based on Personal Computer technology, without passage signals in the interstation sections. All sidings shall be controlled by Computerbased Interlocking (CBI) system installations (Safety level SIL4).

In order to optimize the operation, an integrated telecommunication system will be required. As a minimum, this system shall provide for the following:

- voice communications between the dispatcher and the trains via GSM-R Radio System;
- voice communications between any two locations of the railway; and
- data transmission between all main railway locations.

The project consists of a deployment design for GSM-R for all 3 sections, i.e. Kumanovo – Beljakovce – km 64+942 / Kriva Palanka – Border with Bulgaria, in order to upgrade from ETCS 1 to ETCS 2.

A summary of the most important characteristics of telecommunication system is as follows below:

- A telecommunication system will be installed in order to allow the establishment of voice communication between dispatchers and the trains, and any location in the line.
- A telecommunication system will be installed in order to allow the establishment of data communication between any location of the line (that is, it must include a data network).
- The backbone must be based on optical fiber or microwave.
- VHF Radio System must be the radio communication system for communicating with trains. This system include dispatchers with a console, radio base stations every 40 km, mobile radio sets on board trains and personal mobile radio sets for maintenance people.
- There must be video surveillance and Public Address systems in stations. All systems must be controlled by centralized applications, with recording included.
- **Traction power supply**

Electric Traction for this section will be realized through an Overhead Contact Line System (OCLS) operating at 25 kV, 50 Hz. Electrification of all types of tracks (open track, main lines in stations, secondary lines, loading tracks) will be considered.

- *Tracks to be electrified*

The section comprises Kriva Palanka Station with 2 sidings and 3 tracks for maintenance and stabling, and Zidilovo Halt with 2 sidings. All lines at open track and all sidings and stabling tracks in Stations and Halts will be electrified.

- **Cross-border linking**

As far as the interoperability and compatibility of railway infrastructure, the project *Preparation of Detailed design and tender documentation for construction of new railway section Kriva Palanka – Border with Republic of Bulgaria, as part of Corridor VIII*, is developing taking into account the TSI standards.

In the Bulgarian side, the railway infrastructure manager of the Republic of Bulgaria “NRIC” is developing the Technical Assistance for upgrading of railway line Radomir – Gyueschevo.

The railway alignment of section 3 inside the Bulgarian territory starts from km 88+364.65 (reference chainage of the territory of the Republic of Bulgaria: km 138+325.40) and ends 100m after the portal of tunnel Deve Bair at km 89+658.47 (reference chainage of the territory of the Republic of Bulgaria: km 137+031.58).

The end of Section 3 alignment is inside a horizontal curve of R=300m. The railway alignment of section 3 is connected to the existing main line at Gyueschevo Station at km 90+555.67 (reference chainage of the territory of the Republic of Bulgaria: km 136+134.39), with a connection to the existing main railway line through a turnout of type 200-6°. Design speed for the whole section in the territory of the Republic of Bulgaria is 80km/h.

The railway alignment design between km 89+658.47 and km 90+555.67 (Gyueschevo station) is out of scope of works of the Project Kriva Palanka – Bulgarian Border. From this point to the Gyueschevo Station, NRIC will define the alignment in order to connect with the planned layout of the station.

An intense coordination has been carried out between the Consortium and NRIC in order to guarantee the compatibility of the main design parameters of both projects:

- Track gauge.
- Clearance gauge GC.
- Implementation of ERTMS.
- Electrification system at 25 kV, 50 Hz, with the same height of overhead line contact.

4.4.1 Major project activities in the construction phase

The following activities should be implemented during the construction phase of the Project:

- Vegetation clearing;
- Demolition of buildings and other objects;
- Dismantling, demolition of housing objects and resettlement of people;
- Excavation/digging/fill;
- Blasting;
- Construction of the alignment with the accessory objects;
- Closing or redirecting of the existing transport routes or infrastructure, that will lead to change in traffic;
- Stopping of the industrial activities for a prolonged period of time;
- New road traffic (access roads) during the construction and operation;
- Water supply or water diversion (during bridge construction);
- Transport of personnel and building materials, working;
- Natural resources utilization, e.g. earth, water, materials or energy;
- Fragmentation of habitats;
- Construction of material storage objects;
- Waste generation during the construction;
- Use, storage, transport, handling or manufacturing of materials, waste that can be harmful for human health or the environment, etc.

The above activities can cause negative impacts on human health and the media and areas of the environment.

Duration of the construction activity: In accordance with the project data, the railway traffic is envisaged to start in 2025, i.e. the construction works to start in 2021.

Duration of the operational phase: Closing of the railway is not taken into consideration in the Feasibility Study. All the calculations for the transport model in the Feasibility Study were made for a period till 2050.

- **Raw materials, construction materials, construction equipment and waste during the construction phase**

The construction activities for the railway line Kriva Palanka-Bulgarian border will require different types of materials. The Feasibility Study (December, 2016), which is the base for this study, as well as the prepared Preliminary Designs, lack information on:

- Types of materials, auxiliary materials, fuels and water that will be used during the construction activities, as well as their quantities;
- Source of supply and its location (especially concrete batching plants, asphalt plants, separations, borrow pits);
- Location of storage areas, auxiliary materials, fuels;
- Landfill locations (temporary storage and permanent removal);
- Type and number of vehicles, equipment and mechanization;
- Frequency of movement;
- Number of workers, location of workers camps, working hours and working conditions.

All of the aforementioned data that are missing in the Feasibility Study will be provided in the project documentation and by the Contractor who is engaged in the implementation of the construction activities based on tender.

According to the experiences and the available practices, the following tables show the types of the most commonly used construction materials, construction equipment, as well as the excavated and used soil for filling (construction) and the types of waste streams that are generated during the implementation of the construction activities.

Table 10 Part of the materials that will be used during the construction phase

Type of construction and auxiliary materials
Embankment material
Rails
Sleepers
Ballast
Turnouts
Asphalt
Welding materials
Concrete
Earth
Gravel
Steel
Geotextile
Explosives
Drainage pipes, filters, manholes
Cables
Blocks
Reinforced concrete plates
Dyes and diluters

Insulating materials
Noise barriers
Ceramic and bekaton pavings
Fuels, oils, absorbents

In the following table the estimated quantities of the excavated soil and rocks, during construction are presented, along with the estimated quantities of used soil for filling. Additionally the rest of the materials (soil and rocks) to be lendfilled are also presented.

Table 11 Estimation of the excavated soil and rocks, during construction, used soil for filling and material (soil and rocks) to be lendfilled

EXCAVATIONS ON THE WHOLE ALIGNMENT	Quantities in m^3	**Soil in m^3**	**Rock in m^3**
Excavation. Tunnels in other stated material (soil). Stated diameter: Any m.	140.335,91		
Excavation for cuttings. Material other than topsoil, rock or artificial hard material.	294.778,72		
Excavation for cuttings. Topsoil	7.314,12		
Excavation for cuttings. Rock	1.675.075,05		
Excavation. Tunnels in rock. Stated diameter: Any m.	561.682,77		
Excavation for foundations. Rock. 2–5 m	77.388,93		
Excavation for foundations. Rock. Maximum depth: 5-10 m.	51.753,86		
Total Excavation Alinement + Road Access + Cut&Covers:	**1.562.345,64**	302.092,84	1.260.252,80
Total Bridges Excavation:	**543.965,04**		543.965,04
Total Tunnels Excavation:	**702.018,68**	140.335,91	561.682,77
Total Excavation:	**2.808.329,36**	**442.428,75**	**2.365.900,61**
FILLINGS			
Filling. with soil cement stabilized.	45.214,99		
Fillings. For embankment with excavated rock. Including transport up to 15 km	93.899,54		
Filling. Embankments. For embankment with excavated rock. Protective layer (blanket layer/subballast material according to spec)	12.808,78		
Filling. To structures. Selected excavated material other than topsoil or rock.	212.786,96		
Total Fillings in Alignement + Road Access + Cut&Covers	**106.708,32**		
Total Fillings in bridges + Tunnels	**258.001,95**		
Total Fillings	**364.710,27**		
TRANSPORT			
Transport and filling in thickness in landfill. Non-selected excavated material, up to 5Km	3.799.815,19		
Total Transport to landfill	**3.799.815,19**		
TUNNEL 22 MACEDONIAN SIDE/ CUT & COVER	**Quantities in m^3**		
Excavation for cuttings. Material other than topsoil, rock or artificial hard material.	22.139,90		
Excavation for cuttings. Rock	51.659,80		
Filling. To structures. Selected excavated material other than topsoil or rock.	47.538,80		
Transport and filling in thickness in landfill. Non-selected excavated material, up to 5Km	39.391,35		
Main Tunnel			
Excavation. Tunnels in rock. Stated diameter: Any m.	60.516,31		
Excavation. Tunnels in other stated material (soil). Stated diameter: Any	15.221,46		

m.	
Transport and filling in thickness in landfill. Non-selected excavated material, up to 5Km	113.606,66
Gallery	
Excavation. Tunnels in rock. Stated diameter: Any m.	30.217,55
Excavation. Tunnels in other stated material (soil). Stated diameter: Any m.	6.740,32
Transport and filling in thickness in landfill. Non-selected excavated material, up to 5Km	55.436,81
Total Excavation in Tunnel 22 (Macedonian side)	**186.495,34**
Total Filling in Tunnel 22 (Macedonian side)	**47.538,80**
Total Transport from Tunnel 22 to landfill (Macedonian side)	**208.434,82**

The following table shows the types of waste streams that can be generated during the preparatory and construction phase of the project.

Table 12 Waste streams that are supposed to be generated during the preparatory and construction phase

Types of wastes
Removed vegetation
Demolition waste
Asbestos
Mining waste
Metal
Wood
Plastics
Asphalt
Concrete
Waste from welding
Earth
Sand and gravel
Insulating material
Filter material
Packaging waste
Oil filters
Dyes, diluents
Saturated absorbent materials
Mixed municipal waste
Waste water
Waste oils
Electrical and electronic equipment waste
Contaminated soil

Also, wastewater (blackwater and technical) will be generated during this phase.

The following table shows the mechanization and equipment that is most commonly used for the construction of railway lines and other construction works.

Table 13 Construction equipment and heavy vehicles that are supposed to be used [4]

Type
Compressor
Excavator
Dump trucks
Ballast stabilizator
Machine for ballast compaction
Compactor
Concrete mixer
Vibrator for concrete
Crane
Mobile crane
Bulldozer

[4] The contractors will be obliged to prepare Execution Design, where all the details for the construction equipment and the vehicles

Bands
Agregate
Leveling machine
Pneumatic gun
Pneumatic drill
Drill
Pneumatic tool
Chainsaw
Drill
Roller
Saw
Shaking machine
Scraping machine
Shovel
Stretching machine (rails)
Woodcutter
Loader

Remark: As mentioned previously, the Feasibility Study does not give any data regarding materials, borrow pits, landfills etc.

“Report on materials, borrowings and landfills ", version A from 05.04.2017. is not final, that is, it is still under review.

In order to obtain a representation of the type of materials that will be used for the construction of the railway line, the possible borrow pits for materials, as well as the future locations that can be used as landfills, provides an overview of the information contained in the Study on the Impact Assessment On the environment and social aspects, prepared in 2012 for Corridor VIII, section Kumanovo-Border with the Republic of Bulgaria, data from the Report on materials, borrow pits and dumpsites (2017), as well as provided information from the design team. On the basis of this information there is an opportunity to predict the manner of providing materials and depositing the waste.

Data from the Environmental Impact Assessment and Social Impact Assessment Study, 2012

For Section 3 it is assumed that 70% of the excavation should be done in a rock and that 65% of the excavated soil will be used for making embankments, according to Birkner's standards for the removal of earth masses.

The concrete required for low-grade works will generally be made with alkaline portland cement (with 0.6% less sodium equivalents). The detailed characteristics of the concrete to be used will be given in the technical documentation of the main design.

The concrete sleepers will be made of concrete made with suitable cement and unpolluted aggregates. Wooden or concrete sleepers can be used for scratching. Concrete sleepers on the turnouts are very heavy. Wooden sleepers are easier to handle, but require more maintenance.

Concrete batching plants produce ready-mixed concrete. During the construction period of the Kumanovo-Kriva Palanka railway line in 1994-2004, two concrete concrete batching plants were used every ten kilometers. Some of these installations were static and they are still present on the ground. During the further stages of the project, the exact locations of the concrete bases will be defined. There are no separations along the railway corridor. The closest plants for crushing granulates are located in Banjani Skopje, Zebrenik Kumanovo, Markovi Sushi Skopje and Katlanovo Skopje.

In accordance with the aforementioned Study, regarding the borrow pits and landfills, it is emphasized that during the construction phase of the alignment the excavated land and rock will be reused for the construction works (embankments, trench works, etc.). As a result of the demolition of buildings (houses / buildings / facilities), waste / construction rubble, ie land surplus and rocks will be created that will have to be deposited at landfills for inert waste. The total amount of inert waste (land / rock) is expected to be about 1,300,000 m^3. This type of waste will have to be disposed of at landfills for inert waste specially designed for this purpose or determined by the municipality of Kriva Palanka. The borrow pits for materials will be defined in the pre-construction phase after signing the contract with the Contractor.

For the construction of the track, temporary storage areas for ballast, sleepers and rails will be required. For this purpose, the stations in Ginovci and Zhidilovo can be used. Due to topographic and urban restrictions, it is not recommended to use the station in Kriva Palanka. West of Kriva Palanka, you can build a storage site in the area of temporarily seized land with an area of 15,000 m^2.

On Section 3 is located a municipal landfill, in Kriva Palanka. Public Communal Enterprise "Komunalec", from Kriva Palanka, manages solid municipal waste in the Municipality. The landfill is located in the village Konopnica, near the regional road to Bulgaria M2, near Kriva Reka.

Additional documentation will be prepared for the new landfills, which will be built for the needs of the Project.

Engaged labor

The construction site will vary depending on the construction phase and it can be estimated that about 500 workers will be engaged to work in one work shift.

Data from the "Report on materials, borrow pits and landfills" version A from 05.04.2017 and information from designers

- *Borrow pits*

It is considered that the reserves of excavated material (from construction activities) meet the required quantities for the construction of embankments. However, the Material Report[5] lists potential borrow pits for some special materials, such as alluvial sediments and terrestrial sediments. Although it is mentioned that the need for a borrow pit for a stone aggregate may occur, it does not specify the location.

The proposed location for the first borrow pit, which would be used for the exploitation of alluvial sediments, is the location in the valley of Kriva Reka at approximately 280 m downstream of the bridge no. 43 (chainage from km 84 + 094.529 to km 84 + 107.459).

Figure 38 Location of potential borrow pit

[5] *Preparation of detailed design and tender documentation for construction of new railway section Kriva Palanka – border with Republic of Bulgaria, as part of corridor VIII*, **Report on Materials**, **Borrow Pits and Landfills** Version A, 5 April 2017 EuropeAid/136050/IH/SER/MK

The proposed location for the second borrow pit, which would be used for the exploitation of alluvial and terraced sediments, is located near Kriva Reka, in the vicinity of the village Konopnica, at about 470 m from the bridge no. 1 (chainage from km 65 + 095,735 to km 65 + 155,280).

Figure 39 Location of potential borrow pit

- *Quarries*

For the needs of supply of granular material - gravel, the quarry located near the initial chainage from Section 3 in the village Konopnica can serve. This quarry exploits alluvial and terrace sediments from Kriva Reka.

Figure 40 Location of the gravel quarry

Figure 41 Access to the gravel quarry

- *Landfills*

The Material Report lists locations that could be used as landfills or sites for disposal of the excess excavated material that will originate from construction activities.

At the level of the Preliminary Design prepared in 2010, 27 landfills were selected (Table 14), from which the main designer "ADT" selected 12 locations in the phase of preparation of the new project documentation and are presented in Table 16).

Table 14 Landfills envisaged in the Preliminary Design (2010) and estimated quantity of deposited material

Part from project area (chainage)	Dumping ground/Landfill	Estimated volume (m^3)
66+050 – 72+570	1	200000
	2	290000
	3	700000
	4	100000
	5	100000
	6	50000
	7	200000
71+570 – 72+692	1	100000
	2	100000
	3	50000
	4	200000
72+677 – 81+410	1	890
	2	70500
	3	256000
	4	92400
	5	40000
	6	32300
	7	53500
	8	156000
	1	50000

82+350 – 89+473	2	250000
	3	150000
	4	250000
	5	66000
	6	80000
	7	55000
	8	520000
TOTAL		4212590

In the Main Design[6] of 2010, a total of 35 locations have been selected which can be used as landfills.

Table 15 Landfills envisaged at the level of the Main Design (2010) - estimated volumes from the Detailed Design and chainages

Part from project area (chainage)	Dumping ground/Landfill	Estimated volume (m^3)	Exact chainage
66+050 – 72+570	1	58031	66+241
	2	124366	66+530
	3	79126	66+790
	4	82085	68+197
	5	39806	68+710
	6	18227	69+675
	7	88462	70+080
	8	49532	70+373
	9	104401	70+844
71+570 – 72+692	10	66328	71+630
	11	48815	71+828
	12	46353	72+010
	13	202584	72+194
72+677 – 81+410	14	40603	74+238
	15	9511	74+350
	16	7495	74+490
	17	186954	74+900
	18	77522	75+244
	19	41600	75+700
	20	88458	75+920
	21	77269	76+885
	22	50515	79+224
	23	18855	79+550
	24	327694	79+950
	25	170800	80+200

[6] *Detail Design Kriva Palanka - border Republic of Bulgaria"*, 2010, Balkan Konsalting

	26	71828	81+100
81+410 – 82+350	27	81511	82+084
TOTAL		*2258731*	
82+350 – 88+150	28	365077	82+530
	29	234289	83+550
	30	279678	85+270
	31	173745	87+000
	32	274840	87+410
	33	131950	87+730
	34	82502	87+820
	35	113780	88+150
TOTAL		*1655861*	
TOTAL (from each part)		**3914592**	

The following table presents the selected landfills by "ADT Omega", which are in line with those proposed by "Geohydroconsulting" during the preliminary phase of 2010 (listed in Table 16).

Table 16 Selected landfills by the main contractor “ADT Omega”

Part from project area (chainage)	Dumping ground/Landfill	Estimated volume (m^3)
66+050 – 71+570	1	200000
	2	290000
	3	700000
	4	100000
	5	100000
	6	50000
72+677 – 81+410	3	256000
	5	40000
	7	53500
	8	156000
82+350 – 89+473	2	250000
	8	520000
TOTAL		**2715500**

Geotechnical surveys are carried out at the locations of the abovementioned landfills, which will be included in the "B" version of the Material Report. According to preliminary information by "ADT Omega", other locations for landfills should be selected.

Topographical maps in Annex 10 show the locations of the landfills selected by "ADT Omega" (2017), as well as the landfills foreseen in the Detailed Design (2010).

4.4.2 Operational phase of the railway

In accordance with the **Master Plan of railway services 2017-2050** and traffic analyses can be concluded that in the year 2050, an annual passenger volume of 65,352 is expected in the Section Kriva Palanka-Bulgarian border, representing approximately a daily volume of 230 passengers.

Analysing the complete Corridor VIII, in year 2050, approximately 1.1 million of passengers will use annually the railway line.

Regarding to the freight transport, in year 2050, two millions of tons will be transported in Section Kriva Palanka-Bulgarian border. In all the Corridor, the value will be approximately 5 millions of tons.

The Operation Plan considers the whole Corridor VIII, in order to define correctly the services proposed.

The following tables summarize the number of passenger and freight circulations for each scenario, as well as the itineraries of each service.

Table 17 Daily traffic for passenger services

Passenger service	2017	2022	2025-A	2030	2050
Skopje-Kumanovo (Tabanovce)	4 circ./ direction	4 circ./ direction	4 circ./ direction	4 circ./ direction	5 circ./ direction
Skopje-Kichevo	2 circ./ direction	2 circ./ direction	3 circ./ direction	3 circ./ direction	4 circ./ direction
Skopje-Ginovci	/	2 circ./ direction	/	/	/
Skopje-Sofia	/	/	2 circ./ direction	2 circ./ direction	2 circ./ direction
Skopje-Radozhda	/	/	/	3 circ./ direction	4 circ./ direction

Table 18 Daily traffic for freight services

Freight trains	2017	2022	2025-A	2030	2050
Skopje-Kumanovo (Tabanovce)	2 Skopje+1 Kumanovo	2 Skopje+1 Kumanovo	2 Skopje+1 Tabanovce	2 Skopje+1 Tabanovce	3 Skopje+1 Tabanovce
Skopje-Jegunovce factory	1 Skopje + 1 Kichevo	1 Skopje + 1 Kichevo	1 Skopje + 1 Kichevo	1 Skopje + 1 Kichevo	2 Skopje + 1 Kichevo
Skopje-Ginovci	/	1 circ.-week/direction	/	/	/
Skopje-Sofia	/	/	2 Skopje +1 Sofia	4 Skopje +1 Sofia	6 Skopje +3 Sofia
Skopje-Albania	/	/	/	2 Skopje +1 Albania	3 Skopje +1 Albania

- **Operational activities at the railway line**

Water supply will be established for the station, and waste water will be generated in the operational phase of the railway line Kriva Palanka-Bulgarian border. The Feasibility Study lacks data on the amount of water, as well as for the quantity and management of the waste water.

The maintenance of the railway line is regulated with the Regulation on the way of maintenance, way of keeping records and use of data from the records of the railway tracks (“Official Gazzette of the Republic of Macedonia” No. 137/07).

The Feasibility Study does not define the storage place for the spare parts needed for maintenance of the railway line, which is an obligation stated in the aforementioned Regulation.

According to this Regulation, the maintenance of the track, equipment and objects on the railway line should be in accordance with the relevant railway standards and other technical regulations and norms that relate to the railway line, and the objects and equipment on the tracks, unless indicated differently. The maintenance of the railway line includes regular maintenance of the vegetation within the railway line in order to avoid obstacles during the operational phase and maintenance of the track.

The regular maintenance and control of the vegetation can include the use of mechanical methods (cutting and mowing with machinery or manually) and by applying herbicides. There are no available data for the use of herbicides and their storage in the Feasibility Study.

Along the railway line, mostly in the area of the station and the halt, due to the regular road and freight traffic, and the operations for loading/unloading, the following types of waste streams will be generated: solid waste (organic and inorganic). Also, a source of organic waste will be the maintenance of the vegetation along the railway track.

There is no data on the quantity of waste generated during the operational phase of the railway in the Feasibility Study.

The following tables show the types of raw materials and additional materials that will be used during the operational phase of the railway Kriva Palanka-Bulgarian border, the generated waste, as well as the waste management strategy.

Table 19 Part of the materials that will be used during the operational phase

Types of materials
Water (hygiene, fire fighting)
Electrics
Spare parts
Fuels and oils
Pesticides

Table 20 Types of waste streams that can be generated in the operational phase

Waste type
Biodegradable waste (track maintenance)
Mixed municipal waste
Sanitary waste water
Waste from electrical and electronic devices
Spare parts and track reconstruction waste
Contaminated soil

4.4.3 Description of the main residues and emissions from construction and operation of the railway line

Construction works, as well as the operation of the railway line, will be source of emissions that can reduce the quality of the environmental media, and will also cause socio-economic changes.

The following text gives an overview of the potential emission sources during the construction and operational phase of the railway line, whose impact will be assessed based on different criteria, in the next chapters, and mitigation or avoidance measures will be provided.

- **Sources of air emissions**

Construction phase	Operational phase
Construction/excavation/demolition/blasting/building	Transport of materials
Use of equipment and mechanization	Use of herbicides for the maintenance of the vegetation along the track
Transport vehicles movement	Degradation of biodegradable waste from vegetation removal
Production of materials (concrete batching plants, borrow pits)	Track maintenance
Storage of materials	Fire and other incidents (explosion, spills etc.)
Waste deposition	
Degradation of biodegradable waste from vegetation removal	

Accomodation of workers in worker camps	
Fire and other incidents	

- **Sources of noise**

Construction phase	Operational phase
Construction/excavation/blasting/demolition/building	Train movement
Use of equipment and mechanization	Presence of passengers (at the railway station and halt)
Movement of transport vehicles	Motor vehicles for transport of passengers to and from the station and the halt
Production of materials (concrete batching plants, borrow pits)	Track maintenance
Accomodation of workers in worker camps	

- **Sources of vibration**

Construction phase	Operational phase
Construction/excavation/demolition/blasting/building	Train movement
Use of equipment and mechanization	Track maintenance
Transport vehicles movement	
Production of materials (concrete batching plants, borrow pits)	

- **Waste sources**

Construction phase	Operational phase
Clearing of the location	Vegetation clearing along the track
Object demolition	Train and track maintenance
Construction + blasting	Railway station and halt maintenance
Maintenance of equipment and mechanization	Contaminated soil (from spills)
Equipment and mechanization that are not functional	Incidents
Use of materials	
Production of materials (concrete batching plants, borrow pits)	
Workers camp	
Contaminated soil (from spills)	

- **Sources of waste water**

Construction phase	Operational phase
Drainage of the construction site	Drainage of the railway station and halt
Pumping of groundwater	Fire extinguishing (possible)
Production of materials (concrete batching plants, borrow pits)	
Cleaning of the equipment and mechanization	
Worker camps	
Fire extinguishing (possible)	

4.5 Other development projects in the project area

In the project area or in its immediate vicinity, construction or reconstruction of important infrastructure projects is planned, such as:

- Reconstruction and construction of the railway line from Beljakovce to Dlabochica, part of the railway Corridor VIII - Eastern section (2).
- The alignment of the new expressway from Rankovce to Kriva Palanka, in length of 26 km, will go parallel with the railway line, to Kriva Palanka. It is a modern road with a width of 11.4 m, with two main and two auxiliary brake belts.
- Rehabilitation (small part reconstruction) of the existing road Kriva Palanka - border crossing Deve Bair, leading to the border crossing with the Republic of Bulgaria, in length of 12 km.
- Construction and rehabilitation of the local roads in the municipality, including the road alignments up to the village of Tarnovo, from the village of Stambolici to the locality called Krstata Padina, access road from the Mezovski Livadi to the village Gradec.

5 ANALYSIS OF THE ALTERNATIVES

According to the Commission Implementing Regulation (EU) 2015/207, in the Fisibility Study, December 2016, option analysis is performed to assess and compare different alternative options which are found generally feasible to meet the existing and future demand for the project and to find the best solution.

Options should be compared against different criteria, including for example technical, institutional, economic, environmental aspects.

The option analysis should be carried out in two steps; the first step looks at basic strategic options (i.e. type of infrastructure and location for the project) and the second step at specific solutions at the technological level.

These alternatives should be defined according to the following good practices:

- The options analysis is based on a common baseline.
- The options analysis starts from a more strategic point of view (i.e. general type of infrastructure and/or location/alignment for the project) and continues with an assessment of specific technological variants for the type of infrastructure/site selected.
- New alternative technologies are accompanied by a thorough assessment of their technological, financial, managerial risks, climate risk and environmental impacts.
- For comparisons based on costs, all assumptions on unit costs of investment, O&M and replacement should be disclosed and explained separately for each option to facilitate their appraisal. Unit costs of common consumables (e.g. labour, energy, etc.) are the same for all options.
- Options are compared using the same reference period.

Key aspects of option analysis process are:

- Ability to properly justify the solution chosen,
- If options can meet the same project objectives (i.e. similar externalities, traffic demand, etc.), the least cost solution should be taken into account,
- If the output and externalities are different in different options, then a simplified CBA should be undertaken for selecting investment option.

The project aims to establish an operational continuity along Corridor VIII, so all the alternatives considered should be compatible with this objective, allowing the freight and passenger railway traffic between the station of Ginovci and the border with the Republic of Bulgaria.

In the Fisibility Study are analysed the following alternatives:

- “Without project” Alternative,
- Alternative A (reference alignment),
- Alternative B (alternative alignment).

The analyses in the Feasibility Study take into account the Decision no. 51-3556/1 dated on 19/07/2011, in which the Government of the Republic of Macedonia officially selects the “Reference Alignment” (Alternative A) for its development.

Although the options analysis has been done at a previous stage (Feasibility Study 2011 and ESIA Study, 20102) in the new prepared Feasibility Study, december 2016 are summarised the process and present a reasonable justification for the selection of the preferred alternative.

The information provided of the two alignment alternatives previously studied, has been reviewed, in particular checking the consistency between the information concerning the cost and technical features of both alternatives.

5.1 “Without project“ Alternative

As of January 2014, the European Union has a new transport infrastructure policy, with the main aim to close the gaps between Member States' transport networks, remove bottlenecks that still hamper the smooth functioning of the internal market and overcome technical barriers such as incompatible standards for railway traffic.

The trans-European transport network (TEN-T) is a network which comprises roads, railway lines, inland waterways, inland and maritime ports, airports and rail-road terminals. According to document “Connectivity Agenda Co-financing of Investment Projects in the Western Balkans in 2015”, indicative extension of TEN-T to Western Balkans propose the next core railways network including the section Kriva Palanka – State border.

After revision of REBIS Study in 2015 including prioritising the actions proposed in function of the available resources and the logic of intervention, and the forecast done in 2003, it is included the completion of Corridor VIII.

Moreover, the Eastern link of the Corridor VIII in Macedonia is considered as priority project according to the Multi Annual Development Plan 2016 SEETO, which main objective is to provide Regional Participants, the European Commission and the IFI`s and other possible financiers with a basis for defining their strategic transport development orientation and actions in the South East European region.

In the “Without project” alternative, the current situation will continue to exist. This alternative must be dismissed for the following reasons:

- Currently, the railway section between Kumanovo and Beljakovce is under construction. Also, MZ-I will start soon with of execution of construction works on the railway section between Beljakovce and Kriva Palanka. The main strength of the Corridor VIII is establishing an operational continuity between Albania (Port of Durres)-Macedonia (Kumanovo-Beljakovce-Kriva Palanka-state border)-Bulgaria (Port of Burgas). Therefore, development of the railway section between Kriva Palanka-Bulgarian border is essential, in order to guarantee this operational continuity.
- Already completed works should be removed in order to return to the natural environmental conditions existing before the execution of the works. Dismantling of the already built structures and their disposal in appropriate sites, even if part of the dismantled materials are reused or recycled, is not exempt from environmental impacts, which would be similar to those of the construction phase of the civil infrastructure. In addition, an investment is needed for carry out the works of dismantling.
- The European Union transport infrastructure policy consider the Corridor VIII within the extension of TEN-T to Western Balkans. This action is funded by the European Union, through EBRD or World Bank, and must be completed to fulfil the criteria for development of the railway network in Europe.
- SEETO, as a representative member for the development in Western Balkans, considers the project as priority project eligible for funding according to the Multi Annual Development Plan 2016.

5.2 Alternative A and Alternative B

The alignment alternatives assessed in the previous Fisibility Study concern the Reference Alignment presented in the Main Design from 2010 (for design speed of 100 km/h and about 88 km of the total length), and the Alternative Scenario, developed for design speed of 160 km/h and about 79 km of the total length.

Within the **strategic options** considered, the **"Reference Alignment" (Alternative A)** is envisaged to be the best alignment not only for section 3 but also for sections 1 and 2.

- **Alternative A (reference alignment)**

The alternative A corresponds to the Reference Alignment defined in previous Fisibility Study. The last section of the railway line runs from Kriva Palanka to Deve Bair at the Bulgarian border. There have been no previous railway works undertaken within this section and therefore construction of the railway line and structures is required along entire alignment.

The adopted Main Design for the alignment of Section 3 concerns the alignment of 23.4 km length of single track line. This stretch begins at approximately K.P. 65 and continues on the northern side of the Kriva valley. At K.P. 72.3 it reaches the town of Kriva Palanka, where a station will be located. Since the valley and the neighbouring hill sides of Kriva Palanka are densely covered with buildings, the line will cross the city by means of an 1100 m long tunnel in order to avoid major demolitions.

From the end of the tunnel up to K.P. 77, the line runs between the Kriva River and the planned future motorway. At K.P. 77, the river valley makes a 90° curve, shifting from the North-East to the South-East direction. The line follows this bending with a wide curve in order to gain length and subsequently height. Three kilometres further upstream, the line crosses to the South side of the valley. At K.P. 83 a horseshoe curve has been planned in order to gain length and climb up to the entrance of the existing border tunnel. The horseshoe curve is on the approach to the tunnel.

Macedonia and Bulgaria are to be connected with a tunnel 2350 meters in length, from which 1150 meters are in Macedonia and 1200 meters in Bulgaria. The drilling works on the tunnel started in the 1940's. The length drilled from the Macedonian side is 250 m. The tunnel entrance has partly collapsed at the Macedonian side. The first 250 m of the tunnel are known to be in difficult and unstable soil with the rest of the tunnel being in more stable rock. From Kriva Palanka to the Bulgarian border most of the railway alignment has a gradient ranging from 20 to 25 ‰.

The stretch includes one station in Kriva Palanka and one halt in Zidilovo. Along this alignment there are 22 tunnels with total length of about 9 km, and 52 bridges (viaducts) with total length of about 5 km.

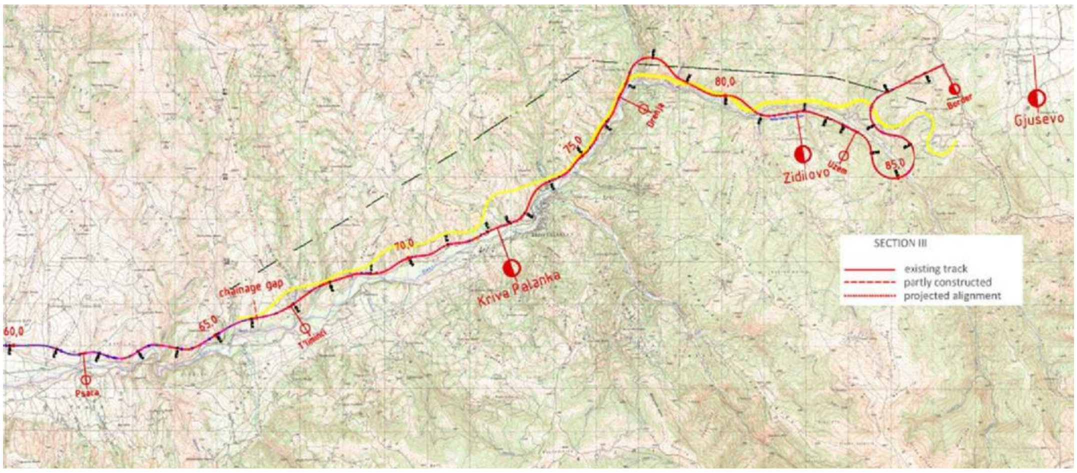


Figure 42 Alternative A - Reference Alignment

- **Alternative B (alternative alignment)**

The objective of the Alternative alignment was to increase the overall speed by enlarging the minimum radius of the horizontal curves and reducing the length of the line in three sections. The design parameters applied are the same as those for the Reference alignment, except for the design speed which is increased to a maximum of 160 km/h, which means to adopt minimum radius of 1100 m.

The Alternative alignment, at K.P. 59.6, crosses to the northern side of the planned motorway in order to arrive to Kriva Palanka at a higher level than in the Reference alignment and to avoid passing through the densely populated valley. The station of the Reference alignment is located at the western limit of the town and the line crosses the town in a tunnel. The proposed Alternative alignment runs north of the town and south of the planned motorway. The distance to the centre of Kriva Palanka is shorter than the one for the Reference alignment, but the station is also about 65 m higher above the town.

After passing the station, the alternative alignment changes again to the north side of the motorway. At K.P. 70, the motorway and the river are crossed and the line continues along the south side of the valley. With a moderate horseshoe tunnel (135°, R = 1100 m), the line turns first to the southeast and then to northeast and joins the Reference alignment at the entrance to the border tunnel. The station Zidilovo is located at K.P. 73.2 in front of the horseshoe tunnel.

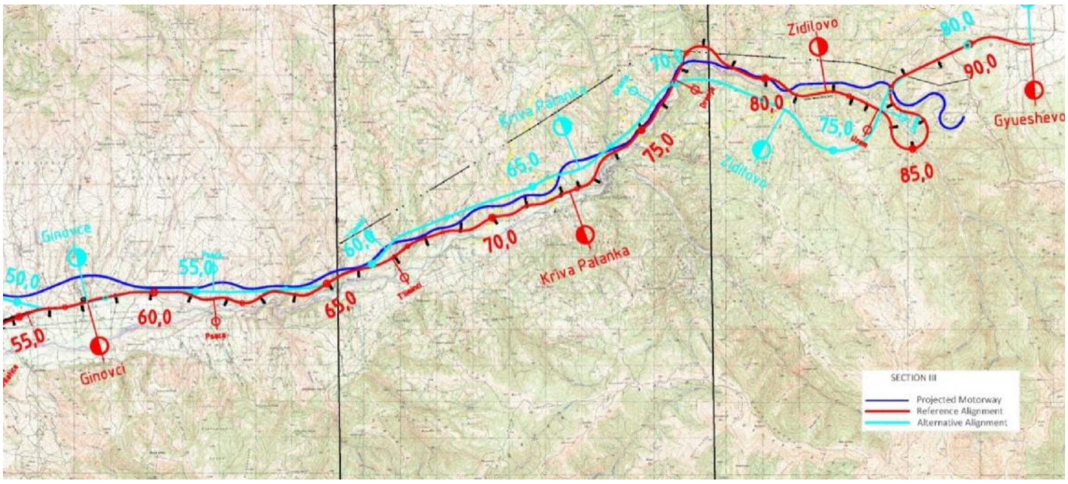


Figure 43 Alternative B - Alternative Alignment

The alternatives A and B present similar solutions with regard to track, bridges, tunnels, signalling and telecommunication, power supply, traction power or stations. The hereafter table summarize the differences between both alignments.

Table 21 Comparison of technical characteristics of the alternatives in strategic appraisal

	Alternative A (Reference Alignment)	Alternative B (Alternative Alignment)
Length	23.4	19.9
Design speed	100 km/h	160 km/h
Minimum curve radius	500 m	1100 m
Number of stations and halts[7]	2 stations	2 stations
	3 halts	3 halts
Length of viaducts	4410 m	3453 m
Length of tunnels	9036 m	8735 m
Motorway crossings	5	3

[7] In the Feasibility Study, December 2016 is prposed to be buil 1 station in Kriva Palanka and 1 halt in Zidilovo

- **Selection of the preferred alternative**

In order to evaluate the two alternatives (Alternative A: Reference Alignment and Alternative B: Alternative Alignment) a multi criteria analysis was used as is presented in the following description.

- *Analysis of cost estimation of alternatives*

The CAPEX (Capital Expenditures) analysis showed that the Reference Alignment for section 3 includes a lower investment cost with the amount of *€ 292 M* comparing to € 317 M needed for the construction of Alternative Alignment. This gives the difference of € 25 M for section 3, the main differences between the cost of the Reference Alignment and the cost of the Alternative Alignment is due to the civil structures.

According to the previous Feasibility Study, the Alternative Alignment include larger and higher viaducts and tunnels with more length. Therefore, with a similar length of viaducts and tunnels, the Alternative Alignment is more expensive than the Reference Alignment.

Taking into account the estimation of the CAPEX of the two alternatives, *it is recommended the selection of Reference Alignment (Alternative A) for further implementation.*

Cost Comparison between Reference Alignment and Alternative Alignment is presented in **Annex 11**.

- *Analysis of preliminary environmental impact of alternatives*

For both alternatives, the following impacts were considered and assessed in this preliminary analysis:

- *Biodiversity* (Flora and Fauna): loss of habitat space due to occupation of the tracks and modification of biotopes in adjacent non-sealed areas, disturbance to wild animal populations, and killing of animals during construction and operation;
- *Soil*: erosion arising from construction activities and induced by built structures, loss of soil function as support for biodiversity, loss of permeability due to soil sealing underneath the tracks, and soil contamination due to drip losses of traction vehicles and use of herbicides during maintenance operations during the operational phase;
- *Water*: decrease of water recharge into subsoil due to soil sealing, water contamination due to the input of pollutants during construction (mainly suspended matter) and operation (from emissions of vehicles and herbicide use);
- *Climate*: microclimate changes due to destruction of vegetation cover;
- *Air*: impairment of air quality due to dust emissions and exhaust emissions from machinery and vehicles during construction activities, and emissions of particulate matter and exhaust emissions of motive power units during operation;
- *Landscape*: impairment of landscape scenery due to the presence of the railway structures, particularly bridges and viaducts.

The following can be concluded from the review of the preliminary environmental impacts of the alternatives:

- From Kumanovo to the vicinity of Kriva Palanka, K.P. 65.1 of the Reference Alignment, the railway line is more or less established and a significant part of the construction work is already finished. Thus, the impacts concern an already altered environment, with less sensitive biotopes, which in the Alternative alignment need to be assessed as full impacts. Therefore, according to the preliminary assessment, the Reference alignment is recommended on Sections 1 and 2.
- The Alternative alignment on the Section 3 is significantly shorter than the Reference alignment and is recommended from the environmental point of view as substantially less areas of sensitive biotopes will be affected.

- *Analysis of preliminary social impact of alternatives*

The preliminary assessment of the social impact of the Reference alignment and the Alternative alignment has been based on the analysis of the following social aspects:

- Resettlement of people/loss of land due to land expropriation;
- Travel times;
- Access to train stations/stops; and
- Quality of life (e.g. noise and vibration effects).

According to the study, the following choice of alignments was recommended for each section from the viewpoint of the preliminary assessment of social impacts:

- For the Section 1, both Reference and Alternative Alignments more or less are following the same alignment so the influence from the social impact is more or less the same. Despite the minor advantages that can be achieved by technical characteristics of the Alternative Alignment, this does not give important prevail for recommending the Alternative Alignment. Reference Alignment is recommended.
- For the Section 2, the negative consequences for not giving the municipality of Kratovo (10,441 people) access to the train can be assessed of the greater influence to the social impact than having the advantages of technically improved alternative alignment. Reference Alignment is recommended.
- *For the Section 3, the negative impacts for the number of families to be resettled and the residents that are living in the parts of the settlement near the railway who should live with a higher noise levels are considered as negative impacts of the Reference Alignment. Alternative Alignment is recommended.*

Conclusion

Based on the judgment criteria and alternatives to be evaluated, the Consultant constructed a multi criteria evaluation matrix with the purpose to conduct multi criteria analysis using the compensation method.

The multi criteria analysis provides a framework in which decision-making can been taken. Based on the fact that the environmental impact is more or less the same for Alternative A and Alternative B, **the Alternative A (Reference Alignment) is envisaged to be the best alignment not only for section 3, but also for section 1 and 2.**

5.2.1 Analyses of alternatives for Reference Aligment-Section 3

As the Reference aligment was adopted **(Decision no. 51-3556/1 dated on 19/07/2011, in which the Government of the Republic of Macedonia officially selects the "Reference Alignment" (Alternative A for its development)***, the scope of the Fisibility Study, 2016* includes only Section 3 and analyses are made on the Referent alternative.

In a stage subsequent to the analysis of strategic options, different technological solutions are evaluated for the Reference Alternative:

Alternative 1: Ballasted track, bridges with precast concrete beams and railway line without level crossings.

Alternative 2: Slab track, bridges with continuous deck and railway line without level crossings. **Alternative 3:** Ballasted track, bridges with precast concrete beams and railway line with level crossings.

To compare different alternatives and choose the proper one, the alternatives have been rated from 0 to 5 in each criterion, with 5 points for the case in which the alternative fits perfectly with the criterion and 0 when the alternative is totally inadequate.

All the criteria have been weighted according to their importance and consistency with the study case.

Once the comparison criteria have been weighted and specifically applied to the case study, the Alternative 1: Ballasted track, bridges with precast concrete beams and railway line without level crossings wins by around 21% of its punctuation against the solution with slab track, bridges of continuous deck and railway line without level crossings.

Considering this solution is in line with the designs of two previous sections, savings in execution time, lower construction costs, improvement on safety of railway line and the lower environmental impact on riverbeds and vegetation, the ***Alternative 1 would be the best alternative for the design of the railway line Section 3: Kriva Palanka – Bulgarian Border.***

The status of the different alternatives (alternative matrix) are presented in Annex 11.

5.3 Traffic analysis

Traffic modelling is used for demand analysis in this project, which enables the simulation of the traffic distribution on the network thereby providing indication on how demand will respond, over the time, to changes in the transport network, such as completion of existing network (missing links), as it is the object of this project.

The demand data used for the traffic analysis is obtained from the fully-calibrated road/rail Transport Model developed by the Consortium for this purpose. A daily VISUM-based multimodal fully-calibrated national transport model for Macedonia has been developed. As starting point, model developed in the previous stages has been used and modifications to be updated have been carried out, taking into account the indications of the guide JASPERS Appraisal Guidance (Transport) for the use of Transport Models in Transport Planning and Project Appraisal (February 2014).

For the purpose of the Transport Model, year 2015 has considered as baseline scenario. Once the baseline is adjusted, calibrated and validated, the demand forecasts is undertaken for various years bearing in mind the implementation of the different sections of the railway corridor and the analysis period.

The Transport model has required substantial input data derived from standard statistics and specific survey done during the contract for building a model of trips, a model of the network and for understanding current traffic flows and demand structure for the purpose of model calibration.

The model consider five different modes in order to simulate the traffic distribution on the network: Passengers travelling by train through railway network; Passengers travelling by bus through road network (BUS mode); Passengers travelling by private car through road network (CAR mode); Freight transported by train through railway network; and Freight transported by truck through road network (HGV mode).

During the modelling process four mode choice models and five trip assignment of demand matrices have been developed.

The forecast has been carried out taking into account the potential development of the network and the growth of the GDP, in the short-term and medium and long-term forecast period.

The construction and extension of Corridor VIII has been dived into these four stages and sections:

- Section Skopje-Kumanovo upgrading, implementation year 2017
- Section Kumanovo-Beljakovce-Kriva Palanka (stages 1 and 2 of the Eastern section of Corridor), implementation year 2022
- Section Kriva Palanka-Bulgarian Border (stage 3 of the Eastern section of Corridor), implementation year 2025
- Section Kicevo-Albanian Border, implementation year 2030

The output from the transport model provides quantitative information about the forecast demand, such as: volumes of traffic forecast for passenger and cargo traffic by studied modes and estimation of the travel times.

Although the transport model covers whole Macedonia and neighbour zones, so the traffic for all network is simulated, additional calculations have been made in order to extract traffic volumes for analysed section part of the Corridor VIII.

In the traffic model, only the "no project" and "project" options were analyzed, shown in the demand analysis tables in Annex 12.

In order to perform a complete demand analysis, the study of the modal competitor to the railway mode and freight market study have been carried out.

Final freight and passenger annual demand that has been assigned to the Corridor VIII and to section Kriva Palanka-Bulgarian state border for each year, along with the resulting demand for both scenarios: “without project” and “with project” alternatives, are depicted in demand analysis tables included in Annex 12.

6 ENVIRONMENTAL BASELINE

6.1 Methodology for data gathering

The study/research of the project area aims to present the baseline of the environmental media and other relevant aspects within the project area and beyond, in order to define the current (existing) state of the environmental media and the other relevant aspects, which could suffer direct and indirect impacts from the project activities, or cumulative impacts, which derive from the combination of the project activities with the rest of the planned development project activities in the area.

In effect, the description of the current state of the environment is the starting point which will lay the groundwork for the possible impacts of the project activities, to help identify the possible damages and prescribe measures for immediate mitigation, elimination and compensation of the possible impacts/damage to the environmental media and other relevant aspects, as well as material assets.

In the description of the baseline of the environment, the state of the environmental media and other relevant aspects in the Kriva Palanka municipality have been analyzed, as well as the wider surroundings, i.e. on the level of the Northeastern Planning Region. Alongside this, the baseline of the environment along the alignment of the railway where the project activities will take place has been analyzed.

In order to identify the sensitive receptors in the area where the Project will be implemented, a research zone has been defined which in the largest part comes to 500 meters (left and right) from railway axis (called project area or contact zone), whereas for the rest of the media and relevant aspects, the sphere of action of the researched area is defined in accordance to the sensitivity of the receptors.[8]

On the basis of the information available from the project documentation and the site visits, made by a team of experts as part of the preparation of this study, as well as the conducted research, measurements and communication with the local population, the sensitive receptors which could be affected by the implementation of the project have been determined.

For the preparation of the environmental baseline of the project area and the wider surroundings, despite the information gathered from the field, major part of the information is based on data gathered from the current project documentation for this specific Project (Feasibility study and other technical documentation, part of the draft Design project, a previously created Study for EIA for the three sections of the railroad Corridor VIII Kumanovo-Kriva Palanka-Border of R. of Bulgaria, etc.), statistical data, reports about the environment quality published by the Ministry of Environment and Physical Planning and the State Statistical Office, Kriva Palanka Municipality and other written or publicly accessible materials (strategic documents on a national, regional and local level) etc.

The detailed description of the biological diversity state (types, habitats, ecosystems etc.), forests, soil, surface waters and erosion areas was created based on literature data, personal experience of the experts and field research. Alongside the descriptive, all natural and anthropogenic habitats (the ones large enough to be represented) have been mapped on a map with 1.25000 scale. The identified habitats, which have been mapped, correspond to the most detailed level of the EUNIS habitat classification (in accordance to the current data and knowledge of the expert team).

The determination of the current social state in the Project area and wider, is based on the data collected in direct communication with the interested parties, the project documentation available, the written materials and the visits (the realized communication with the population) in the project area.

As stated, in the direction of gathering current and truthful data about the way of life, the current problems and possible threats, a process of consultation with key interested parties from the project area was realized. The following methods and strategies were used during the consultation:

[8] And could range from 50-200-1000 m.

- Overview of the available technical specification connected to the planned project, aimed at identification of the possible social influences, as well as the individuals and groups which could be affected,
- An analysis of national and international legislature,
- Overview of the use of the land in the project area,
- Inclusion of interested parties through consultative meetings with the representatives of the different interested parties: local authority, national authority (ministries and agencies), population from the project area and non-governmental sector.

Two types of data have been used, namely:

- Directly gathered data refers to information gathered directly in the project area, between the hired expert and the local population or other interested parties;
- Indirectly gathered data refers to information which has already been published/printed.

By using this dichotomy in data collection, important for the understanding of the local concern for social and environmental questions, the current processes and conditions in the environment and the social sphere, the cultural and social habits, as well as the socio-economic conditions of the population in the project areas, we aim at achieving an appropriate identification of the possible negative social influences, as well as suggesting appropriate measures for avoidance, mitigation and alleviation.

The data of the current social conditions come from different available sources. Part of the published data has been gathered through a realization of the activities for inclusion of the interested parties, which is a standard practice during analysis of the social surrounding. The gathered and processed data has been checked in parallel to the official data published by governmental institutions.

During the realization of the several field visits, important unpublished data and information has been gathered, which helped in the creation of a solid basis for an analysis of the current social conditions in the project area, i.e. information about:

- Current state of the infrastructure (local roads, water supply, electricity, management of wastewaters and waste),
- The location of nearby settlements and the distance from the project area,
- Field configuration,
- Quality of housing and population density,
- Living conditions in the settlements (way of life),
- Identification of other living habits and cultural values,
- Identification of economic habits and conditions, which could not be found in the published documents.

The directly gathered data include consultations with official publications and data bases developed primarily by government bodies/institutions. Most government bodies/institutions gather statistical data connected to their activity field.

The reports of the local government, as well as scientific, social, ethnological, cultural, archeological and other studies for the project area have been published in different form. Part of the data is available at the National and university library in printed form, and a larger part could be found on the Internet.

This analysis has micro (specific to the location) approach towards the conditions of the living and social environment of the project area. The mezzo (municipal) approach, and sometimes macro (national) approach have been used mostly due to the necessity to accurately describe the sensitivity of the receptors of possible negative influences which the Project implementation could cause.

6.1.1 Lack of data

While procuring data for the wider surrounding, i.e. Kriva Palanka Municipality and the project area, lack of data to truthfully represent the state of the mediums and areas of the environment and the social environment have been identified, that is:

- Nonexistence of relevant data for the monitoring of the emissions and quality of mediums in the environment (air, noise, soil, water) for the wider area and the lack of the same ones for the project area;
- Nonexistence of precise available data for the biological diversity of the length of the railroad corridor, especially for plants and mammals. The lack of the Red book of data and red list for Macedonian flora, fauna and fungi was an obstacle in the evaluation of species. Also, the vegetation and habitat map has not been defined. Some of these deficiencies have been amended through field research in the project area.
- Lack of data for the correct population number, living in th e affected settlements, which would be directly or indirectly affected by this project. The approximate number of population on the basis of slightly outdated data has been presented. The State Statistical Office does a census of people, settlements and households every ten years. The major part of the presented data has been generated by the census in 2002. In 2011, a new scheduled population, apartments and households census has been done. The census was planned and started, but it did not reach its goal, due to some technical and lesser political obstructions. It was postponed indefinitely.

6.2 Geology and soils

6.2.1 Relief conditions

In regards to the relief, the Kriva Palanka area is mainly mountainous and hypsometrically belongs to 3 zones: low-high mountains up to 1500 m.a.s.l., average-high mountains 1500 to 2000 m.a.s.l., and a tiny part that stretches over 2000 m.a.s.l. The south side of the area is represented by the tall Osogovo Mountains, with the highest peak Ruen, 2252 m.a.s.l. This large mountainous morphostructure is the second by area and 9^{h} by height in the Republic of Macedonia. Also, it is the highest mountain in the eastern part of the country. On the northern side, the areas is “fenced” by the average-high mountain massif Bilino (Chupino Brdo, 1703 m.a.s.l.), which continues westward with the branches German and Kozjak. The Osogovo Mountain and the Bilino massif are separated by the valley of Kriva Reka, with dominantly parallel direction (east-west), same as the aforementioned mountains. The valley of this river deeply cuts the Precambrian to Paleozoic crystalline rocks, out of which the area is formed, as part of the geotectonic Serbian-Macedonian massif. According to the direction, it is obvious that the valley of Kriva Reka is conditioned by fault, especially in the gorge part east of Kriva Palanka. Downstream from the town, the valley expands, and the valley bed is flatter and filled with sediments as an alluvial flat. This part is the only notable plain surface in the Kriva Palanka area. The intensive incision by Kriva Reka has caused incision by its tributaries, which aim to align their lengthwise profile with the main river. Because of this, the whole area is dissected with numerous valleys, smaller valleys, crests, summits, hilly elevations, peaks etc. The powerful river erosion, in newer times, has been empowered by the anthropogenic influences over the environment. Therefore, the current intensity of erosion and accumulation of deposit is quite large, and in many places we find “young” or recent relief forms.

- **<u>Project area</u>**

The section 3 Kriva Palanka-Border of R. of Bulgaria (as part of the railroad corridor VIII Kumanovo-Kriva Palanka-Border of R. of Bulgaria) passes mainly along the southern and quite dissected base of

Bilino, i.e. along the right valley side of Kriva Reka. East of v. Zhidilovo, the line moves over the Osogovo massif, to be precise, at the Central-Osogovo and Ruen structural block. This is the most complex part of the line, in terms of elevation and relief.

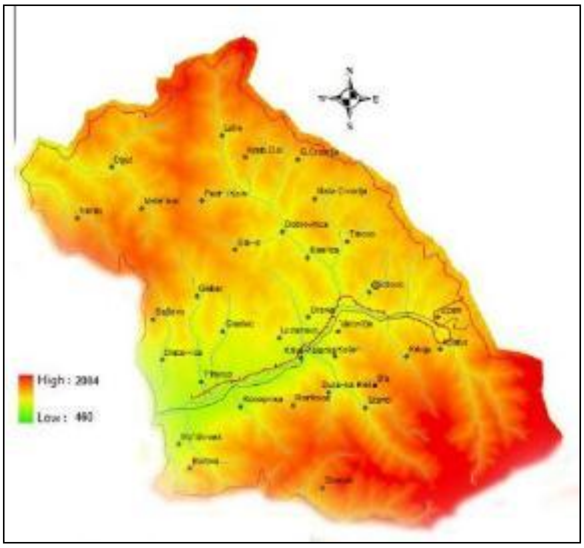


Figure 44 Digital elevation model

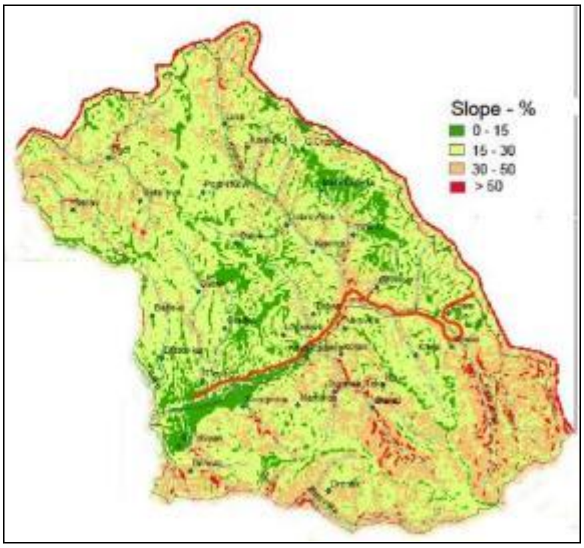


Figure 45 Terrain inclination

6.2.2 Geological characteristics in the municipality of Kriva Palanka

Geological history of Osogovo region is very complicated. Beginning from the paleozoic to the diluvium, it was covered by horizontal and vertical tectonic movements that burst, elevated and fragmented. Tectonic movements caused disruptions and volcanoes through which magma poured out.

Tectonic movements caused disruptions and volcanoes through which magma poured out. Osogovo is composed of various rocks, consisting of archaic and paleozoic shales, older and younger eruptive rocks, paleogens and neogene sediments, and diluvial and alluvial creations.

The eruptive rocks contain a significant amount of various ores. A suitable percentage of ores also contain crystalline shales. Hence, Osogovo region enters in the line of the important mining areas in our country. The mining areas in this area are the Toranicko and the Crkljansko-Duracko. The Toranicko-Sasko area is rich in lead-zinc ores, which were the basis for the construction of the lead and zinc mine "Toranica".

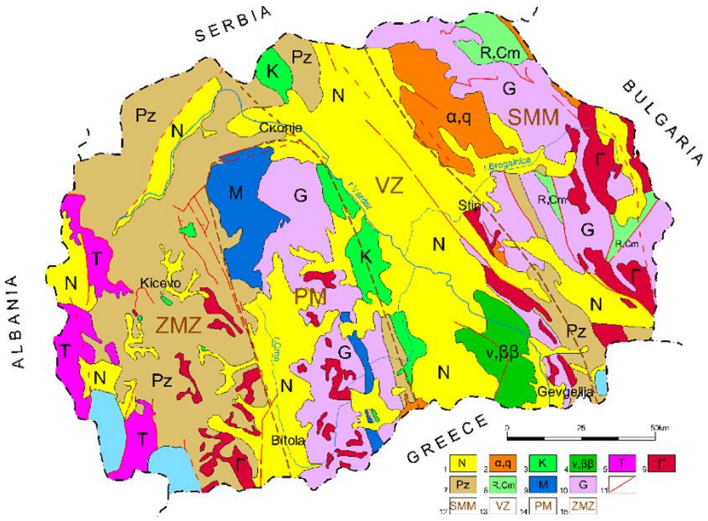
The wider area of the terrain is built of many lithological units: alluvial sediments, dilluvial and proluvial formations, andesite breccia, Pliocene sediments, tuff, quartzlatite, volcano sediments, conglomerate, quartz-graphite schist, amphibolite schist and metabasite, quartzite, albiteepidote-chlorite schist and albite-epidote-muscovite schist. The most present lithological unit at the investigated area is albite-epidote-chlorite schist.

With the contemporary geological processes in the Quarternay and the Holocene, through the erosive processes and the activity of the river flows, today's relief has been formed, which characterizes with formation of proluvial and diluvial creations and alluvial deposits.

In Osogovo region there are several types of soils that are differ in each other, both in terms of their physical and chemical properties and their fertility. Their distribution is conditioned by the geological composition, relief, altitude, climate, hydrography and vegetation cover. These elements also affected the differences that exist in the amount of loose material between the individual parts of the area.

- **Geological characteristics of the project area**

The area foreseen for the construction of the railway alighment Section-3 (Kriva Palanka-Border with the Republic of Bulgaria) belongs to the Serbian Macedonian massif geo-tectonic unit, as part of the Macedonian pre-Cenozoic basement.



SMM – Serbo-Macedonian Massif, **VZ**-Vardar Zone, **PM –** Pelagonian Massif**, ZMZ –** West Macedonian Zone**, α,q –** Kratovo – Zletovo volcanogenic area, **R,Cm –** Green Schist Series

Figure 46 Location of the Serbo-Macedonian Massif in relation to the other geo-tectonic units (1979, M. Arsovski)

The area crossed by the alignment of Section 3 is mainly is built of Precambrian metamorphic rocks, sedimentary-igneous series which is metamorphosed under conditions of facies of the green schist.

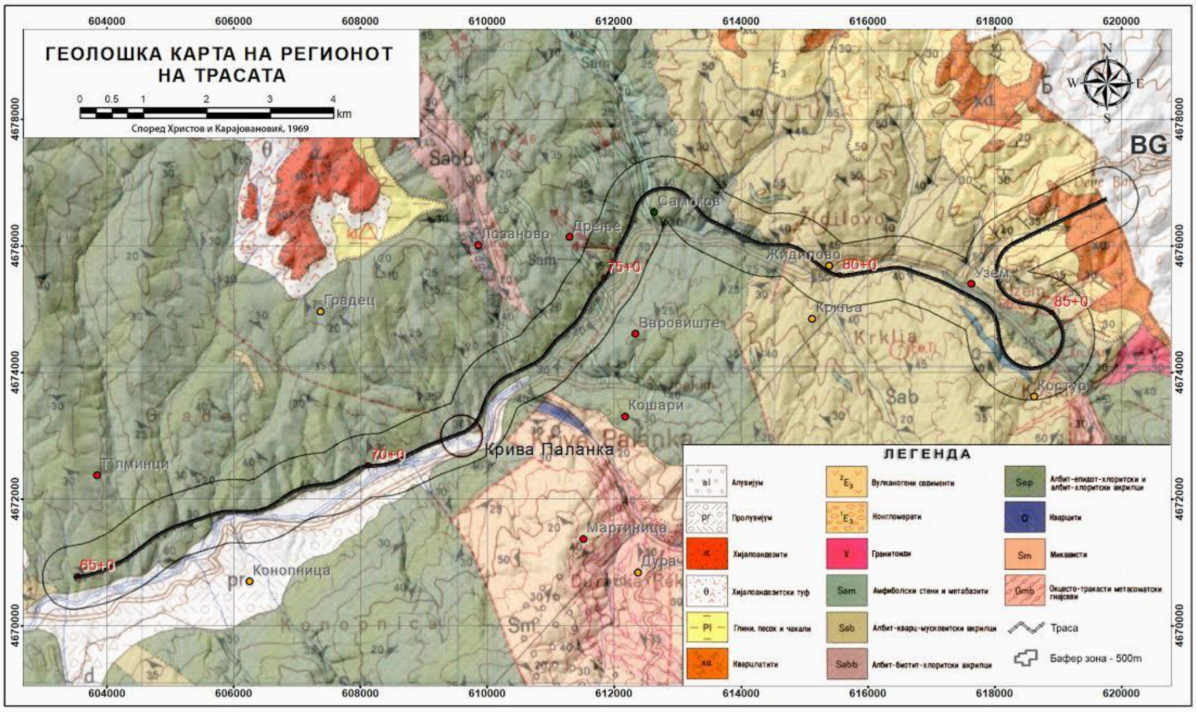


Figure 47 Geological map of the project area

In order to define lithological and geological units, along the entire alignment of the railway section 3, mineralogical petrographic analyzes of samples from the excavations were made in the investigated area. The obtained results from the performed analyzes are shown in the following table.

Table 22 Mineralogical-petrographical analyses

BOREHOLE	DEPTH (m)	TYPE OF ROCK	GEOLOGICAL UNIT
BT-66+132	13,15-13,3	Albitised epidote-quartz-chlorite schist	Sep
BV-66+817	16,5 -17,0	Fine-grained gneiss	GN
BT-66+906	5,9 - 6,0	Hydrothermally pyritised quartzite	Q
BT-67+017	11,3-11,37	Metagabbro	Met
BT-67+187	21,8-21,9	Bandlike spherical muscovite schist	Sse
BT-70+646	9,5 - 9,7	Chlorite-sericite schist	Sse
BV-73+372	13,0-13,1	Albite-epidote-chlorite-amphibole schist	Sep/Sam
BV-73+697	6,7 - 6,9	Micaschist and layered gneiss	Sep/GN
	14,5 -14,6	Contact between quartz-graphite schist and granitoide	Sgr/GN
BV-74+825	5,5 - 6,0	Hydrothermally altered granitoide	G
	14,3 -14,7	Hydrothermally altered granitoide	G
BT-77+108	89,0 - 89,1	Chlorite-epidote schist	Sep
BT-79+492	14,3 -14,45	Quartz-chlorite-muscovite schist	Sab
BT-82+872	82,4 - 82,6	Quartz-graphite schist	Sgr
	98,0 - 98,2	Augen gneiss	GN
BT-83+530	149,0 -149,2	Quartz-graphite schist	Sgr
BT-84+070	1,2 - 7,4	Slightly altered quartzlatite	xa
BT-84+842	32,2 - 32,5	Chlorite-muscovite-quartz schist	Sab
	98,65 - 98,85	Cataclised granites	G
	108,25 -108,45	Quartz-muscovite-sericite schist	Sab
BT-86+142	29,0 - 30,0	Quartz-amphibole-chlorite muscovite schist	Sab
BV-86+297	13,8 -14,0	Calcitised quartz-sericite schist	Sab
BT-87+712	36,8 - 37,0	Altered dacite	xa
	94,5 - 94,7	Altered dacite	xa
BT-88+322	26,35 - 27,0	Completely altered andesite	xa
BT-88+322	61,25 - 61,8	Lithic sandstone with calcite cement	2E3
BT-88+322	92,0 - 92,7	Intensively altered andesite	xa
BT-88+322	213,0-213,1	Intensely altered dacite	xa

Riphean - Cambrian

The major part of railway section under study runs through low-grade metamorphic shales with a vivid green colour, which is the reason why in literature they are known as the green series. The following groups of rocks occur in this section of the alignment:

- Albite – epidote - chlorite and Albite-chlorite shales (Sep)
- Albite – quartz - muscovite shales (Sab)
- Quartzites (Q)
- Amphibole rocks (Sam)
- Metabasites (Met)

Albite – epidote - chlorite and albite - chlorite shales (Sep) - are the most permanent lithologic members of the series. They are distributed on both sides of the Kriva River. They have a distinctively green colour, and are shale - like in texture with dense dots (balls) of feldspar (up to 3 mm). They contain albite, chlorite, epidote, quartz and albite - chlorite. According to the aforementioned petrographycal analysis, it is characterized with compact medium-grained structure and weakly expressed schistose texture. The base mass of the analyzed samples show high grade of crystallinity.

The main minerals are albite, epidote and chlorite.

Sericite Schist (Sse) - occur as layers of few meters thick intercalated between layers of chlorite schist (Sep). The contact with the adjacent shales is gradual and rarely sharp. They were found only in the first part of the alignment. In these rocks were determined the following minerals: quartz, sericite, muscovite, chlorite (clinochlor), illite, graphite and limonite.

Albite – quartz - muscovite shales (Sab) - differ from the previous shales by composition and by the vivid yellowish or brownish colour. They are comprised of quartz (40 - 50 %), muscovite (25 % - 35 %), albite (10 - 20 %) and accessories (3 - 7 %). They occur on both riverbanks of the Kriva river valley in the vicinity of Zidilovo.

Quartzites (Q)- are very seldom found in shales, taking the shape of thin strata. They are rocks constituted by approximately 80 % quartz, thin layers of muscovite and rarely of fine – grained albite. In this Section, quartzites were found associated with hydrothermal alteration.

Amphibole rocks (Sam) - are characterized by vivid green colour, which clearly differentiates them from other rocks. Amphibole shales or Amphibole schists occur as layers of up to a few hundred meters in length and a few tens of meters in thickness. The contact with the adjacent shales is gradual and rarely sharp. They consist of amphibole, albite and quartz, while epidote, swanstone, rutile and granite are secondary components. They are developed in the lower catchment of the Kiselicka river before its confluence with the Kriva River, and downstream along the Kriva River towards Kriva Palanka

Graphite schists or ampelites (Sgr): They are found in layers interbedded with the Quartz – Muscovite Schists (Sab). They are usually a few centimeters to meters thick. They were mainly found in Tunnels 16, 19 and 20. The rock has schistose structure. Mineral content: quartz, graphite, muscovite and ilite.

Paleozoic igneous rocks (dikes)

They are found as dikes in the pre-Cenozoic basement, following the main foliation or discordant with the main anisotrophy.

Metabasites (Met): are characterized by massive texture and green colour, which clearly differentiates them from other rocks. The contact with the adjacent schist is sharp and highly weathered and with hidrothermal alteration. They were found in Tunnel 2 and Tunnel 07. These rocks are characterized with dark-green medium grained to coarse grained massive rock with massive structure. The rock is cut with fractures which in the central parts are filled with carbonate (calcite) infill, while in the edge parts there is also parallel aureole with thickness of 5 to 15 mm with limonite, hematite composition. The base mass is characterized with homogeneous mineral composition presented by green amphibole minerals, as well as lighter granoblastic grains of feldspar. In the base mass rock, the following minerals are present: amphibole (actinolite) 55%, plagioclase (35%) and epidote (7%) as main minerals. From side minerals there are chlorite, feldspar and garnet (0,5%). From the accessory minerals there are: magnetite, ilmenite, sphene and rutile (2,5%).

Granites (G): They were found with the electrical tomography and drilled boreholes at Viaduct 29 and Tunnel 20. The contact with the schist are sharp and usually altered, showing hydrothermal alteration.

Mineral composition: quartz, feldspar, graphite, kaolinite and calcite.

Gneis (GN): They were found with the electrical tomography and drilled boreholes at Viaduct 5 and Tunnel 19. The contact with the schist are sharp and usually altered, showing hydrothermal alteration and quartzite presence (Q).

The rock has a pale gray colour. Texture is medium to coarse grained. The sample has banded structure due to alternation of schistose (dark coloured) and granulose (light coloured). Mineral composition: quartz, feldspar and muscovite.

Palaeogene Sediments (Upper Eocene)

In the area of the current section of alignment, Palaeogene sediments are mainly found in the part of the Deve Bair border crossing. They are developed in the volcanogenic-sediment facies with share of volcanogenic sediments.

Breccias and conglomerates (1E3): with layers of sandstones, siltstones, claystones, and tuffogenic sandstones. They are purple, red and grey in colour. Breccias and conglomerates are comprised of debris from crystalloid shales up to 1 m in size. Sandstones are coarse-grained to medium-grained and fine grained.

In the Deve Bair portal, a smoothly polished surfaces likely caused by frictional movement between rocks along the two sides of the bedding planes were found (slikensides).

Volcanogenic-sediment series (2E3): is found in the upper part, and it shows certain flysch features. According to their composition and structure, the volcanogenic sediments belong to the following groups: tuffites, lythocrystaloclastic and crystaloclastic tuffs and tuffogenic claystones. The basic mass of tuff rocks is built of pyroclastic material. The depth of the volcanogenic sediment series is approximately 1,300 m. They were found in Deve Bair boreholes, mainly in BT-87+712. From the mineralogical point of view, lithic sandstone with calcite cement were found in boreholes drilled at Deve Bair Tunnel area.

Main minerals are quartz grains, micas of muscovite, rare grains of orthoclase, unclear fragments of muscovite-sericite schists, and subordinate are chlorite, epidote and ore grains. These grains lay in calcite matrix that represents around 50% of the entire rock mass. The matrix – cement material is from basalt type. The sample is characterized with grey-green color, fine grained composition, and strong massive texture.

Tertiary – Quarternary Volcanic Complex

Quartzlatites (xa): They appear along the state border with Bulgaria (Deve Bair) in the form of necks through shales and Upper Eocene sediments. They occur in the form of veins, dikes and effusions above the aforementioned rocks. Quartz latites are incised by younger effusive rocks – dacites and andesites. In the area they evidently differentiate from other rocks by their gray or dark greenish colour.

According to the engineering geological mapping, drilled boreholes and petrographycal analysis, in addition to quartzlatites, dacites and andesites were found. The macrospic texture was brecciated or laminated as shown in the annexed geotechnical engineering profile. Microscopically it is visible that the rock has fine porphiritic structure, and it is consisted of plagioclase phenocrystals with size 1–1,5mm, as well as completely metamorphosed forms of colored mineral. The base mass is micro-crystalline.

Tuff (θ): They were only found at Tunnel 1, with reduce thickness according to the geological mapping. In general, they are well-stratified. Tuffs are grey-yellowish, pinkish to green in colour. They are intensely degraded, kaolinized, limonitised and even silicified.

Pliocene Deposits

Clays, Sand and Gravels (Pl): They were found in the area of the village of Kriva Palanka. Pliocene sediments are represented by alluvium and colluvium origin. They are as follows: clays, clayish sands and sands with layers or jets of gravels.

Quarternary Sedimentary Deposits

Proluvium (pr): The proluvial sediments occur along the Kriva River valley and they are chiefly reddish in colour. The sediments are composed of scantily workable fragments of various rocks with clayish - sandy material.

Diluvium (d): Diluvial sediments are found on the slopes north of the Kriva River (Radibus, Ginovci), and they mildly descend towards the river. They are made of coarse, unworkable material originating from adjacent rocks, mixed with clayish - sandy material.

Alluvium (al): It occurs downstream along the Kriva riverbed. It is represented by typical alluvial sediments (sand, gravel). In the upper segments it is more coarse - grained whereas in the lower ones it is processed.

6.2.3 Geomorphological characteristics of the project area

- **Basic geomorphological characteristics of the terrain along the line**

The Section-3 line of the railroad Corridor VIII completely passes through the valley of Kriva Reka, more specifically through its upper flow, from the area of v. Dlabocica in the west, to v. Uzem in the east. At an appropriate length of 23, 35 km, the line mainly follows the right (18, 7 km or 80, 3%), and for a shorter distance, the left valley side (4, 6 km or 18, 7%). The valley of Kriva Reka, though this area, has a predominantly gorge character, especially upstream (east) of Kriva Palanka. Downstream from Kriva Palanka, on the other hand, the valley gradually expands, entering the narrow Slavishko Pole. At the analyzed section, the valley of Kriva Reka cuts into the dissected massif Bilino (Chupino Brdo, 1703 m.a.s.l.) in the north and the high central part of the Osogovo Mountains (Ruen, 2252 m.a.s.l.) in the south, so the valley actually separates these large morphostructures (Arsovski, 1997). The valley of Kriva Reka and some of its tributaries, in this part, is tectonically induced with several regional and local faults. Among the most characteristic valleys of the Kriva Reka tributaries, which are tectonically induced and the line cuts into, are the valley of Kiselicka Reka, Domacki Dol, Zhidilovski Dol etc. Due to the tectonically differentiated rise of the mountain structures Osogovo and Bilino (3-4mm/year), and the predominantly vertical incision of the Kriva Reka valley system (0,3-0,9 mm/year), relief-wise the area alongside the line is quite dissected. This is especially true of the right valley side, which has southern (sunny) exposition. All that, together with the geological structure, made by soft tectonic squeezed or cracked schists, has conditioned the part of the line (on the right side) to be highly dissected and exposed to current geomorphological (erosive and accumulative) processes. Morphologically, the major part of the line moves along the remains of the Kriva Reka river line, at a relative height of 15m, 30m, 45m and 60-70m. The flattening of the river terraces are a great terrain for construction and functioning of the railroad line. On the other side, the river terraces of this sector are usually subject to deposition with eroded material from the escarpments and the slopes above them, or are themselves over unstable rocks covered in gravel and sand-like materials. Therefore, during construction and maintenance of the railroad line, we need to take care of the placement, morphology and structure of the river terraces and the terrace escarpments along the railroad line (except in case of tunnels and bridges).

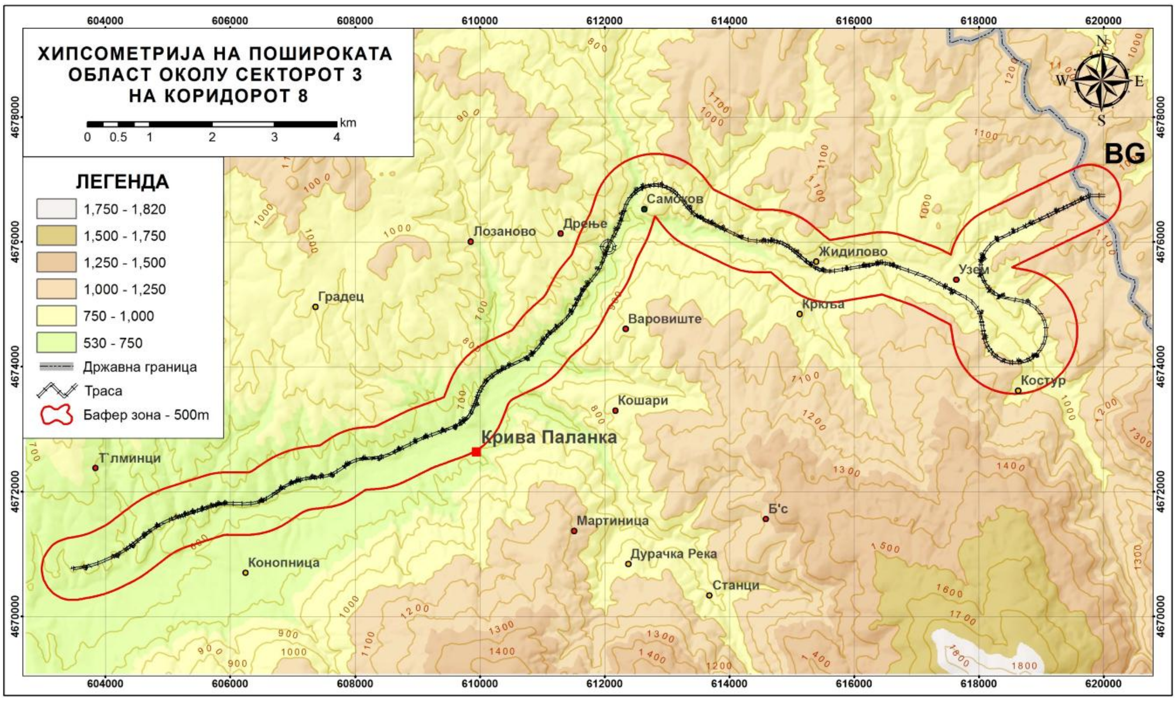


Figure 48 Hypsometry of the relief along the corridor line

- **Morphological description**

As it was mentioned, from a morphological view, the line at Section 3 passes through especially dissected relief. Hence the great difference in the hypsometry, the inclinations, expositions etc. Hypsometrically, the lowest point in the corridor line (with a buffer zone of +500m) is at 543 m.a.s.l. and the highest at 1192 m.a.s.l., which means the elevation difference is 649 m. The average elevation is exactly 800m. In regards to the inclinations, the line stretches over a terrain with inclination of 0° (plateaus) to above 60° (distinctly steep terrain). The average value of the incline is 18,5°, a great value (the average for the Republic of Macedonia is 15,1°), which represents a significant factor for the numerous current geomorphological (erosive and accumulative) processes in the area. In regards to the expositions, southern and south-western terrains are predominant, whereas the rest are noticeably less present. The values for the vertical terrain dissection (elevation difference in meters, at an area of 100x100 m or 1 ha) are high (30-50m/ha) pointing to the great potential erosive energy of the relief.

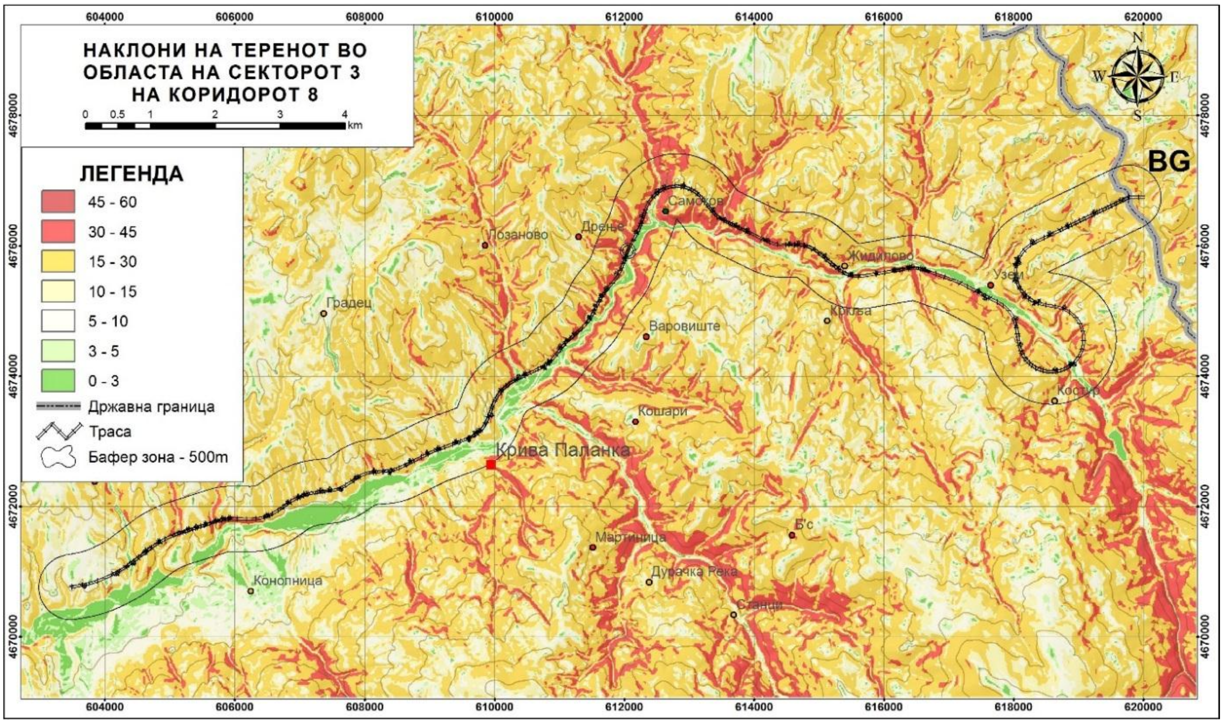


Figure 49 Relief inclinations along the corridor line

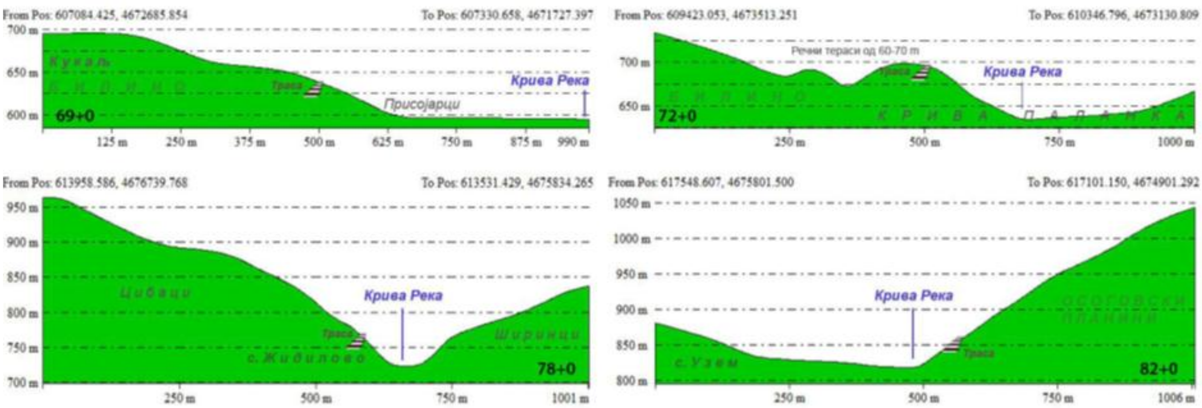


Figure 50 Crosswise topographical profiles of the corridor line (in the buffer zone from 500+500m), at 69+0, 72+0, 78+0 and 82+0. In the top two profiles, the valley of Kriva Reka is shallow and wide with prominent river terraces, and in the lower ones, it has steep, mountainous character

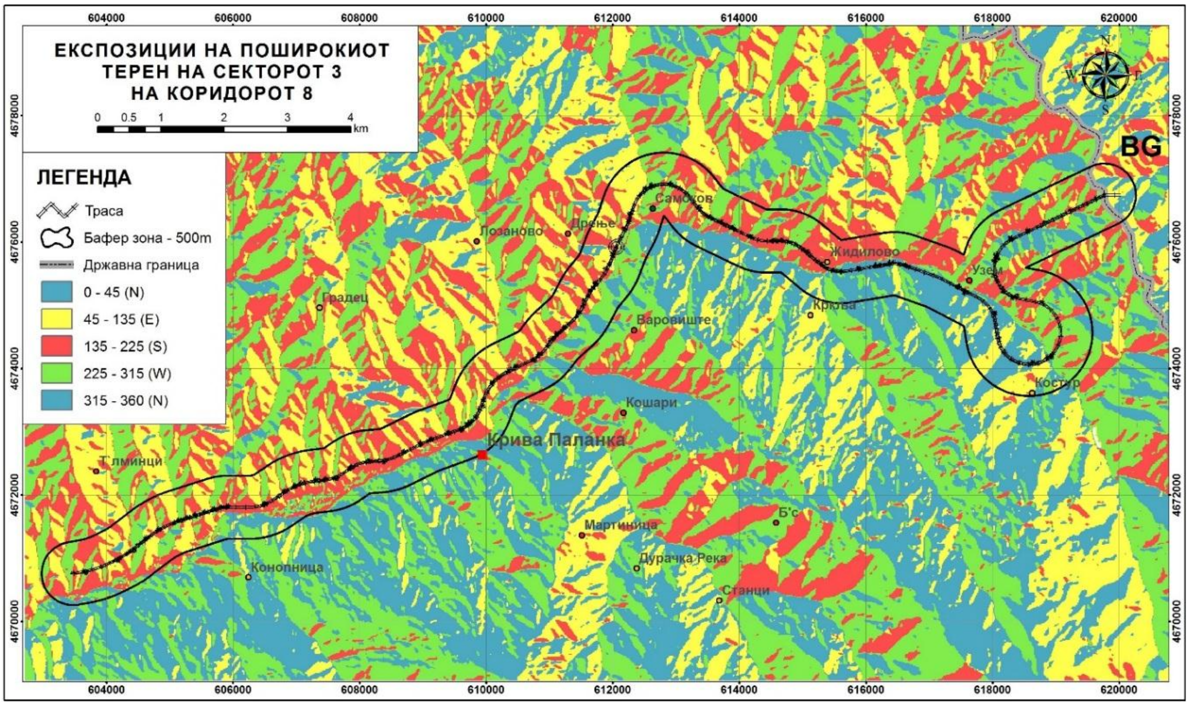


Figure 51 Relief expositions along the corridor line

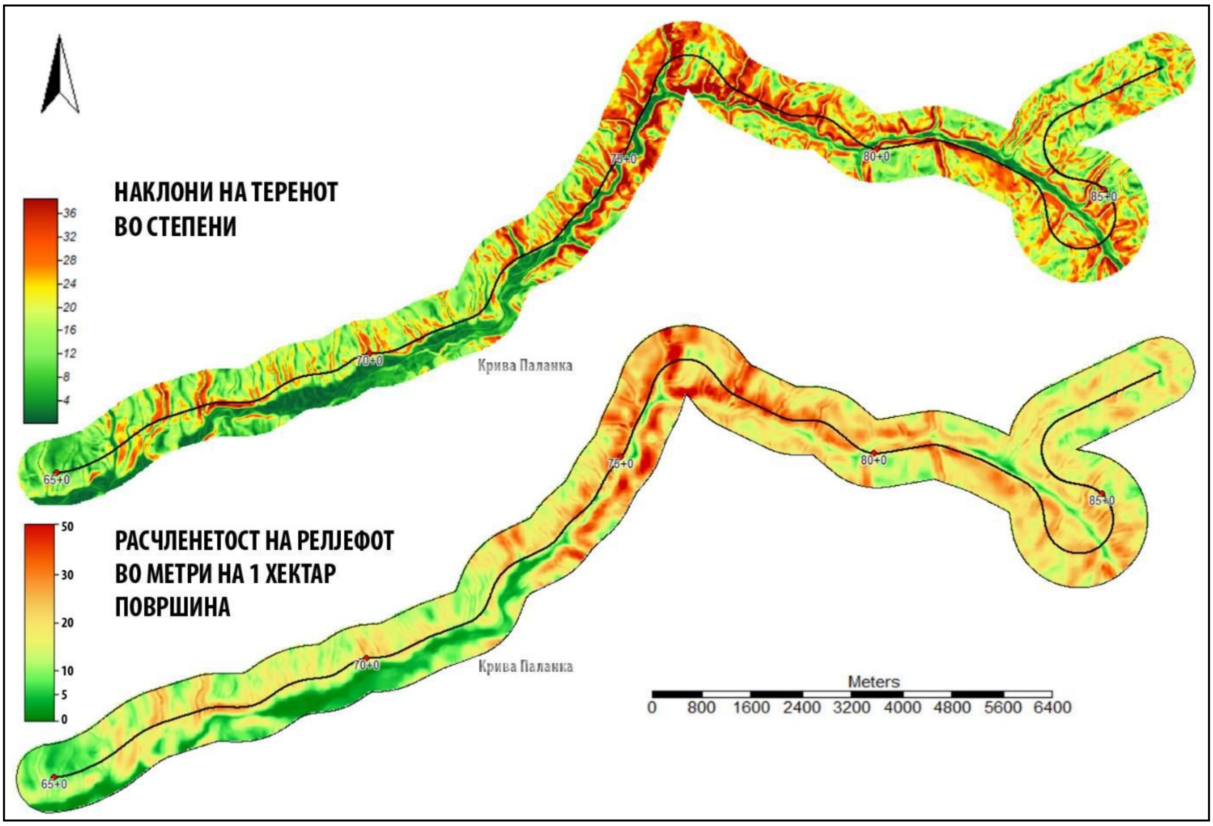


Figure 52 Relief inclinations and dissection (vertical) along the corridor line

The Section 3 of the line starts in the area of the village Dlabocica and the base of the Mramor hill, where it spans from 64+942 to 65+800 km. Because the terrain is composed mainly of soft resistant schists, in this segment we have rock breakdown, latent landslides, strong surface runoff etc. The average elevation of the terrain here is 600 m.a.s.l.

Figure 53 The broad valley of Kriva Reka with the river terraces on the sides and the alluvial valley at the bottom, at v. Tlminci, (67+0 km). The line goes along the river terraces in the picture.

At the section from 65+700 to 66+200 km, the line cuts the valley of Gabarska Reka, which is relatively shallow. The line then continues along the southern slopes of Orov Rid, cutting into the little valleys of several periodical watercourses. Between 67+0 and 67+500 km, the line moves across the shallow valley of the periodical watercourse Rangel. Towards east, the line moves in the base of several hills – southern end branches of the Bilino massif, along the right valley side of Kriva Reka. In several places it passes over the river terraces from 30 m and 45 m, and in the town Kriva Palanka over the terrace from 60-70 m. Eastwardly, the line enters in the relatively narrow (Zhidilovska) gorge of Kriva Reka, which is narrower, especially between Varovski Rid (865 m.a.s.l.) on the southern (left) valley side and Drenje (835 m.a.s.l.) on the northern-right side. There is a minor change in the type of schists, where we have mixing of the non-resistant with stronger, more resistant parties, and the formation of lesser denudation forms is a result of this. At the section between 76+0 and 77+0 km, the line cuts into the relatively deep and morphologically prominent valley of Kiselicka Reka which is among the major right tributaries of Kriva Reka. Over this reach, the line changes its general direction and from southwest – northeast direction, it turns southeast, following the valley of Kriva Reka (whose direction is tectonically induced). Through a system of tunnels and bridges, the line cuts the base of the hills Momica (1085 m.a.s.l.), Cibaci (1015 m.a.s.l.) and Zhidilovski Rid (1137 m.a.s.l.), passing through the valleys of Zhidilovski Dol, Ovhcaricki Dol etc. At v. Zhidilovo, by a relatively larger bridge, the line moves across the valley of Kriva Reka, at its left valley side. From here (80+0) to 84+100 km or in the length of 4 km, the line moves along the north base of the Osogovo Mountains, specifically its branch Luti Rid (1620 m.a.s.l.). This part of the terrain is with high steepness, but with somewhat stronger rocks and is also well-wooded, and thus the current geomorphological processes are not as prominent. At the passage point, the valley of Kriva Reka is characterized by strong fluvio-denudation deposits brought mainly by the bare slopes below Ruen and Carev Vrv.

The last segment from 84+300 to 88+365 km, again moves along the right valley side of Kriva Reka, over a terrain with elevation of around 900-950 m.a.s.l. Due to the predominantly western exposition, the prominent fault tectonics and the change in rock masses (albite–chlorite, albite-quartz-muscovite schists, Eocene conglomerates, volcanogenic sediments etc.), the terrain here is quite dissected. As a result, the line will be overcome with a number of bridges and several tunnels.

Figure 54 The deeply cutting valley of Kriva Reka at v. Uzem, where part of the line crosses between 82+0 and 86+0 km. The peak Ruen in the Osogovo Mountain (2252 m.a.s.l.) is in the background

From the detailed model of potential erosion risk, presented through the Z coefficient (Milevski et al., 2017), we see that the average value for the buffer zone is 0, 51, and the values move from 0 (no risk of erosion or accumulation areas), to 1, 95 (areas with extremely high risk of erosion). We can see on Figure 56 that the southern (sunny) slopes are much more erosive than the northern ones, which is a consequence of the larger anthropogenic influences on the right valley side of Kriva Reka. Otherwise, the soil erosion part has been elaborated in more detail in the appropriate chapter.

The created landslide vulnerability model (Figure 55) shows that the average value for the line and the buffer zone is 17,5, which corresponds to moderate to high risk of landslide events (Milevski et al., 2017). Actually, almost the whole area, with the exception of the flattened valley floors and alluvial plains, are under a certain risk of landslides and rockfalls, as a result of the great inclinations, the geological structure, the bareness, the anthropogenic influences etc.

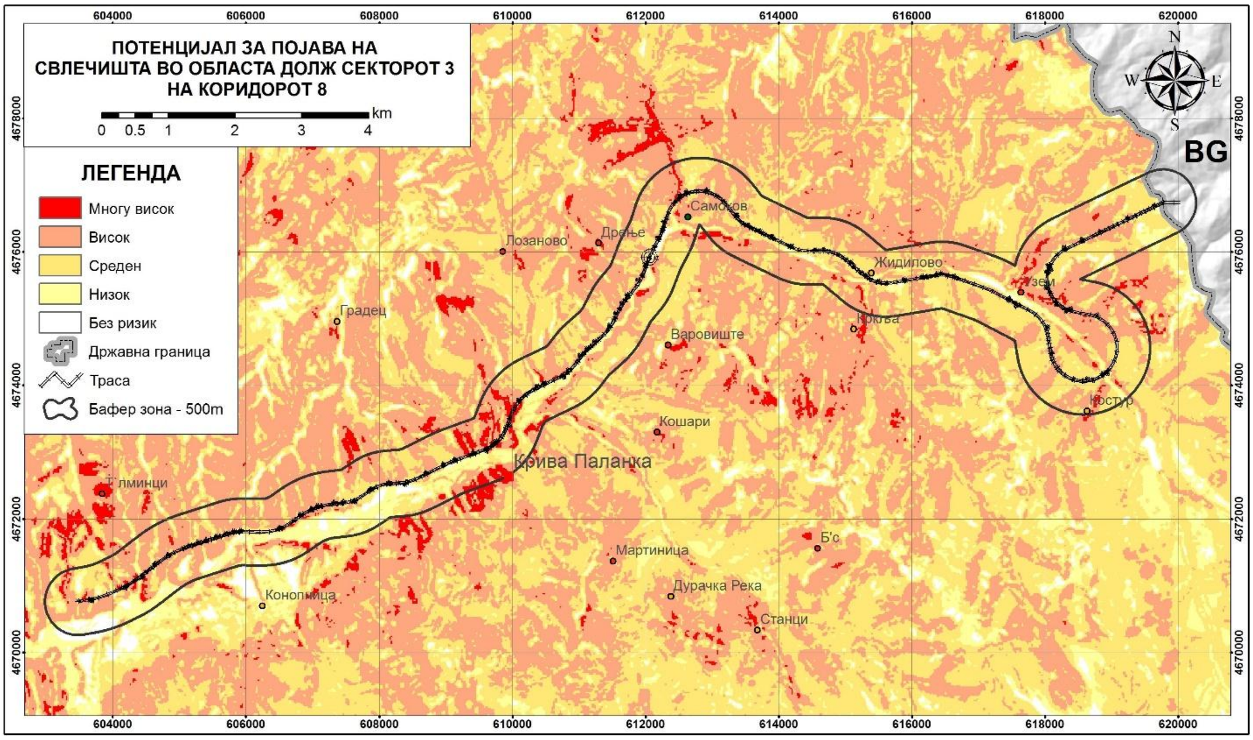


Figure 55 Potential vulnerability of landslides appearances along the corridor line

The following map shows the models for erosion vulnerability, landslides and potential floodplain surfaces (with a topographical index of depth) in the event of extreme rainfall of 100mm/day. It is clear that almost the complete corridor line, i.e. the buffer zone is exposed to the abovementioned geohazards.

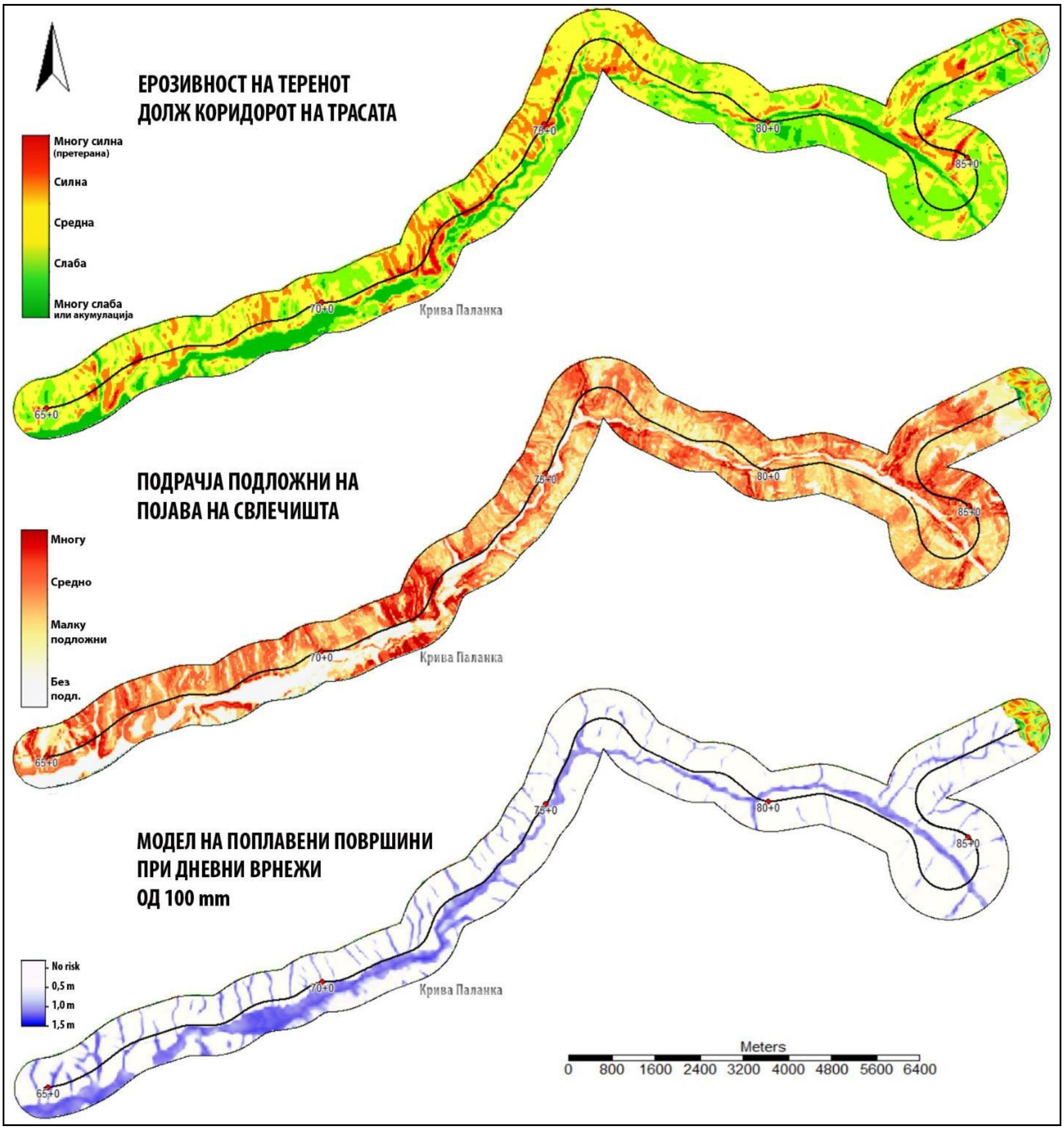


Figure 56 Models of some geo-risks along the corridor – buffer line (according to Milevski et al., 2017)

- ***Current geomorphological processes along the corridor line***

Due to the presence of weak resistant crystalline rocks in the area along the line, and due to the great inclinations of the terrain, the sunny expositions, climate characteristics, the bareness and the anthropogenic influences in the area along the line and the buffer zone of 500 m, a number of current (recent) geomorphological processes are present or could be expected. So, according to the field analysis of the Kriva Reka valley sides, where the line is set, there is existing and potential appearance of surface rock breakdown with the so-called scree, small talus cones from schist materials, numerous denudation initial or advanced processes, and appearance of rill erosion, gully erosion, and also areas prone to landslides.

Figure 57 Breakdown of chlorite and muscovite schists on the asphalt road to Deve Bair, near the line at 86+0 km

From the other side, at 10 to 80 m lower from the line, we have the inundatory (floodplain) alluvial plain and the Kriva Reka riverbed, where a large quantity of alluvial and fluvial material eroded from the barren, steep and exposed slopes. In this way, there is gradual deposition of the Kriva Reka valley bed and thus rising of the riverbed, and even its meandering. With the construction of the railroad line, where several embankments are planned, we expect the intensity of the current geomorphological processes to be increased in certain places, if appropriate preventative measures are not taken. It is good that a significant part of the line will be with tunnels and bridges, contributing to minimal surface breakdown and anthropogenic degradation of the relief. In addition, we need to mention that in most bridge constructions, the pillars and their bases will be exposed to significant erosive undermining of the material in which they will be placed. In some valley beds (Kriva Reka, Kiselicka Reka, Arbanaski Dol), the pillars and the rest of the constructions will be under threat of deposition of gravel-like and larger alluvial material, which needs to be addressed during the construction and maintenance of the railroad. This is especially important about the torrential watercourses in this area, which during excessive rain (that could reach even 120mm/day), will perform undermining, deposition and strong pressure on the bridge pillars, train stops, stations, etc.

Figure 58 Deposition of the Kriva Reka valley bed with alluvial fluvial-denudation material from side torrential watercourses

– ***Overview of the current geomorphological processes registered on the field***

In the following overview, the current registered geomorphological (and/or engineering-geological) appearances along the line and corridor have been presented, from 500m on both sides of the lane. At the beginning, from 65+0 to 66+0 km, the corridor line moves across terrain with relatively low incline (up to 10°) and with a southern exposition. From geomorphological processes, we have surface weathering, washing, and in some places weak rill erosion. The Gabarska Reka valley is at 66+0 km, where there are relatively weak-intensity fluvial processes. Between 66+0 and 66+800 km, the terrain is steeper and with increased surface and underground erosion of the chlorite schists (Sep.).

Figure 59 The terrain of the line at the inflow of the torrential watercourse Rangel in Kriva Reka (67+500)

The terrain consists of albite-epidote chlorite schists, affected by surface weathering, especially at the barren parts.

Further on, in the next 300 m, up to 67+0 km is the Gradecka Reka valley, with steep inclinations (even above 40°) and a significant accumulation of fluvial material (tuffs, Pliocene sands, and decomposed schists) along the valley floor. Evidently, a great quantity of eroded deposit is produced at the mouth of the river, especially from the paleovolcanic area of Gradecki Chuki. From 67+0 km to 68+300 km, the line moves towards the Kriva Reka valley bed, over a terrain with steep sides and surface weathering of rocks. Up to 71+0 km, the corridor line follows the foot of the valley, and the buffer zone encompasses a significant part of the Kriva Reka alluvial plain. Due to the steep change in inclination (hill-plain zone), special care should be placed during construction because the excavated, cut or deposited material could be easily transported towards the alluvial plain (hydrogeological collector and conductor). At the part through the town of Kriva Palanka, i.e. up to 74+0 km, the line and buffer zone encompass manly urban space, the Kriva Reka riverbed and the several points where the side tributaries flow into the river. The terrain has variable inclination, and as the models used show, there is an increased risk of landslide activation (several calmed landslides in the buffer zone). From 74+0 km to 79+600, the line and the buffer zone pass through quite dissected and steep relief along the valley floor. Because of the great inclination, the sunny sides and the significant bareness of the terrain, surface and underground processes of erosion appear, and the eroded material goes directly into Kriva Reka. Here, there is a significant possibility of landslide, increased rockfall, and rock breakdown of bare rocks. This is especially true about the area from 77+700 to v. Zhidilovo.

Figure 60 Schist weathering (talus cones, screes) along the corridor at v. Zhidilovo

Figure 61 Great quantity of alluvial material which from Arbanaski Dol enters the Kriva Reka valley bed (81+0 km)

At v. Zhidilovo the line moves to the Osogovo Mountains, at the left valley side of Kriva Reka. Regardless of the steep inclination, the current geomorphological processes are relatively weak, mainly as a result of the solidly wooded area. However, in the Kriva Reka valley, a large quantity of deposit from the torrential tributaries such as Arbanaski Dol at 81+0 km could be seen, where the Zhidilovo station is planned to be built.

However, from 85+0 km to the last tunnel towards the border of R. of Bulgaria, strong fluvial denudation processes appear, with extreme erosion, transport and accumulation of material, and intensive schist weathering (chlorite and muscovite Sab) in this area.

- **Geoheritage along the corridor line**

From a geomorphological viewpoint, the line moves through relatively interesting terrain. In the length of only 23, 3 km, we meet erosive widening, gorges, river terraces, denudation forms, interesting elements of structural relief, etc.

With the ongoing system of protected areas and areas planned for protection by R. of Macedonia's spatial plan, in the nearer areas along the line, no valuable geomorphological sites have been noted. In the draft version of the "National Strategy for Nature Protection (2017-2027)", several geomorphological sites have been identified and submitted for protection:

- Carev Vrv (2085 m.a.s.l.) and the peak Ruen (2252 m.a.s.l.) of the Osogovo Mountains, where periglacial and nivation processes and occurrences have been identified and
- The Kozja Reka waterfall (tributary to Duracka Reka) at v. Stanci, with around 15m height, as a hydro-geomorphological occurrence.

The three sites are distanced at least 8-9 km from the line, so no negative influence in that regard is possible (Milevski, 2011).

According to the Map of Development of the Representative Network of Protected Areas in the Republic of Macedonia (MES, 2011), the corridor line in the length of 1 km passes through the draft protected area "Kiselicka Reka Gorge" (no. 85.). This part, where the valleys of Kiselicka Reka and Kriva Reka meet, is interesting from a geomorphological aspect and worthy of protection (Milevski and others, 2012). We are talking about a 200-300m deep gorge dissecting into amphibolite rocks and metabasites (Hristov and Karajovanovic, 1969), with denudation occurrences, escarpments, but also various natural life. However, according to the technical documentation, the line from 76+0 to 77+0 km (over the gorge), will be constructed mainly through tunnels and a high bridge, thus limiting the negative impact over the geomorphological values.

Figure 62 The Kiselicka Reka valley where it flows into Kriva Reka

The Kriva Reka valley, in the upper part above Kriva Palanka, is distinguished by a gorge character at places, and it deeply cuts into schist rocks. The gorge is tectonically predisposed and Kiselicka Reka has a heavy influence over its direction. There are several smaller meanders in the gorge, cut into sediment material or created by suppression of the main watercourse from the side tributaries. Alongside this, there are several denudation forms on the side, especially where Kiselicka Reka flows into v. Zhidilovo. In this part, there are rock pillars, rock escarpments, lesser denudation forms etc.

These forms have local meaning, but on the other hand, due to the construction means of the line by tunnels and bridges, no significant destruction of the mentioned geoforms will happen. On the contrary, they will be an additional visual and tourist motive when travelling along the railroad.

Figure 63 Denudation forms in the Kriva Reka valley along the corridor line, at 78+0 km

6.2.4 Geotechnical characteristics

In order to get data for the characteristics and strength properties of the fractures and the monolithic rock, geotechnical investigations and laboratory analyzes were performed, ie SHRV test was conducted. Along the railway alignment many monolithic rock samples were taken to determine their physical-mechanical properties. This test covers rocks such as albite-epidotyte-chlorite shale (Sep), albite-quartz-muscovite shale (Sab) and quartzlate (xα).

The obtained Schmidt Hammer rebound values are presented in Annex 13.

Analysing the obtained results it may be noted that albite-epidote-chlorite schist (Sep) havem medium values of the Schmidt Hammer rebound being 20.0 – 40.5, albite-quartz-muscovite schist (Sab) have medium values of the Schmidt Hammer rebound (SHRV) being 16.0 – 40.0, whereas the quartzlatite (xα) have medium values of the Schmidt Hammer rebound being 30.0 – 48.0.

In order to obtain the data regarding the engineering-geological, hydrogeological and geotechnical properties of the ground, 72 (seventy two) investigation boreholes are drilled. Sampling for laboratory testing was done with the purpose to be determined the physicalmechanical properties of the present lithological units along the area of the new railway alignment. Also in the investigation boreholes Standard Penetration Test (SPT) has been performed, in order to define the relative resistance of the ground in aspect of density orconsistency of the present materials.

After the boreholes were drilled and the permeability tests were performed, in most of the boreholes where groundwater table was encountered, piezometers were installed and protected with concrete blocks and covers on the ground surface, in order to monitor the groundwater.

From the monitoring of the groundwater level in the boreholes, it can be seen that the groundwater. level changes depending on the hydrological period, from several cm to several m (see Annex 8).

Beside the foreseen investigative boreholes, investigation boreholes were performed in order to make a macroscopic identification of the materials encountered in depth, to define their stretching, to define the required number of samples for laboratory tests and to determine all aspects that will be needed to define the terrain as well as the re-use of the excavated material.

The basic information for the depth of the boreholes, are given in Annex 8.

In order to evaluate the possible aggressiveness of soils and water, chemical analysis have been carried out. The rocks analyzed the presence of $CaSO_4$, $CaCO_3$ and Cl, while the presence of SO_4, pH, CO_2, NH_4 and Mg was analyzed in water. The results have been analysed according EHE standard and given in the Geotechnical Report (25.10.2011). Of the available analyzes, only the sample corresponding to alluvial soil of borehole BV-74 + 272 presents a medium aggressiveness. The other soil samples analyzed are not aggressive.

For the study of the aggressiveness of water, a sampling of water was carried out in certain boreholes and analysis were carried out. The results of these analysis are also given in the Geotechnical Report (25.10.2011). According to available analysis the water is not aggressive.

Table 23 Chemical analysis of groundwater

Borehole	**Groundwater table (m)**	**Water analysis**						**Classification of aggressiveness**
		pH	**Mg2+ (mg/l)**	**NH_4+ (mg/l)**	**SO_4 (mg/l)**	**CO_2 (mg/l)**	**Dry residue (mineral content, mg/l)**	
BV-65+952	0,9	7,78	10,19	0,5	31	-	-	Not aggressive
BT-72+562	20,9	7,88	2,01	2	3	-	-	Not aggressive
BV-76+517	1,7	7,43	13,77	3,7	20	-	-	Not aggressive
BV-79+877	1,8	7,15	6,76	1,1	28	-	-	Not aggressive
BV-84+152	10	7,05	7,14	1,1	58	-	-	Not aggressive
BT-84+842	48,6	6,78	71,26	2,7	19	-	-	Not aggressive
BV-87+372	27,7	7,01	20,96	1	40	-	-	Not aggressive
BT-87+712	124,8	*1,1*	16,11	2,9	59	-	-	Not aggressive

Aggressiveness parameters	>6,5	<300	<15	<200	<15	>150	Not aggressive
	5,5 - 6,5	300-1000	15-30	200-600	15-40	150 - 75	Low aggressive
	4,5 - 5,5	1000-3000	30-60	600-3000	40-100	50-75	Moderately aggressive
	<4,5	>3000	>60	>3000	> 100	<50	Highly aggressive

6.2.5 Hydrogeological characteristics

The wider area of the terrain is built of the following lithological units: alluvial and terrace sediments, delluvial and proluvial deposits, Pliocene sediments, volcanic rocks (tuff, quartzlatite, andesite and dacite) and volcanoclastic rocks, granite, breccia and conglomerate, quartz-graphite schist, amphibolite schist and metabasite, quartzite, albite-epidote-chloriteschist, albite-epidote-muscovite schist and gneiss.

The project area is mainly built of Precambrian metamorphic rocks, sedimentary-igneous series which are metamorphosed under conditions of greenschist facies.

Regarding their hydrogeological characteristics and function, the above mentioned units can be classified as following:

- Quaternary unbounded delluvial and eluvial sediments (d) and Pliocene deposits (Pl), mainly built of sandy silts, mainly with hydrogeological function of transmitters to isolators, rarely collectors;
- Quaternary unbounded alluvial and terrace sediments (al), proluvial deposits (pr) and Pliocene sediments (Pl) (silty sands and gravels) with occurrence of inter-granular porosity, in which porous type of aquifer is formed with free groundwater level, rarely sub-arterial level, with hydrogeological function of collector and in certain cases hydrogeological transmitters;
- Effusive and pyroclastic rocks: tuff, quartzlatite, dacite and andesite (xα),with rare fissure porosity, at some parts inter-granular, where in the tectonically prone zone to fracturing systems, fracturing or porous type of aquifer may be formed with free groundwater level, with hydrogeological function of transmitters (above GWL) and collectors;
- Conditionally waterless, mainly impermeable rocks: quartz-graphite schist (Sgr), amphibole schist and metabasite (Sam), quartzite (Q), albite-epidote-chlorite schist (Sep), albite-quartzmuscovite schist (Sab), granite (G) and gneiss (GN), with local occurrence of fracturing porosity, with hydrogeological function of isolators, and rarely in the tectonically prone zones to fracturing may have hydrogeological function of collectors;
- Altered clastic rocks, volcanoclastic rocks (2E3) and breccias and conglomerates (1E3), mainly impermeable and waterless with local but very rare occurrence of fracturing porosity, which mainly have function of hydrogeological isolators, rarely they can have a function of collectors.

From hydrogeological aspect, the whole area of the alignment belongs to the watershedof river Kriva Reka’s basin which presents main watercourse with its tributaries with constant or temporal flow as Tl’minska Reka, Kiselichka Reka, Gradechki Dol, Treshten Dol and other smaller rivers. Much of the river flows are from temporal torrent character, and they dry out during the summer period.

In frame of the investigated terrain several springs were mapped:

- Spring zone at chainage km 70+730, where diffusive flow-out of the groundwater on the surface of 60x10 m was registered.
- A few smaller springs from contact-over spills or gravitational type were registered, at chainage km.69+760 and km.71+120, mainly with yield of Q<0.1l/s, present at the contact between more water-permeable quaternary sediments and the surrounding less water-permeable rocks (schist).
- In albite-epidote-chlorite schist (Sep), two springs were registered, both primitively capped: the one at the geomechanical station M-57 has a yield of Q=0.023l/s, and the other one near the geomechanical station M-71has a yield of Q<0.01l/s.

The Border Tunnel 22 is mainly built of volcanic rocks. Furthermore, colluvium deposits were found at the tunnel entrance.

Considering the geological properties of the investigated terrain along the Tunnel 22, the geotechnical units, regarding their hydrogeological characteristics and function, can be classified as following:

- Diluvial, coluvial and proluvial soils, mainly composed of sandy silt with small angular fragments of quartz and schists, with hydrogeological function of isolators;

- Conditionally waterless, mainly impermeable rocks: volvanic rocks, with local occurrence of fracturing porosity, with hydrogeological function of isolators, and rarely in the tectonically predisposed zones may have hydrogeological function of collectors.

For the purpose of determining the groundwater table at the alignment of Border tunnel 22, several boreholes were drilled; in most of the boreholes where groundwater table was encountered, piezometers were installed, flushed and cleaned, and protected with concrete blocks and covers on the ground surface, in order to monitor the groundwater table. The groundwater level is being registered in the boreholes in different periods during the investigations and it is shown in the following table below:

Table 24 Monitoring the groundwater table in the investigated boreholes at Border Tunnel 22

Borehole		Piezometers	Date / GWT (m)									
Chainage	Depth (m)		16/06/2016	23/06/2016	24/06/2016	29/06/2016	14/07/2016	21/10/2016	28/10/2016	12/04/2017	26/04/2017	11/05/2017
87+372	35	5-					27,70					/
87+712	135,9	3-		97,80	98,00	99,80	124,80				damaged	/
88+322	220	212,30	75,60			75,60		colapsed				/
89+088	50	0-							9,00	6,75		/

For the study of the aggressiveness of the water, three samples of water were collected in Tunnel 22 as shown in Table below. The results of these analyses are included in the Geotechnical Report. According to available analysis, the water is not aggressive.

Table 25 Chemical analysis of groundwater in the area of Border Tunnel 22

Borehole	Groundwater table (m)	Water						Classification of aggressiveness
		pH	Magnesium Mg^{2+} (mg/l)	Ammonium NH_4^+ (mg/l)	Sulphate SO_4 (mg/l)	CO_2 (mg/l)	Dry residue (mineral content, mg/l)	
BV-87+372	27,7	7,01	20,96	1,04	40	/	/	Not aggressive
BT-87+712	124,8	7,7	16,11	2,94	59	/	/	Not aggressive
BT-89+088	9,0	7,29	5,28	1,47	37	/	/	Not aggressive

- **Permeability testing**

Permeability tests are made into the boreholes to determine the permeability coefficient (K). Two methods are used, each specific for a given ground type: Lefranc in soils and Lugeon in rock.

The Lefranc test is performed in quaternary alluvial, proluvial and diluvial sediments. Along the alignment of the railway alignment, total of 9 tests are performed and the results of these tests are shown in Annex 8.

The permeability of the rock masses was carried out using the Lugeon method (see Annex 8). On the investigated terrain along the railway alignment, total of 28 tests are performed in 14 investigation boreholes, each in specific geological medium. The tests are mainly performed at designed tunnels.

All the rocky geotechnical units have a permeability between 10^{-6}-10^{-7} m/s (very low permeability).

- **Border Tunnel 22**

For the border tunnel 22, coefficient of filtration is done for soil materials encountered along the alignment. The Lefranc method was used, that represents a process of water pouring in investigatory boreholes. In boreholes performed in solid rock masses, the permeability is tested according to the Lugeon method.

In the following tables the average permeability of soil units found at tunnel 22 and average permeability of rock units are presented:

Table 26 Average permeability of soil units found at Tunnel 22

Geotechnical unit	K (m/s)	Permeability classification (Terzaghi, Peck, 1967)
d(V)	3,86E-08	Very low
3E1	1,02E-07	Very low

Table 27 Average permeability of rock units found at Tunnel 22

		Geotechnical units	
		2E3	**xα**
K (m/s)	maximum	3,01E-06	1,98E-06
	medium	**2,42E-06**	**1,98E-06**
	minimum	1,82E-06	1,98E-06

The permeability of the fault zones (F) can be conservatively considered as the permeability of the unit “d (V)” (debris and completely weathered rock).

6.2.6 Tectonics

The area of the railway line under study Section 3 –Kriva Palanka-Border with R. Of Bulgaria belongs to the geotectonic unit of the Serbian - Macedonian massif as part of the Macedonian pre-Cenozoic basement.

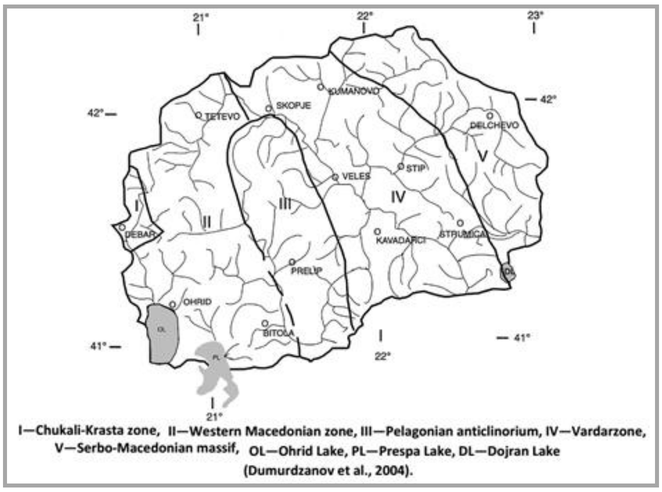


Figure 64 Major tectonic units in R. Macedonia

The Serbo-Macedonian massif consists of Riphean/Cambrian mafic plutonic and volcanic rocks and early Paleozoic schist and phylliteall intruded by large bodies of Paleozoic granite.

The structures in the pre-Cenozoic basement rocks are dominated by NW-trending foliation, folds and faults that form an important crustal anisotropy that controlled many of the basin bounding faults in Cenozoic time (Dumurdzanov et al., 2005).

The Alpine orogenesis is represented by disjunctive tectonics, which has led to the formation of many rifts filled with volcanic rocks and various other pyroclastics.

Kriva Palanka Cenozoic basin contains faults on only one side and is tilted as NW-trending half graben. These narrow basins contain red, brown, and yellow sandstone; mudstone; and sometimes very thick sections of conglomerate deposited in non marine fluvial and lacustrine environments. Locally these basins contain large masses of brecciated to semicoherent blocks of pre-Cenozoic rocks.

Kriva Palanka basin lies within a belt of contemporaneous arc magmatic rocks and their origin is probably related to within 1) arc extension perhaps due to rollback at the trench or 2) gravitationally induced spreading within the magmatic arc, or both.

Foliation

According to the geomechanical analysis, two main foliation were defined: “S1” or main foliation and “S2” or secondary cleavage foliation which fold the “S1”. The main anisotropy (S1) in the pre-Cenozoic basement is NW-trending foliation with important folds.

Faults (F)

The faults in the pre-Cenozoic basement rocks are dominated by NW-SE and NE-SW trend, with subvertical bedding (dip). The main fault in the wider area of the alignment is the Kriva River, running with NE-SW direction. In a preliminary stage, faults were analysed with stereoscopic pictures and google earth images.

Mineralogical analysis with X-Ray Diffraction were carried out in clayed fault areas. The sample tested at BT-66+345 (17-17,3 m) contains following clay minerals: nontrite, montmorillonite and kaolinite. In accordance with the geotechnical survey, along the alignment of the line from Section 3, the following main faults have been recorded:

- Bridge 3 (Chainage 65+970),
- Bridge 5 (Chainage 66+800): faults were recognized according to the borehole BV- 66+817 and the electrical tomography TE-66+832,
- Bridge 6 (Chainage 67+100): fault was recognized according to the borehole BV-67+097 and the electrical tomography TE-67+097,
- Bridge 23 (Chainage 72+850): fault area recognized in TE-72+892,
- Bridge 28 (Chainage 74+260): fault area recognized in TE-74+317,
- Bridge 29 (Chainage 74+825): fault was recognized according to the borehole BV- 74+825 and the electrical tomography TE-74+797,
- Bridge 30 (Chainage 75+400): faults were recognized according to the borehole BV-75+402 and the electrical tomography TE-75+352.
- Chainage 79+100: fault area was recognized in the Tunnel 16 portal area, according to the electrical tomography TE-79+082 and also with the stereoscopic pictures. Bridge 37 (Chainage 79+900): fault area along Kriva River.
- Bridge 42 (Chainage 82+100): fault area was recognized in the borehole BV-82+092 and geophysical profile. Clayey soils are expected according to BV-82+092.
- Tunnel 19 (Chainage 82+520 to 83+300). Subvertical fault areas were recognized according to the stereoscopic pictures and the geophysical survey in following chainages: 82+540, 82+700, 83+300, 83+600 and 84+000.
- Bridge 43 and 44 (Chainage 84+070 to 84+277): фault area recognized with TE-84+242.
- Tunnel 20: fault area was found in boreholes BT-84+842 and BT-85+182. According to the geotechnical profile the fault area crossing the tunnel alignment approximately from Ch. 85+200 to Ch. 85+300. Subvertical fault areas were recognized according to the stereoscopic pictures and the geophysical survey in following chainages: 84+300 and 84+700.

- Tunnel 22 (Deve Bair): Fault area was recognized in the portal area, at Ch. 87+240. Anothern faults were recognized along the tunnel alignment: Ch. 87+370, 87+700, 87+900 and 88+160.

6.2.7 Seismology of the territory of Kriva Palanka

The seismicity of Macedonia is related to recent tectonic processes associated primarily with vertical movement of tectonic blocks. Two regions of specific neotectonic features are well distinguished: West Macedonia, characterized by longitudinal (NE-SE), and Central and East Macedonia with transverse (E-W) stretching of principal tectonic morphostructures.

The municipality of Kriva Palanka is located near the Skopje seismogene zone. This zone is seismic most eminent and very dangerous for the Balkans. All the epicentral areas of this zone (like Skopje) are well known for catastrophic earthquakes and they have constant impacts and effects on the stratum in the area of Kriva Palanka. From earthquakes so far, the maximum observed intensity, caused by the local epicenter hotspots, has a magnitude of 5° MCS scale, respectively, the maximum level of earthquakes so far, caused by the distant epicenter hotspots is 8° according to MCS scale. For the Municipality of Kriva Palanka and the near surroundings, It is calculated and obtained the longest and maximum extentpoint of expected earthquakes. This extenpoint is 8° on the MCS scale.

On the following figure is presented The Republic of Macedonia seismotectonic map, which shows the regional faults and zones of maxsimal intensity. The black ellipse shows the location of the project area. Faults with evidence of recent activities are displayed with a blue line. Faults recorded from recent activities are marked by a blue line.

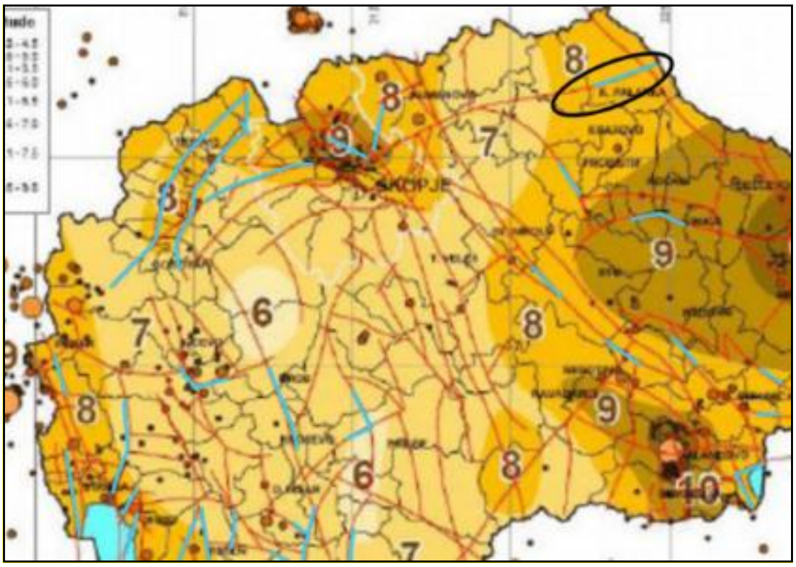


Figure 65 Seismotectonic and seismic intensity of Macedonia (regional faults with red line, faults of recent activities with blue color, researched area with black color, Dumurdzanov

- **Project area**

The project area belongs to seismic zone with maximum intensity of earthquake of VIII, which is important factor for a seismic design of structures. Earthquakes occurred in 1900-2016 period, with magnitude higher than 2.5 (MCS scale), into a radius of 100km of the middle point of the alignment.

In the surroundings of the alignment (in a radius of about 35 km) earthquakes are very rare, and the existing ones are of low magnitude (2.5-3.5).

In order to define the seismic-geological structures and the structural-tectonic structure of the ground along the alignment of the railway line, geophysical investigations were carried out.

The result from the measurements performed by use of seismic refraction and MASW are the seismo-geological characteristics of the site, with mapping of the variation of the seismic wave velocity laterally and along depth (20-50 metres). Depending on the variation of seismic wave velocities, the obtained 2D seismic models distinguish the following media:

- Surface layer – quaternary deposit (al, pr, d) or crushed bedrock material that is characterized by seismic velocities in range of: Vp=350-800 m/s; Vs=140-330 m/s;
- Subsurface “weathered” zone (albite quartzite muscovite or albite epidote chloriteshales) of very loose and crushed rock: Vp=800-1500 m/s; Vs=330–650 m/s;
- Intensively to moderately cracked rocks (albite quartzite muscovite or albite epidote chlorite shales)–with seismic velocities: Vp=1500-2000 m/s; Vs=650 - 870 m/s;
- Moderately cracked, loosened rocks (albite quartzite muscovite or albite epidotechlorite shales)–with seismic velocities: Vp=2000 –3000m/s; Vs=870 – 1360 m/s.
- Local/Regionally loosened, more compact rocks (albite quartzite muscovite or albiteepidote chlorite shales), with seismic velocities: Vp>3000-4000 m/s; Vs>1360-1880 m/s;
- Compact rocks (albite quartzite muscovite or albite epidote chlorite shales), with seismicvelocities: Vp>4000 m/s; Vs>1880 m/s.

Layers with lower velocities trapped between layers of higher velocities have been detected at some 2D Vs models obtained from these investigations.

On the seismic model PM-66+012, at depth of 4-6 metres, there is a layer where the shear velocity drops from Vs≈150- 200m/s in the surface layer to Vs≈50m/s and then there follows again an increase of Vs.

In addition to vertical variations of velocities, there are also lateral variations of velocities, i.e., at depth of 10-16 metres, at a distance of 0-25 metres, the shear wave velocity is Vs≈300-500 m/s, while at a distance of 25-60 metres, the velocity ranges within an interval of Vs≈600-900 m/s.

Based on geotechnical in-situ investigation the terrain of this location is composed of alluvial terraced sediments down to depth of 10 metres, while over 10 metres, there are layers of albite epidote chlorite shales that represent the base of the terrain.

Also, in model MASW PM-71+702, where the terrain of the investigated site is composed of disintegrated shales in the surface layers whose characteristics are improved with the increase of depth. At depth of 20-40 meters it can be noticed a zone of quite loose shales, i.e., a discontinuity.

Model MASW PM-76+532, also points to quite big variations of thickness of the quaternary deposit.

Results from MASW investigations shows variations of the topography of the bedrock, i.e., the thickness of the quaternary deposits as well as the characteristics of the shales that compose the terrain, i.e., there are quite a lot of discontinuities in the seismo-geological structure of the terrain.

6.2.8 Soils

The pedogenesis (development, evolution, formation and genesis of soil) is a process of soil formation, regulated by the effects of the place of the process, the environment and history. The soil formation happens in time under the influence of climate, vegetation, topography and the parent substrate.

The basic moving force for the occurrence of certain soil degradation processes in mountainous and slope terrains in the wider area, i.e. Kriva Palanka Municipality, are human activities, firstly the intensive and unplanned falling of trees, then forest fires or overgrazing of natural pastures and meadows.

The forms of degradation, characteristic for the soils of Kriva Palanka Municipality are: decreasing the organic matter content, of which we have little data, but taking the intensive degradation of the forest cover into consideration, due to various reasons, we may surely expect an organic matter content decrement trend in the soil. Also, the intensive grazing by larger and smaller cattle, leads to degradation of the natural pastures, not allowing regeneration. This practice leads to decrement of organic matter content in the soil as well as compaction of the soil due to intensive passage (mechanical action).

Compaction is another serious form of soil degradation, which together with the decrement of organic matter content in the surface layer, helps worsen the hydro-physical properties of the surface layer, thus decreasing its stability, filtration ability and rain water infiltration, and allowing for intensive erosion processes.

These kinds of processes are present in many sites in Kriva Palanka Municipality, especially in the r higher inclinations relief forms at the Osogovo Mountains.

The main natural factors influencing erosion are: climate factors, geological base and soil properties, vegetation cover, the incline and the slope length, described in detail in the specific chapters of this study. Different human activities have direct influence over the vegetation cover, the incline and the slope length.

Taking into consideration the height distribution of the Kriva Palanka Municipality area, we have 5 soil-climate-vegetation zones starting from the warm continental area, all the way to the subalpine area in the higher zones of the Osogovo Mountains. The railroad line for the most part passes through the lowest warm continental area, whereas near the end of the line, after passing to the left bank of Kriva Reka and all the way to the border of R. of Bulgaria, it enters the cold continental area.

Figure 66 Soil climate vegetation zones

In the zone of the warm continental area, the dominant plant community is *Quercetum-frainetto cerris macedonnicum Oberd.emend.Ht,* but due to the proximity of the settelements, it is degraded to the point where it does not provide a good protection from erosive processes.

6.2.8.1 Soil condition in the wider region

6.2.8.1.1 Description of the soil cover in the wider region

The soil cover in Kriva Palanka Municipality is the result of the relief characteristics, the geological base and the climate-vegetation conditions. The area is dominated by soils formed in mountainous terrains, rolling-hilly terrains and lake terraces. They are represented in the following chart.

Table 28 Presence of separate soil types and complexes in Kriva Palanka Municipality

Soil type	Area (ha)
Settlement	239,11
Cinnamon forest soil and Luvisol	86,44

Ranker	10797,74
Brown forest soil	19967,96
Fluvisol soil	347,2
Colluvial soil	281,33
Ranker and Regosol	14,78
Leptosol	304,48
Brown forest soil, Leptosol and Regosol	6034,17
Cinnamon forest soil and Regosol	1674,81
Brown forest soil and Leptosol	1895,75
Brown forest soil and Regosol	6394,66

In the Kriva Palanka Municipality area, the most present soil type are the brown forest soils, as separate cartographical units or in a complex with regosol, then the complex ranker-regosol-litosol, then ranker, and in smaller locations in the lowest parts, vertisol and fluvisol. According to texture, apart from the fluvisol, all the rest of the soils are part of the sand-silt soils.

In the higher regions, bellow the forest vegetation, the brown forest soils dominate or their complex with regosol, formed at steeper terrains with degraded vegetation. In the high mountainous terrains bellow the grass vegetation, in conditions of accumulation of greater quantity of organic matter, significant areas under ranker have been formed. The soils in the mountain areas of the region are formed over silicate base made up from metamorphic rocks groups such as: schists (mostly mica and chlorite schists where phyllosilicates dominate such as feldspar, biotite, chlorite etc.), gneiss where quartz and feldspar dominate, amphibolites (amphibolite schists) and quartzite, whereas in the northern part of the area, a conglomerate belt is present.

Considering the specifics of the relief and geology, the soils over the mountain and rolling-hilly forms of the Osogovo Mountains descending towards Kriva Reka, due to the easy physical degradation of the parent substrate, they have different depth of solum and different hydro-phsicial properties, which on the other hand has influence over the different hydro-physical properties of these soils and their resistance to degradation. These soils, dominated by brown forest soils (ranker, leptosol and their complexes), are most often subject to increased organic matter decrement, due to degradation or total destruction of the soil cover, and thus, the soil loses its hydro-physical properties (infiltration, filtration, etc.) which leads to increased erosion and retrograde processes of surface soil layer loss, and in some cases even the complete solum. Because of this, the brown forest soils and rankers, in the wider area, are oftentimes separated in a complex with regosol where the pedogenesis processes are in an initial phase. This is especially expressed in the steep terrains along the mountain slopes and higher areas.

Along the flow of Kriva Reka (the narrower extent of the line), over recent alluvial and colluvial deposits, soils characteristic for slope and plain relief forms (alluvial and colluvial forms) are being formed.

On the other side, the slope-form soils, descending towards Kriva Reka, as well as the plain soils formed on the alluvial terraces along the flow of Kriva Reka, take up noticeably less area compared to the mountainous and soils of rolling-hilly forms.

In the slope relief forms, at several sites near Kriva Reka, small areas under deluvial and in the lowest river terraces alluvial soils (fluvisol) have been separated. In the flattened slope forms, separated are the cinnamon forest soils, as the next stadium in the development of the colluvial deposits, whereas in the flattened forms, at the greater height of the Osogovo Mountains in several sites, the presence of complex cinnamon forest soils and luvisols has been detected.

The alluvial soils along the flow of Kriva Reka, and the colluvial soils in the less steep inclinations, are under intensive agricultural production.

The following picture shows the soil map of the project area.

Figure 67 Soil map of Kriva Palanka Municipality

6.2.8.1.2 Soil quality in the wider region

From the data presented in Table 28, it is evident that the brown forest soils, as well as the rankers and their complexes, dominate the mountain zone. From the studies so far and the data available about the quality, genesis, evolution and the production properties of the soils in the Kriva Palanka region, we can determine the following:

Brown forest soils

- **Spread and formation conditions**

These are soils which are mostly spread in the mountainous terrains and appear either as a pure cartographic unit or in a complex with some of the following soils: leptosols, regosols, luvisols, rankers and cinnamon forest soils. In the area, they are spread over number of sites in the mountainous range of all valleys. They appear in terrains with different exposition and inclination, if the forest is not destroyed. Most parts of these soils are formed over compact acidic silicate rocks or their regolith (granite, gneiss, mica, slates and different schists such as muscovite, biotite, sericite etc.).

Smaller part of them are formed over compact base and transition rock (diabase, gabbro diabase, amphibolite, andesite, dacite, and various schists with base character). Quite rarely do they appear over non-carbonated tertiary sediments.

In the past, the terrains under brown forest soils were only under forest vegetation which is today partially degraded or destroyed. They acquire the most typical properties under subalpine and alpine beech forests.

The forests in the beech region are under anthropogenic influence, resulting in their destruction and strong erosion (appearance of leptosols and regosols).

- **Mechanical composition, hydro-physical and chemical properties of the brown forest soils**

These soils contain enough skeleton which in horizontal A^3 is on average 18,51%, whereas in (B)v skeleton content average is 21,47%. The second characteristic of the mechanical composition is the small quantity of clay (average in horizon A 8,20%, and in (B)v 10,03%). The horizon (B)v is not significantly different in clay composition from the horizon A. With the altitude increase, the clay composition drops. These soils do not possess noticeable differentiation in texture. The third characteristic of the mechanical composition is its heterogeneity because it depends on the substrate.

In regards to the hydro-physical properties of these soils we should point that in regards to the aggregate composition (during the dry sowing in the both subtypes) the larger aggregates are predominant. By decreasing the aggregate dimensions, the representation percentage is decreased too. There is proximately equal percentage of a grainy structure aggregate (1-3 mm), i.e. around 25-30%.

Brown soils have good hydro-physical properties, good aeration due to the high porousness and stable small granular structure. If the natural cover is destroyed, the brown forest soils erode quickly, especially on steep terrains.

The chemical properties are heterogonous, because these soils appear over parent rocks and in a highly broad altitude belt with different climate-vegetation conditions. The average humus composition in these soils is in horizontal A 7,62%, and in (B)v 2,91%. As with the other forest soils, the humus composition in horizontal (B)v decreases rapidly. For instance, in hor. A there are 2,6 times more humus than in hor. (B)v.

The average values for pH in water are: in hor. A 5,51, in hor. (b)v 5,48. The humus dystric soils are the most acidic, in A 5,08, and in (V)V 5,15). The dystric subtypes belong to the classes of extremely acidic, very acidic, acidic and moderately acidic soils, whereas the eutric subtypes belong to the classes of moderately acidic, weak acidic and neutral soils.

- **Production properties**

The brown forest soils are spread in the mountainous relief part and most of them are under the forest vegetation. The main wood mass is produced and exploited (beech, oak, and pine) from the forests in the area. Small part of these soils are under pastures and even a smaller part is cultivated. With cultivation, the productive ability is decreased very strongly, because the hummus mineralizes fast. Also, the nutrient composition is worsened, as well as the structure and the physical properties. Potato, rye, oat is mostly planted in the cultivated areas.

Rankers

- **Spread and formation conditions**

Rankers are typical mountain soils. They appear in all climate-vegetation zones. They are dominant in alpine but less in the subalpine region, where they only appear as a climax stadium (zonal soils). They are widespread in this area. They could be found in the mountain ranges around all valleys. That means they could be found in all mountains in the project area. They have the most typical form over flattened surfaces with decreased erosion, in rounded and flattened crests characteristic for the area. A small part of them could be found in the uneven hill terrain of the valleys.

The rankers are relatively young soils, with no deep changes in the mineral composition. Therefore, the native rocks have great importance over their properties. The vegetation, along with the climate, substrate and other pedogenetic factors, play an important role in the genesis of these soils. Most of the ranker soil are below the mountain (above 1600 m.a.s.l.) and hill pastures (bellow 1600 m.a.s.l.). They gain the most typical properties below the mountain pastures (1600-2000 m.a.s.l.), as well as in the higher terrains (2000-2200 m.a.s.l.). The grass vegetation plays an important role in the formation of the humus horizon, i.e. in the accumulation of humus and biogenic elements, as well as in the creation of the granular and straight structure which protects the soil from erosion. The grass formations above the forest zone have climactic-zonal character.

In such conditions, several processes characterizing the genesis of rankers appear:

- Strong accumulation of humus and slow decomposition of organic waste,
- Weak chemical decomposition due to low temperatures,
- Stronger physical decomposition due of extreme temperatures, frosting and defrosting,
- Strong dealkalization and acidification.

- **Mechanical composition, hydro-physical and chemical properties of rankers**

The mechanical composition of this type of soil is influenced by their relative youth and their formation over compact rocks, in conditions of weak chemical and stronger physical decomposition. Because these soil are not hydrated, no interest has been shown in studying their physical properties. From the aggregate composition data and the aggregate stability gained from dry sowing, we can conclude that the aggregate composition is mostly determined by the humus composition. The greater the humus percentage, the less percentage of larger aggregates, especially those above 5 mm.

The rankers are soils with a high organic matter content, a low clay content which influence the weakly expressed “powder-like” structure (dominated by aggregates lesser than 5 mm), but are with good stability of the structural aggregates. Generally speaking, despite the high porousness and stability of the structural aggregates, due to the weak structure and shallowness of the solum, these soils do not possess good hydro-physical properties. Because of that, we need to be careful in the preservation of their natural cover (meadows and pastures) because by disturbing that, we will face quick and intensive erosion processes, which could lead to fully losing the fertile soil layer in a very short time span.

The chemical properties data shows heterogeneity. They depend on the substrate, because the substrate does not change significantly during the formation of these soils. Notable is in what kind of climate-vegetation zones these soils appear, because the hydrothermal soil conditions are different in the different zones. Therefore, the intensity of separate processes (accumulation of humus and its mineralization, chemical decay, dealkalization, acidification) is different. That creates heterogeneity in the chemical properties.

The average values for soil reaction (pH) for the whole soil type are 5,60.

- **Production properties**

These properties depend greatly from: solum depth to the compact rock, the physical, chemical and biological properties, relief and native rocks, the content of nutrient macro and micro elements, the erosion degree and manmade changes.

Due to the great quantity of humus, the ranker are rich in total nitrogen, but due to the weak mineralization of the organic matter, the content of mineral nitrogen accessible is low. These soils are characterized by a low content of easily accessible phosphorus.

Small part of the rankers is arable and turned into farmlands, but most of them are now abandoned. Potato was successfully harvested from those farms, with great quality yield. Alongside this, high quality seed material from potatoes, rye and oat was produced there, and at lower elevation different fruit cultures.

Regosols

Despite that in the soil map in the region, this soil type is not divided as a separated cartographic unit, however, it covers great areas in a complex with other soil types. Despite of this, a good portion of the line passes through surfaces of this soil type, therefore a more detailed elaboration of the soil properties of the Region is needed.

- **Spread and formation conditions**

The spread over these terrains depends on the level of destruction and degradation of the natural vegetation. That is why they are mostly found in the oaken zone and less in the beech zone and the pasture zones. In the valleys, they appear in complexes, together with the soils from whose erosion they were created: with vertisols, rendzinas, cinnamon forest soils and luvisols. In the places with highest erosion, they appear together with leptosols. Those are weakly developed or undeveloped soils, deeper than 25 cm, over loose substrate and substrates which could very easy physically decay in loose mass. Such substrate for the mountain regosols in the area is the residual regolith from the compact, but easily physically decaying acidic, transition and basic rocks, as well as from the impure carbonate rocks (carbonate schists etc.). In the uneven-hill terrains of the valleys, there are many hill regosols. They are formed after the erosion of the soils over clastic sediments, spread around the area. Several processes take place in the area with regosols. Previously, it was mentioned that they are formed by soil erosion. The erosion process continues in the regosols, if not protected by vegetation. With tillage (deep plowing of soil) humans significantly change regosols, by deeply mixing the soil.

- **Mechanical composition, hydro-physical and chemical properties of regosols**

The mechanical composition of the regosols depends on the substrate. Because these soils appear in all substrates, they are characterized by the most heterogeneous mechanical composition.

The dominant fraction is the tiny sand (0.02-0,25 mm) which varies from 34-49%, clay varies from 5-39% (particles under 0,002 mm), whereas the skeleton content (particles above 2 mm) is usually under 10%.

The hydro-physical properties depend on the mechanical and mineral petrographic composition of the substrate, especially in the clay content and its mineral composition, because there is little humus. The chemical properties are very heterogeneous, because they depend from the heterogeneous substrate, from which these soils are made. The $CaCO_3$ content plays an important role, as well as the mineral-petrographic content of the whole substrate, especially the clay. The average clay content is low. The mountain regosols (especially dystrict) are more acidic, because they have been formed over residuum of acidic rocks and appear in mountainous terrain with wetter and colder climate, with stronger washing and acidification. The state in the carbonate regosols is different: in them, the average pH value is 7,80.

- **Production properties**

These soils have lower production properties, in comparison to all the soils over the uneven-hill and mountain terrains. Erosion, drought, low quantity organic matter, instability of macro aggregates and absence of nutritional materials change the properties of these soils. The P_2O_5 presence is weak. Contrary to this, the presence of K_2O is medium and good. Part of the mountain regosols are under degraded forests and pastures and need to be reforested. With the immigration of people from the mountainous villages, juniper, spread over the regosols, as well as pine, used for reforestation. The regosols over tertiary segments in the valleys are more intensively used. Most of them are farmlands used for grain crops, and where there are conditions for irrigation even field crops (corn, sunflower, tobacco, etc.)

Alluvial soils

The greatest part of the agriculture produce in the Region is done over alluvial soils, which are spread in the lowest areas of the studied area along the flow of Kriva and Kiselicka Reka. These soils have a great economic value to the population, therefore a detailed description of their properties is needed.

- **Spread and formation conditions**

The alluvial soils are the most widely spread soil type in the plains of the area. They appear near Kriva Reka, Kiselicka and some other smaller watercourses. Their area is small, narrowed by the braches of neighboring mountains and tertiary sediments. In the Kriva Palanka valley, they are spread along Kriva Reka. The alluvial soils are current river or lake deposits with layers. The soil formation processes are weakly developed due to the youth of the deposits or because sedimentation surpasses pedogenesis.

- **Mechanical composition, hydro-physical and chemical properties of alluvial soils**

The properties of alluvial soils in the studied area, for the most part depend from the mechanical and mineral-petrographic content brought and deposited by rivers and human influence.

Alluvial soils spread over river valleys somewhere in a wider, somewhere in a narrower belt. They are fertile soils, created during floods when the river spilled out from their riverbeds and deposited soil material or regolith from the lake sediments.

They could contain more or less skeleton with rounded edges. Usually the dominant fraction is the small sand, but they could be sand, silt, and even silt clay by mechanical composition with a strongly expressed layer and good classification, unlike colluvial soils. They border delluvail souls, even lake sediments or soil formed over lake sediments. From the available data about the mechanical composition of the alluvial soils in the area, we can conclude that the small sand is dominating. More clay is to be found in those profiles which have been deposited in calmer waters and which contain more soil material or regolite from tertiary sediments.

Alluvial soils are porous, good water-permeable, water-retentive and aerated soils. They are characterized with pretty stable macro-aggregates and quite stable micro-aggregates.

From the depth of the profile, the physical and chemical properties very, depending on the transition and sedimentation of the soil material and regolith. The reaction of the soil solution is neutral to weakly alkaline, whereas pH in H_2O is weakly acidic to neutral, rarely moderately acidic.

- **Production properties of alluvial soils**

Undoubtedly, the alluvial soils are the most fertile in the region. The highest agricultural yields are produced from them. They have good physical and chemical properties, deep solum, great water presence, possibility for irrigation and on them, mainly vegetable crops (tomatoes, peppers, cucumbers, quality seed and mercantile potatoes, cabbage, watermelon, onion, garlic, leak, etc.) quality beans with corn, as well as subcultures, soy, sunflower, grains, fruits – apples, pears, sour cherry and cherry could be found, but also grapes. Small parts of the alluvial soils, with shallow underground waters, are used for meadows.

6.2.8.2 Soil erosion in the wider region

All the natural and socio-economic factors in Kriva Palanka Municipality contribute to the intensive development of various erosive processes.

Rocks of different age are present in the geological structure of Kriva Palanka Municipality. From an erosive aspect, the proneness to a certain lithological structure of the erosion processes is important. In the following pictures, the vulnerability of the soil and rocks to erosive processes (presented through the parameter "γ" coefficient of reciprocal value of the resistance of the rocks and soil to erosion), as well as erosion distribution.

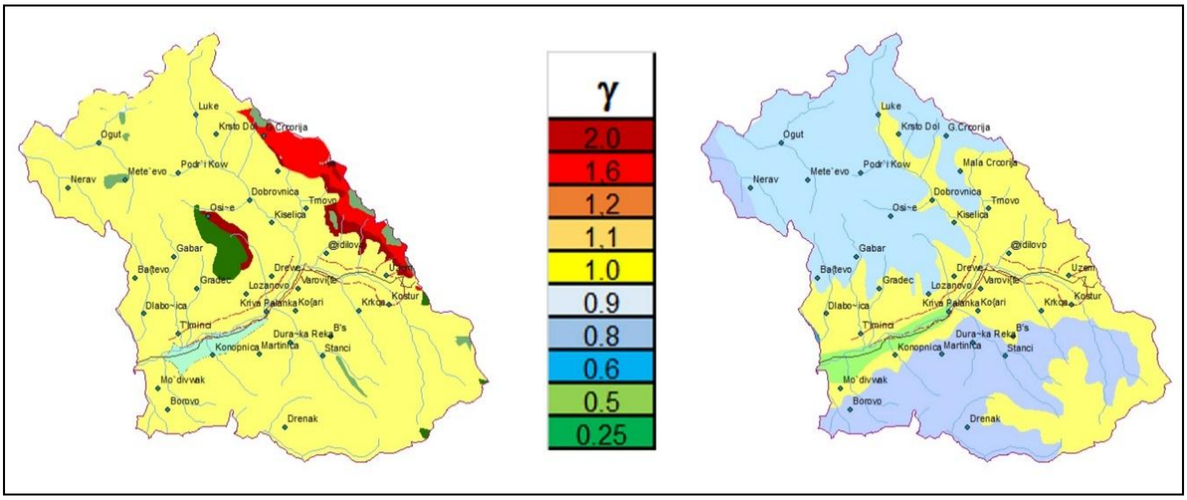


Figure 68 Rock and soil vulnerability to erosive processes

From the picture we can conclude that the value of "y" coefficient is averagely high, that is 1,0 for the schist rocks, whereas in the eastern most part it is exclusively high, at locations where the surface is from conglomerates and other unconnected sedimentary rocks.

According to the vulnerability to erosion processes, the soils in the Region could be classified as medium to highly vulnerable to erosive processes, because the values of the coefficient move from 0,9 – 1,6, with the exception of the plain part where it is 0,5.

The erosive processes are shown in the following picture according to their intensity.

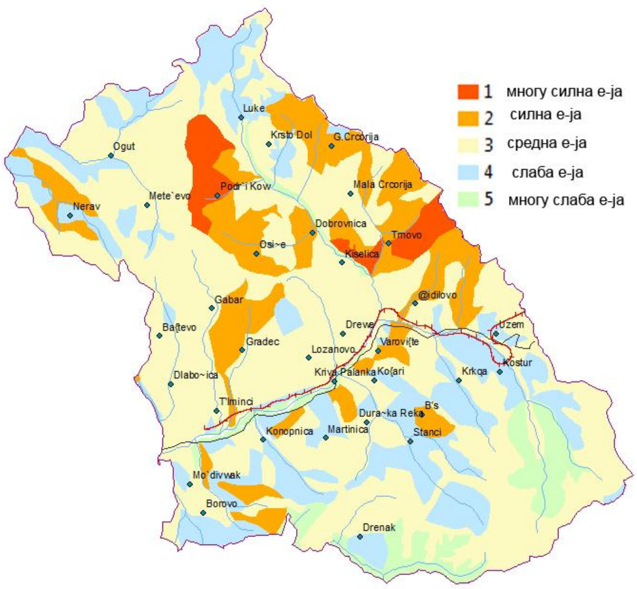


Figure 69 Map of erosion areas (source: 3BPM)

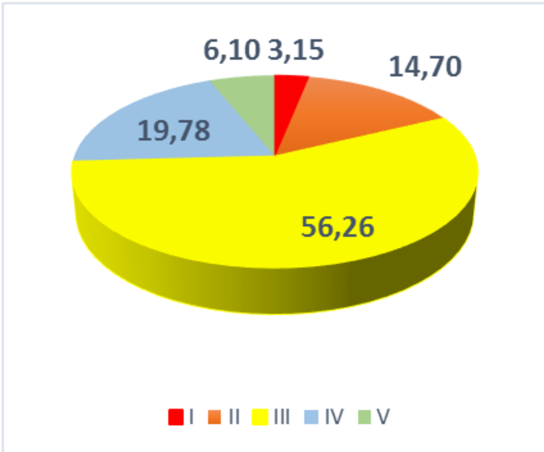


Figure 70 Area division by erosion intensity

From the pictures above, we can conclude that most of the area is under medium intensity erosion (category III), which takes 56% from the territory and that is not acceptable[9]. The average erosion intensity for the area of Kriva Palanka Municipality, expressed through the erosion coefficient by Gavrilovic (moving from 0,05-1,51 and more in extreme cases), is Z=0,53. At 18% of the territory, intensive processes from first and second category have been detected, which are extremely important, because from these places come the highest quantities of deposit into the water bodies. Around 26% of the territory is under IV and V category of erosion, which is considered an acceptable level of erosion risk.

The watercourses (permanent and temporary) in Kriva Palanka Municipality, belong to three basins. The largest part belongs to Kriva reka, where the average erosion intensity is Z=0,52, whereas in the northern part of the river Pcinja the erosion intensity is the highest with Z=0,56, and in the southern part of the Municipality, the waters gravitate towards Zletovska Reka, where the erosion intensity is the lowest with Z=0,29.

When comparing the stated erosion values to the average value of the erosion coefficient of R. of Macedonia which is Z=0,31, it turns out that the erosive processes in Kriva Palanka Minicipality are around 70% more expressed than the average values in the R. of Macedonia.

Most of these processes, from first and second erosion category, are located north of the line and present a possible threat to it.

Although the cover of the area with forest and bush vegetation is considerable, the specific year deposit production (Wsp) expressed in [m^3/km^2year] is 25% more expressed than the average of R. of Macedonia (844:680). Considerding the topographical conditions, a significant part of this generated deposit comes to the end recipients (Kriva Reka, Pcinja, Zletovska), so the specific quantity of yearly pre-transported deposit (Gsp), expressed in [m^3/km^2year] is about 80% higher than the average value for R. of Macedonia (544:303).

Table 29 Overview of the most erosive torrential basins in Kriva Palanka Municipality

	Name	Left/right	A	Z	Wsp	Gsp	W	G
			km^2		m^3/km^2	m^3/km^2	m^3	m^3
1	Martin Dol	R	0,65	0,75	1421	455	924	296
2	Arbanaski Dol	R	8,00	0,69	1244	572	9953	4578
3	Radilinski-Zhidlovski torrent	R	8,70	0,66	1137	587	10207	5104
4	Gradecka Reka	R	11,95	0,66	1179	672	14092	8032
5	Kiselicka Reka	R	114,70	0,65	1133	793	130015	91010
6	TB Kiselicka-Domacki Dol	R	3,58	0,65	1135	454	4066	1626
7	Nameless torrent	R	1,13	0,65	1126	293	1273	331
8	TB Krklanska- Babin Dol III	L	6,22	0,59	982	619	6111	3850
9	Domacki Dol	R	10,40	0,59	984	433	10237	4504
10	Gaberska Reka	R	19,63	0,59	979	607	19228	11921
11	Mozdivnacka R. – Borovska R.	L	14,62	0,56	920	616	13448	9010
14	Strcev Dol-Kartalanski	R	2,45	0,53	850	331	2082	812
15	TB Arbanaski-Zhidilovski	R	2,85	0,53	848	382	2419	1089

[9] According to the European and EC-JU standards, I-III Category is consider as class of soil with higher risks of erosion. In newer times, the term “unacceptable” is used for the medium erosion processes, which means here we need to act with counter-erosion measures.

16	Boboshinski poroj	R	1,85	0,52	804	281	1487	520

Legend: A basin area, Z- erosion coefficient by Gavrilovic Esp – specific year production of deposit (m^3 /km^2.year), Gsp – specific year production of pre-transported deposit (m^3/km^2.year), E- absolute year production of deposit (m^3 /year), G-absolute year production of pre-transported deposit (m^3.year)

From the date presented in the chart above, we can conclude that ***the basins of Martin Dol and Arbanski Dol are the most erosive***. Martin Dol threatens the location where the railroad line is planned, whereas Arbanaski Dol, whose basin is spread around the part where the line crosses the left bank of Kriva Reka, at the v. Zhidilovo, does not threaten the line. Taking into consideration the size of the basin, absolutely largest quantities of deposit are produced and pre-transported from Kriva Reka. We need to mention that alongside Arbanaski Dol, Gradecka Reka, the torrential series Krknjanska-Babin Dol and Mozdivnacka-Borovska Reka are not a threat to the future line.

As an indirect effect of the erosive process in the basins, after intensive rainfall, torrential swelling carrying large quantities of deposit appear, causing damages to settlements and infrastructures. Such events have been recorded in the last years.

In the last ten year, several accidents connected to erosion have been registered, such as: large landside on the road towards the villages Duracka Reka and Stracin, damages to retaining walls along the road to the village Uzem, damages to the slopes near the road, torrential swelling and pilling of deposit in the settlements, major damages from swelling of torrential waters of Kriva Reka. This points out that the erosive processes are very much active to this day.

6.2.8.2.1 Erosion and counter-erosion activities in the past

Due to the proneness of the soil to erosive processes, the influence of the natural factors and the inappropriate use of the land, clearings and intensive erosion processes have developed in the area.

Due to the intensive erosive processes in the past, a special company for erosion protection and torrent management “Kriva Reka” was formed. This company existed until 2008. During its existence, it performed many activities for erosion protection and torrent management in the Municipality.

Reforesting of around 7000 ha most erosive terrains, mainly with black pine, scots pine and black locust had been done. Considering the extreme conditions, the successfulness of the counter-erosion reforestations is around 60%. To add to this, many torrent swellings have been managed, that were gravitating towards Kriva Reka and other inhabited areas, as well as those threatening the main road. The riverbed of Kriva Reka was managed also.

Figure 71 Reforested clearings in the 70s

6.2.8.3 Soil contamination

The soils are a very sensitive medium, and in regards to their chemical pollution, the contamination with hazardous materials most often comes from human activity, industry, mining, inappropriate waste management, traffic, etc. Basically, the meaning of chemical degradation of soil comes from the risk level it has over people's health, over animals and plants, disruption of the productive ability of soils and the quality and safety of food and drinking water.

Because of this, the level of certain dangerous materials in the soil should be known, materials with high risk to the previously mentioned categories. In newer times, more detailed examinations have been made, into the heavy metal content of the soils in R. of Macedonia, in relation to their soil content, as well as their distribution in areas.

The heavy metals in the soil, unlike other chemical materials, are weakly mobile, but by means of erosion or through construction activities, heavy metal rich sediments could end up in surface waters and pollute them.

Because of these reasons, a short overview of the heavy metal content in the soil of the wider area has been given in continuation.

Data has been provided from the geochemical studies about the content of heavy metals in the soils of Kriva Palanka (Hadzi-Petrushev B. Et al. (1999)), from which we can conclude that the lead concentrations in certain trials are high (1,728 mg/kg). In the Kriva Palanka region, zinc most often appears together with lead in large concentrations. The values of copper, molybdenum, arsenic, chrome and nickel are low, whereas manganese and cadmium are in the upper levels.

From the data, published in the "Geochemical atlas of Republic of Macedonia" (Stafilov, T., Shajn, R. 2016) we can prove the previous assertion about the high concentration of lead and zinc. According to the authors, the average lead content in the surface layer of the soils in R. of Macedonia is 32 mg/kg, but in the Northeastern plan region, to which Kriva Palanka Municipality belongs, due to previous mining activities while mining lead-zinc ore, the average values are higher at 39 mg/kg.

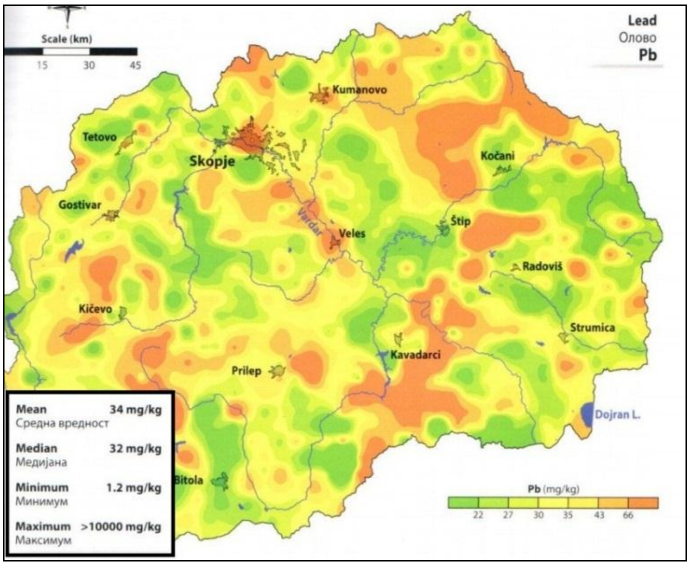


Figure 72 Map of lead concentration in RM

Source: Stafilov T., Shajn R. (2016), "Geochemical atlas of Republic of Macedonia"

The zinc content in the surface layer of soils in the Northeastern region is around 85 mg/kg, which is somewhere above the Country average (82 mg/kg). Still, there are small zones, especially in the Kriva Palanka area, and the area near the border of R. of Bulgaria, i.e. near the Toranica mine, where the zinc content is in the 90-110 mg/kg border, and in some parts even 110-140 mg/kg. This is mostly the result of the substrate itself, but of course, a result of the mining and flotation activities in the Region too.

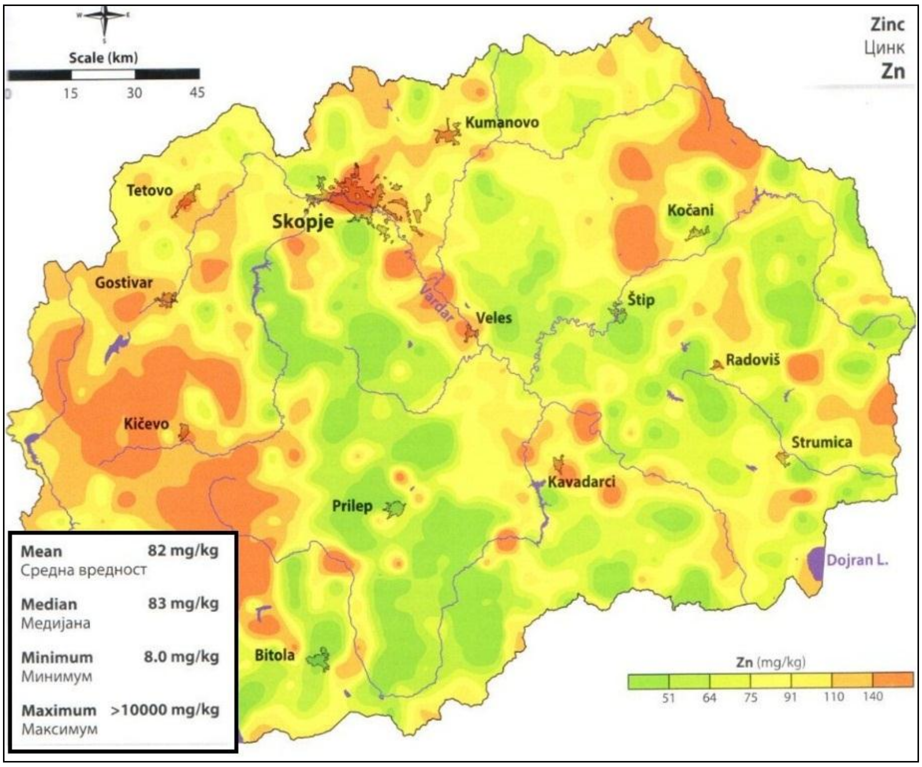


Figure 73 Map of zinc concentrations in RM

Source: Stafilov T., Shajn R. (2016), "Geochemical atlas of Republic of Macedonia"

In the Year Report by the Ministry of Environment and Physical Planning from 2006 (soil area), it has been established that alongside the rest of the mines in R. of Macedonia, the wastewaters from the „Toranica" mine caused pollution of the waters with heavy metals, as a result of the flotation processes. Thes waters are used for irrigating soils and cause further enrichment (pollution) of the soil with heavy metals, especially lead and zinc.

Detailed studies have been done over the influence of the mining work and the floatation "Toranica" over the soils, which showed that the mining and flotation activities have effect over environment pollution with Pb, Zn, Cd and other metals which could be found in the soil (Balabanova, 2014b, 2015a, 2015b, 2016), in the air (Balabanova et al. 2014, 2016; Anglovska et al. 2014), in river water and sediments (Stafilov & Levkov, 2007; Stafilov et al., 2014b, 2015a; Ilic Popov et al. 2014, 2015).

In November 2001, after the crack of the piping used to transport the tailing to the hydro-tailing pond, a great hazard occurred, where the hydro tailing spilled into Kriva Reka. The tailing soil caused heavy metal pollution of the Kriva Reka water, pollution of the underground waters and the wells used for drinking water, and the soils as well.

In the period after the hazard, reparation measures were taken to alleviate the damage, such as cleaning the riverbed of Kriva Reka all the way to the village Uzem.

- ***An analysis of the state of the line contact zone***
- ***State of the soils***

In the starting section, the line moves across a complex of cinnamon forest soils and regosols. The cinnamon forest soils are spread over flattened parts in the narrower extent of this line part, where abandoned agricultural areas and degraded forest vegetation could be seen. The regosols are developed in the steeper terrain parts under rare forest vegetation. The terrain specifications and the pedogenetic conditions dictate an occurrence of constant surface erosion process, which leads to constant rejuvenation of the regesol soil profile. Therefore, these soils are constantly in an initial pedogenetic phase and unless the appropriate measures for their protection are taken, they will be a source of sediment which will be a threat to the planned infrastructural objects.

This section of the line stretches over contact zone between paleogenic metamorphic rocks represented by chlorite and albite-muscovite schists and recent colluvial sediments created by the accumulation of eroded silicate material from the slope terrains and alluvial sediments in the lowest part of the area along the flow of Kriva Reka and its tributaries. As a result, the soil cover on the left side of the line is mainly a complex of brown forest soils, leptosols and regosols, whereas the right side is in a constant change between alluvial, colluvial and cinnamon forest soil. Taking into consideration the complexity of the terrain, in this part of the line 22 tunnels and 52 bridges are planned (from which one has been replaced by a culvert), as well as many embankments with retaining walls.

From the bridge no. 21 (71+569) the line is guided by a system of bridges and tunnels all the way to the end of bridge no.23 (72+935,5) across the town Kriva Palanka, where are separated urbisols. These soils are affected by human activities and urbanization.

From bridge no. 23 (72+804) the line moves over quite steep terrain, where rankers have been formed under natural pastures and rare degraded oak forest. The rankers in this part of the line are with a shallow horizon A, which in some parts in pretty eroded, and in some parts completely washed away by erosion and on the surface a weak humus transitional horizon AC. From the beginning of tunnel no. 10 (74+423), all the way to the entrance of tunnel no. 12 (75+968,75), the terrain on the left side of the narrower area is steep with little vegetation and southern exposition, where the litosols over strong substrate dominate and regosols over mixture of native rock (albite-quartz-chlorite schists) appear. These are most likely previous rankers, which due to the degradation of the forest vegetation, have lost the greatest part of their solum, and are now in a stadium of initial formation of hor. A, which is under a constant process of surface erosion. In separate places where the forest and meadow vegetation are still preserved, rankers have been formed with good developed humus hor. A. on the right side of this reach, the terrain is under a well-developed oak forest, under which are good developed rankers, with a strong humus hor. A.

In the following picture, the sites and profiles of the most important soil types in the contact zone have been shown.

Figure 74 Site under cambisol

Figure 75 Cambisol

Figure 76 Site under rankers

Figure 77 Ranker

Figure 78 Site under regosols

Figure 79 Regosol

From tunnel no. 12 the line turns at the basin of Kiselicka and Kriva Reka, crossing Kiselicka Reka with bridge no. 23 and continuing over a steep and inaccessible terrain all the way to v. Zhidilovo. This part of the line, especially where the two river flow into, is a complex of rankers and regosols, whereas after the exit of tunnel no.14 (78+058,8) the narrower extent of the line is under rankers, in the higher and flatter places under pastures, and under brown forest soils in sites under good developed forest. Similar state we have all the way to v. Zhidilovo, when the line by bridge no. 37 (79+785,9-80+068,7) passes Kriva Reka and continues down its left side over well-forested, somewhat flatter terrain at the site Dzikovsla maala. Under this vegetation, separated are brown forest soils with a good developed solum and deep hor. B(v).

Further on, the line cuts into the hills, right above the left side of the Kriva Reka riverbed. The whole reach is under beech forest or pastures, and in some flattened site even abandoned arable areas have been determined. Through this kind of terrain the site continues all the way above the village

Uzem, above which after bridge no. 42 (82+056,25-82+177,75), following the terrain logic, moves away from the Kriva Reka riverbed and the main road and almost makes a full circle. At this part of the line, separated are well developed brown forest soils with a good developed soil profile and a deep humus-accumulative hor. A.

After exiting the tunnel no. 19 (82+670) over the bridges no. 43 and 44 the line moves through the mesophilic oak forest under which there is a complex of brown forest soils and regosols at the locations with steep incline and degraded vegetation. At the reach 85+100 to the start of bridge no.49 (86+373) the line moves over farmland which is mostly abandoned, and also over pastures and urban areas. The terrain is with a mild inclination towards the Kriva Reka valley, and consists mostly from degraded brown forest soils and larger areas under regosols.

The line then cuts into the hill above Uzem village, near the site Vitanovci and over bridge no. 50 and 51 enters the tunnel no. 22 (87+280) near the site “Mangjalska Maala” all the way to the border of R. of Bulgaria. This reach is dominated by regosols in a complex with brown forest soils, which are separated over flattened terrains under oak forest vegetation.

The following picture shows the soil covers, in the narrower extent of the line, in different chainages.

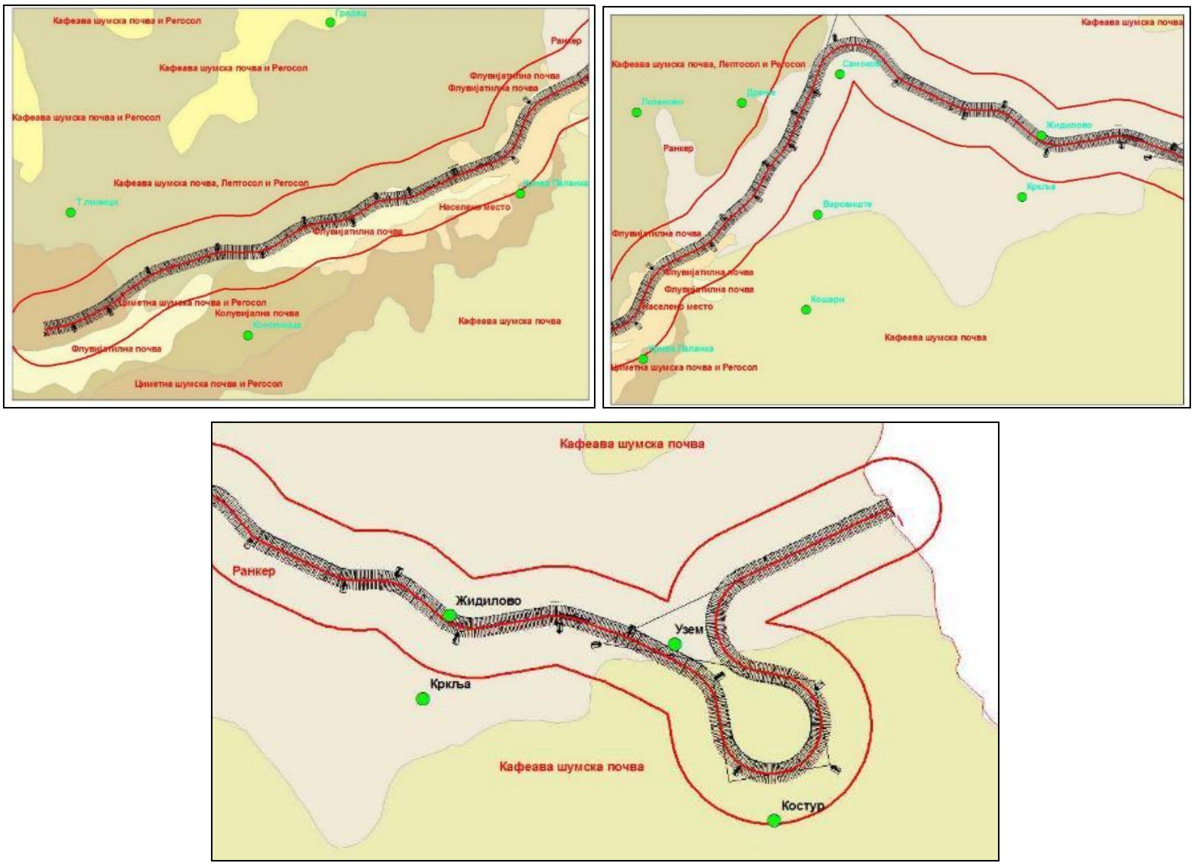


Figure 80 Soil cover in the narrower extent of the line in different sections

- ***The state of erosion***

The terrain over which the line moves is sloped, cut by number of dry valleys and watercourses. Due to the slope character of the terrain the line cuts into the slope which during the railroad line construction will produce great quantities of excavation material.

From Figure 49 and Figure 52, as well as Figure 68, we notice that at the section from the start to 2 km away from the town of Kriva Palanka, the line mainly moves through terrain with inclination from 10-15 degrees which corresponds to 15-30%, and in some places over mildly inclined terrain (bellow

15%). Generally speaking, on such terrain, occurrences and processes of surface, rill and gully erosion is expected, if the soil is not protected by vegetation. From there, and almost all the way to Uzem, the line moves through terrain with steep incline above 15 degrees (3-50%), where alongside the previous erosion forms, urvinic processes (decay and landslides) are possible. In the last part of the section, the line moves through moderately steep terrain.

Figure 81 Moderate and moderately steep terrain at the beginning of the line

Figure 82 Steep to very steep terrain

The line in almost all its length (from the start, and all the way to the last parts of the line) moves through a complex of schist rocks i.e. albite-quartz-muscovite-chlorite schists which are medium high vulnerability to erosion processes, where the erosive process resistance coefficient is γ = 1,0-1,1.

Figure 83 Native substrate (schists) at the surface

These schists could easily decay under the influence of difference outside agents.

Figure 84 Erodibility of the cambisol soil

Generally, the brown forest soils along the line are overgrown with some vegetation, usually oak, but if there is change in the cover, they become vulnerable to erosive processes.

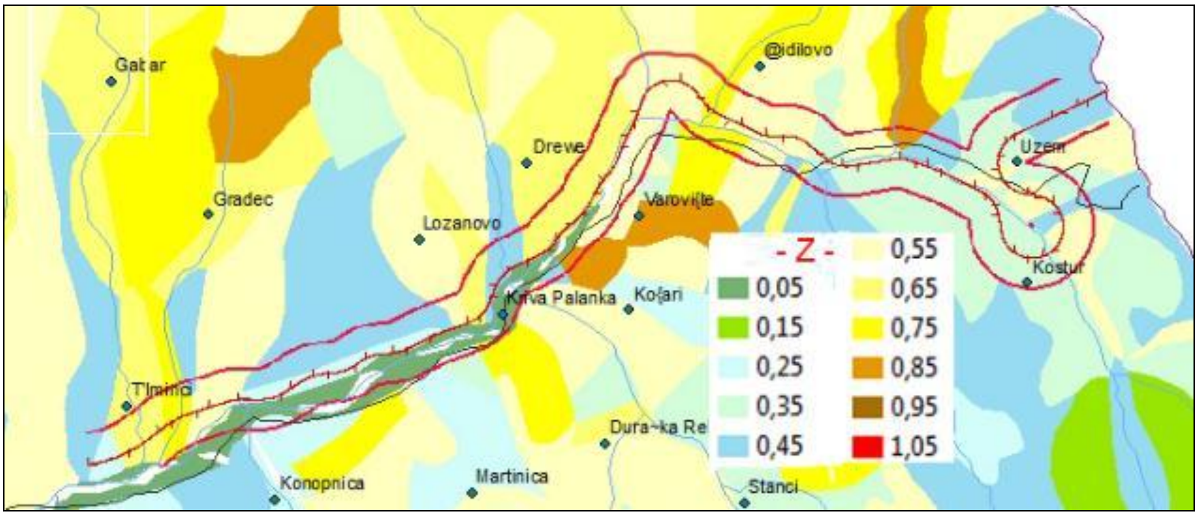
Figure 85 Transitive land (abandoned farmland overgrown with natural vegetation) with weak and medium erosion

Figure 86 Dispersed broad-leaved forest – weak erosion processes

Figure 87 Mixed forest with minimal erosion processes

Figure 88 Thickly forested (coniferous forest) – erosion marks

The erosion intensity in the contact zone is shown in the following picture:



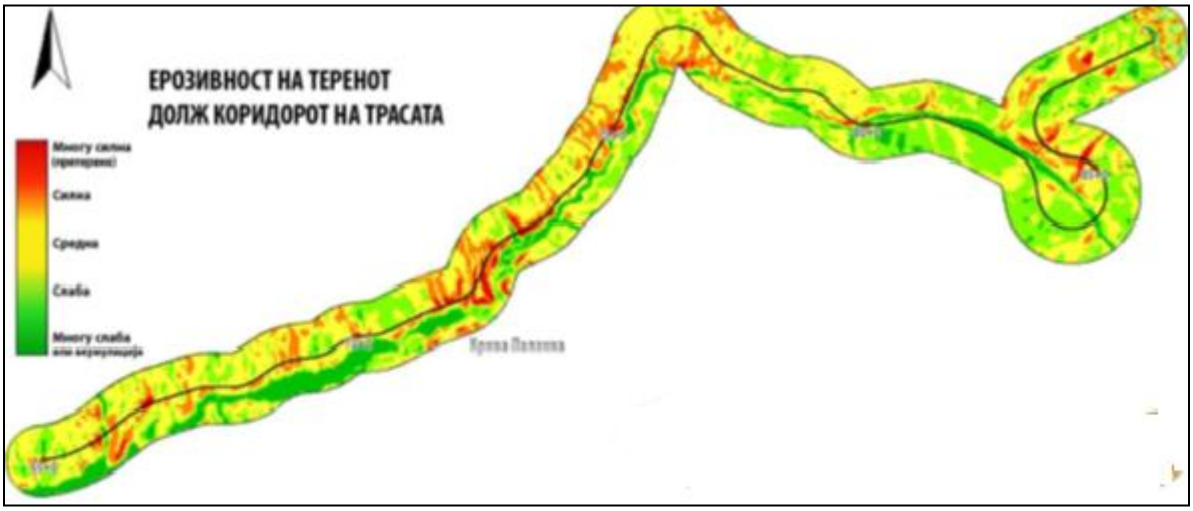


Figure 89 Erosion intensity in the contact zone

From the picture we can see that in the contact zone, generally dominant are the III category destructive processes, especially in the part where the construction site will be, although in the certain places, processes of strong erosion could be noticed. A more detailed display of the erosion intensity along the line has been given in the map and chart below.

Table 30 Erosion category in the present state of the project area

	CHAINAGE		CATEGORY	
Nº	FROM	TO	E-B	OBJ
	64+492,01	64+036,52	III	
	65+036,52	65+095,735	IV	
1	65+095,735	65+155,280		IV
	65+155,280	65+500,00	III	
2	65+605,724	65+758,346		III
	65+758,346	65+841,065	III	
3	65+841,065	66+106,750		III
	66+106,750	66+126,00	III	
1	66+126,00	66+352,70		III
	66+352,70	66+447,279	II	
4	66+447,279	66+516,721		II
	66+516,721	66+742,660	II	
5	66+742,660	66+884,280		II
	66+884,280	66+895,35	III	
2	66+895,35	67+039,41		III
	67+039,41	67+039,41	III	
6	67+039,41	67+128,250		III
	67+128,250	67+155,30	III	
3	67+155,30	67+356,39		III
	67+356,39	67+360,246	III	
7	67+360,246	67+455,813		III
	67+455,813	67+464,66	III	

4	67+464,66	67+579,90		III
	67+579,90	67+596,622	III	
8	67+596,622	67+630,125		IV
	67+630,125	68+167,685	IV	
9	68+167,685	68+273,442		IV
	68+273,442	68+273,442	IV	
10	68+273,442	68+636,856		IV
	68+636,856	68+738,717	IV	
11	68+738,717	68+814,348		IV
	68+814,348	68+821,56	IV	
5	68+821,56	68+957,23		IV
	68+957,23	69+066,200	IV	
12	69+066,200	69+193,750		IV
	69+193,750	69+250,000	IV	
13	69+250,000	69+273,500		IV
	69+273,500	69+402,142	IV	

Nº	CHAINAGE		CATEGORY	
	FROM	TO	E-B	OBJ
14	69+402,142	69+478,073		IV
	69+478,073	69+683,217	IV	
15	69+683,217	69+778,911		IV
	69+778,911	69+965,189	IV	
16	69+965,189	70+070,852		IV
	70+070,852	70+159,478	IV-V	
17	70+159,478	70+343,707		IV-V
	70+343,707	70+528,00	IV-V	
6	70+528,00	70+646,00		IV-V
	70+646,00	70+889,500	IV-V	
18	70+889,500	70+923,000		IV-V
	70+923,000	71+038,977	IV-V	
19	71+038,977	71+127,140		IV-V
	71+127,140	71+323.500	III-V	
20	71+323.500	71+419.000		III-V
	71+419.000	71+569,000	III-V	
21	71+569,000	71+602,502		III
	71+602,502	71+636,02	III	
7	71+636,02	71+758,63		III
22	71+760,00	71+768,00		III
	71+602,502	71+793,14	III	
8	71+793,14	72+789,87		III

	72+789,87	72+804,013	III	
23	72+804,013	72+935,520		III-V
	72+935,520	73+329,000	III-V	
25	73+329,000	73+398,753		III-V
	73+398,753	73+558,500	III-V	
26	73+558,500	73+721,265		III-V
	73+721,265	73+766,218	III	
27	73+766,218	73+815,775		III
	73+815,775	73+824,63	III	
9	73+824,63	74+040,55		III
	74+040,55	74+195,656	III	
28	74+195,656	74+409,944		III
	74+409,944	74+423,70	III	
10+11	74+423,70	74+759,77		III
	74+759,77	74+767,234	III	
29	74+767,234	74+842,762		III
	74+842,762	74+989,95	III	

	CHAINAGE		CATEGORY	
Nº	FROM	TO	E-B	OBJ
11a	74+989,95	75+171,26		III
	75+171,26	75+187,692	III	
30	75+187,692	75+473,294		III
	75+473,294	75+667,100	III	
31	75+667,100	75+952,510		III
	75+952,510	75+968,75	III	
12	75+968,75	76+156,68		III-IV
	76+156,68	76+402,00	III-IV	
32	76+402,00	76+611,500		III
	76+611,500	76+622,00	III	
13	76+622,00	77+678,00		II
	77+678,00	77+698,75	II	
33	77+698,75	77+789,25		II-III
14	77+799,89	78+058,80		III
	78+058,80	78+078.739	III	
34	78+078.739	78+200.239		III
	78+200.239	78+417.444	III	
35	78+417.444	78+492.991		III
	78+492.991	78+783.458	III	
36	78+783.458	78+842.958		III
15	78+851,77	79+092,00		III

16	79+092,00	79+720,00		III
	79+720,00	79+785.906	IV	
37	79+785.906	80+068.737		IV
	80+068.737	80+314.800	IV	
38	80+314.800	80+338.300		IV
	80+338.300	80+571,00	IV	
17	80+571,00	80+639,00		IV
	80+639,00	80+670.300	IV	
39	80+670.300	80+745.800		IV
	80+745.800	80+792,00	IV	
18	80+792,00	80+842,00		IV
18a	80+842,00	80+916,00		IV
	80+916,00	80+959.858	IV	
40	80+959.858	81+164.750		IV
	81+164.750	81+947.750	IV	
41	81+947.750	81+971.250		IV
	81+971.250	82+056.250	IV	
42	82+056.250	82+177.750		IV
	82+177.750	82+670,00	IV	
19	82+670,00	84+070,00		IV
	84+070,00	84+094.529	IV	

	CHAINAGE		CATEGORY	
Nº	FROM	TO	E-B	OBJ
43	84+094.529	84+107.459		IV
	84+107.459	84+145.800	IV	
44	84+145.800	84+154.600		IV
	84+154.600	84+300,00	III	
20	84+300,00	85+564,00		III
	85+564,00	85+607.648	III	
45	85+607.648	85+628.578		III
	85+628.578	85+698.471	III	
46	85+698.471	85+882.732		IV
	85+882.732	85+982,00	III	
21	85+982,00	86+119,00		III
	86+119,00	86+262.000	IV	
47	86+262.000	86+311.614		IV
	86+311.614	86+345.870	IV	
48	86+345.870	86+384.870		IV
49	86+373.630	86+412.630		IV
	86+412.630	86+594.830	IV	

50	86+594.830	86+633.830		IV
	86+633.830	87+023.890	IV	
51	87+023.890	87+032.970		III
	87+032.970	87+280,00	III	
22	87+280,00	89+560,00		III
52	0+045,26	0+069,24		

Legend:

White field – railroad line in excavation/bank/embankment
Blue field – railroad line over bridge/viaduct
Black field – railroad line in a tunnel
E-B – railroad line in excavation/bank/embankment
OBJ – object – bridge/viaduct – tunnel
Erosion category – I very strong, V – very weak
Where there are 2 category we mean left-right
At the railroad line in excavation/bank/embankment, an authoritative erosion category has been defined, at the line in tunnel or over bridge/viaduct, the surrounding erosion has been defined.

From the start of the line, and all the way to the chainage 66+352,70 (end of first tunnel), there are mostly third category erosion processes.

From there, from chainage 66+252,70 (exit from tunnel no.1) to 66+884,28 (bridge no. 5), the line moves through a zone with strong erosion (second category).

From chainage 66+884,280 to 67+596,622, mainly dominant are the middle (third category) erosion category processes.

At the reach with chainage 67+596,622 (bridge no. 8) to 71+127,140 (bridge no. 19), the erosion processes are weak, and in parts on the right side, consider the closeness of Kriva Reka and the flatter terrain, the erosion is quantified as very weak.

From the chainage 71+127,140 to 77+678,00, i.e. the town of Kriva Palanka to the inflow of Duracki dol, third category destruction processes (medium erosion) are present, and in some parts on the right side, due to the flattened terrain, there are weak and very weak erosion processes.

Further on, in length of 100m, i.e. from 77+678,00 to 77+789, 00 the line moves through a part where there are strong erosion processes (second category).

From the bridge no. 33 (76+622,00), to the end of tunnel no. 16 (79+720,00), the erosion processes are medium. At the exit of this tunnel, and to the bridge no. 44 (84+154.600), the erosion processes are weak. From there, and to the end of tunnel no.21 (86+119,00), the erosion processes are mainly third category (medium erosion).

From tunnel no. 21 (86+119,00) and to the beginning of bridge no. 51 (87+023.890), the erosion processes are weak. In the last section the erosion processes are with medium intensity.

According to the map and overview of the chart above, the line for the most part moves through a territory where the erosion processes are with medium intensity. But, due to the special climactic and relief conditions of the terrain, in certain sections where the erosion risk is not as high, erosive processes with high intensity could appear.

6.3 Land use

The land cover/use in Kriva Palanka Municipality is presented in the following picture and chart, in accordance to the CORINE LCU classification of third level.

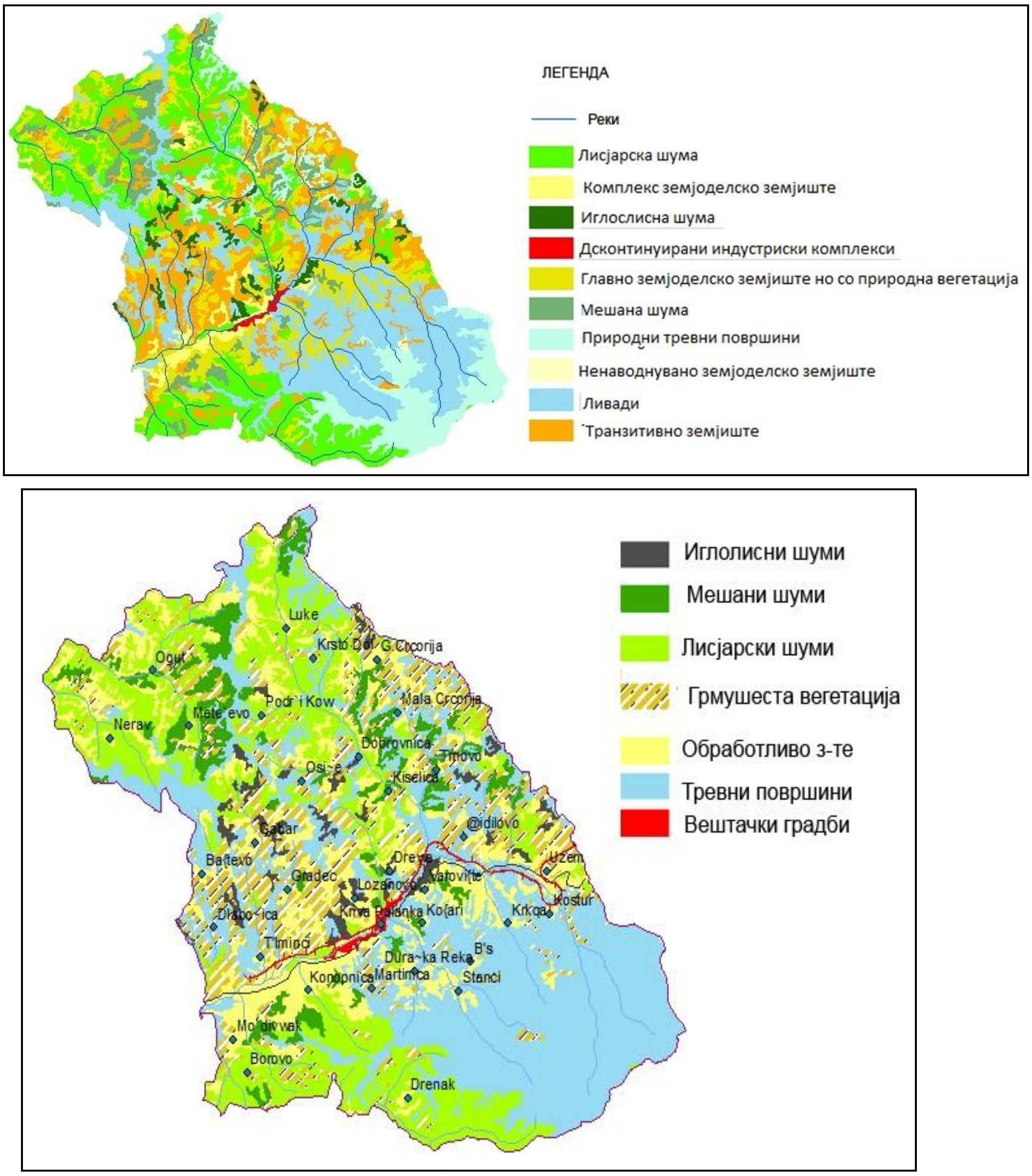


Figure 90 Land cover/use in Kriva Palanka Municipality

Table 31 Land cover/use in Kriva Palanka Municipality

code	cover/use	area	
		ha	%
112	Discontinuous urban fabric	159,94	0,33
211	Non-irrigated arable land	38,13	0,08
231	Pastures	12195,74	24,78
242	Complex cultivation patters	1427,67	2,90
243	Land principally occupied by agriculture, with significant areas of natural vegetation	7011,52	14,25
311	Broad-leaved forest	10906,18	22,16
312	Coniferous forest	1186,15	2,41

313	Mixed forest	3126,45	6,35
321	Natural grassland	5181,16	10,53
324	Transitional woodland - shrub	7975,30	16,21

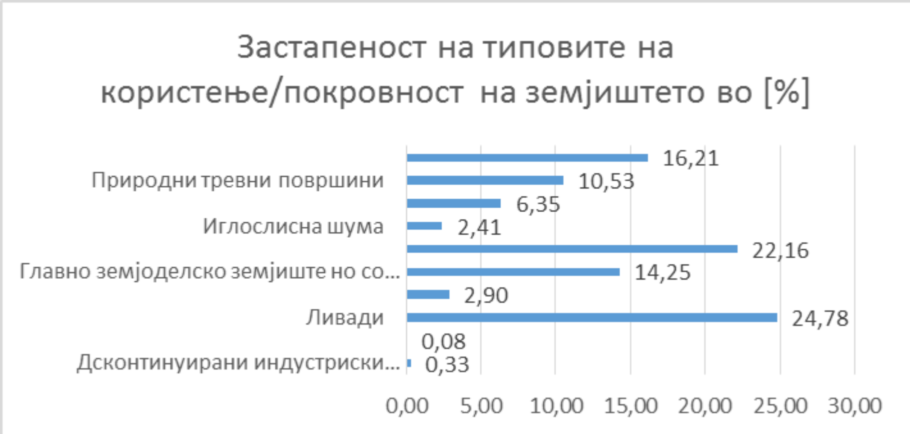


Figure 91 Prominence type for land use/cover in [%]

The most prominent type of land in Kriva Palanka Municipality are pastures with 24,78%, and together with the rest of the natural grass surfaces, they occupy around 35%. Forests are present at around 31% of the territory, with the broad-leaved forests being dominant. The transitional land, where the shrub vegetation is dominant, but also grass areas and wood, occupies around 16%. The arable land takes around 17% of the territory.

- **Project area**

The railroad line will pass dominantly through forests, pastures, partial construction sites (inhabited places), through tunnels and not much arable land. Most of the land in the project area is neglected and not in use.

The land along the river valleys and their immediate surrounding is mostly used for agriculture, and here and there farm vegetables and meadows could be found. The agricultural land near the settlements is divided into small parcels of fields with borders, pastures and gardens.

Although the land is mostly used as a forest/forest land, most of the tall forest grows in patches interconnected with surfaces under degraded forest and forest plantation. The hill pastures in the project area are most numerous in the first section of the railroad line. Due to the abandonment and change in the agricultural practices of the local population, much of the pastures (13%) are overgrown with shrubs. The arable land abandoned long ago in the hill areas is mostly overgrown with anthropogenic broad-leaved forests, shrubs, and sparse short oak trees. The poplars and willow segments on the riverbank and belts are most often found with narrow belts and riverbank forest remains (often degraded, similar to shrubs and mixed with the surrounding broad-leaved trees) which could be found near the rivers and stream along the railroad corridor.

The settlements along the railroad corridor have mostly rural character (7%), whereas the town of Kriva Palanka and its immediate surroundings (8%) could be characterized as a semi-urban area. The settlements are mostly dominated by anthropogenic broad-leaved trees and belts. The ruderal vegetation consisting of annual plants and shrubs is often found at the periphery of the rural areas, industrial locations and along the roads. The latter are characterized as artificial and all of them combined take up around 1% of the railroad corridor.

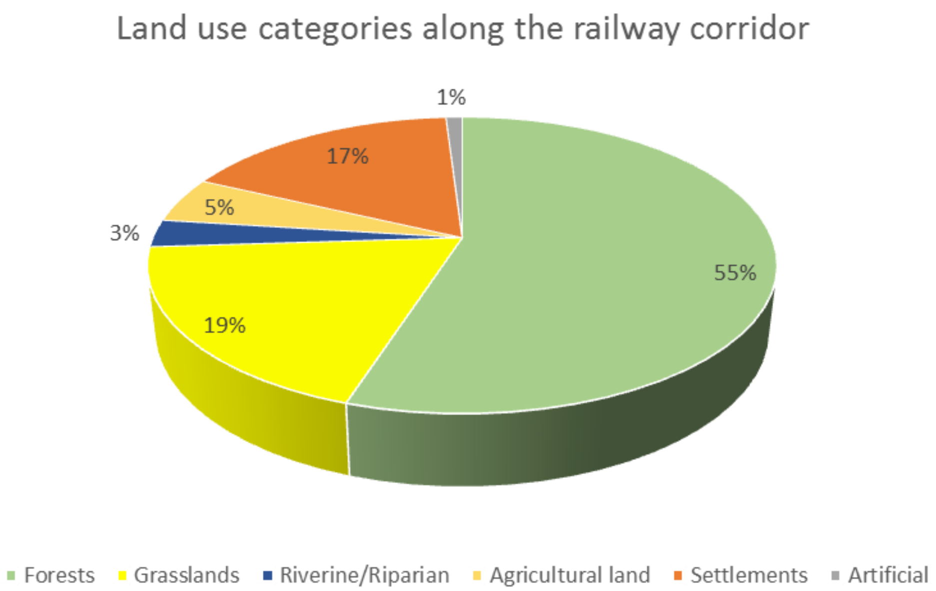


Figure 92 Overview of the land use in the project area (categories of land use: 1% artificial, 3% aquatic/riparian, 5% agrarian, 17% settlements, 19% pastures, 55% forests)

The largest part of the land is government property, although there is private property land. Currently, we cannot provide more information about the land which needs to be taken for project implantation. The use and type of land which needs to be taken, will be part of a specifically created study of expropriation[10].

6.3.1 Agriculture

Kriva Palanka Municipality has a lower percentage of land use from the fully available land (56%), whereas this percentage in R. of Macedonia is 82%.

The relationship between the complete available land and the agricultural land used, during the agricultural census in 2007 is shown in the following chart. Actually, this chart makes a comparison between the status of the Kriva Palanka Municipality and the national status. The average part of used agricultural holdings in Kriva Palanka is 0,25 ha, whereas in Macedonia that is 0.42 ha.

Table 32 Agricultural land status (2007)

Total available land, used agricultural land and number of spared parts by municipalities and agricultural land and number of parts on the land	Kriva Palanka	Macedonia
Number of individual agricultural holdings	2865	192378
Surface area of total available land ha	5308	321814
Total used agricultural land (ha)	2948	264339
Privately used agricultural land (ha)	2824	222820
Utilized agricultural land leased from others (ha)	158	4672
Utilized agricultural land leased to others (ha)	34	5202
Number of parts of used agricultural land	11643	636911

(Source: State statistical office – Census of agriculture, 2007)

[10] Which will be created on the basis of the Main Project.

The utilized agricultural land in Kriva Palanka consists of meadows (52.8%), pastures (16,7%) and arable land and gardens and kitchen gardens (22.3%) of which, half are vegetable, 1/3 cereals, and 14% fodder crops. In the next chart the relationship of utilized land in Kriva Palanka during the census in 2007 is presented.

Table 33 Surface of utilized agricultural land (ha)

UTILISED AGRICULTURAL LAND (ha)	Kriva Palanka
Total utilised agricultural land	**2948**
Meadows	1577
Pastures	500
Orchards	211
Vineyards	2
Nurseries	1
Arable land and gardens and kitchen gardens	**657**
Cereals	223
Industrial crops	4
Fodder crops	91
Vegetable	330
Aromatic and medicinal plants	0
Flowers and decorative plants	1
Seeds and seedlings	0
Fallow land and other uncultivated land	8

(Source: State statistical office – Census of agriculture, 2007)

According to the date of the State statistical office, in 2014 in Kriva Palanka maize was planted on 67 ha (7.7%), whereas wheat was planted over 49 ha (5.6%) of land. The clover was present on 83 ha (9.5%), whereas the noted Palanka potato was planted on almost half of the used agricultural land with 424 ha (48.6%). There was a similar relationship in 2015, except that the surface for potato has been significantly decreases to 372 ha (47.3%). Actually, the total sowed land in 2015 is lower by 10% than the one in 2014, and thus the quantity of agricultural products has decreased as well (kg/ha).

In the following chart, an overview of the state of utilized agriculture land in Kriva Palanka Municipality in 2014 and 2015 has been given.

Table 34 Agricultural areas by category of use (ha)

2014/ha	2015/ha	Kriva Palanka
30.780	30.736	Agricultural area
14.067	14.023	Total arable area
11.157	11.156	Arable land and gardens
160	145	Orchards
0	0	Vineyards
2.750	2.722	Meadows
16.713	16.713	Pastures

(Source: Internet page of the State statistical office)

6.3.2 Forestry

Broad-leaved, coniferous and mixed forest are dominant in the Kriva Palanka region. The broad-leaved forests, for the most part, are autochthonous, whereas the major part of the coniferous and mixed forests are created by reforestation of bare and degraded forest surfaces. By using extensive agricultural and animal husbandry practices, migration processes have appeared, such as decrement of the stock fond and land use, and thus several hills and abandoned farmlands, pastures and other types of low productive land are slowly overtaken by shrubs and forest vegetation.

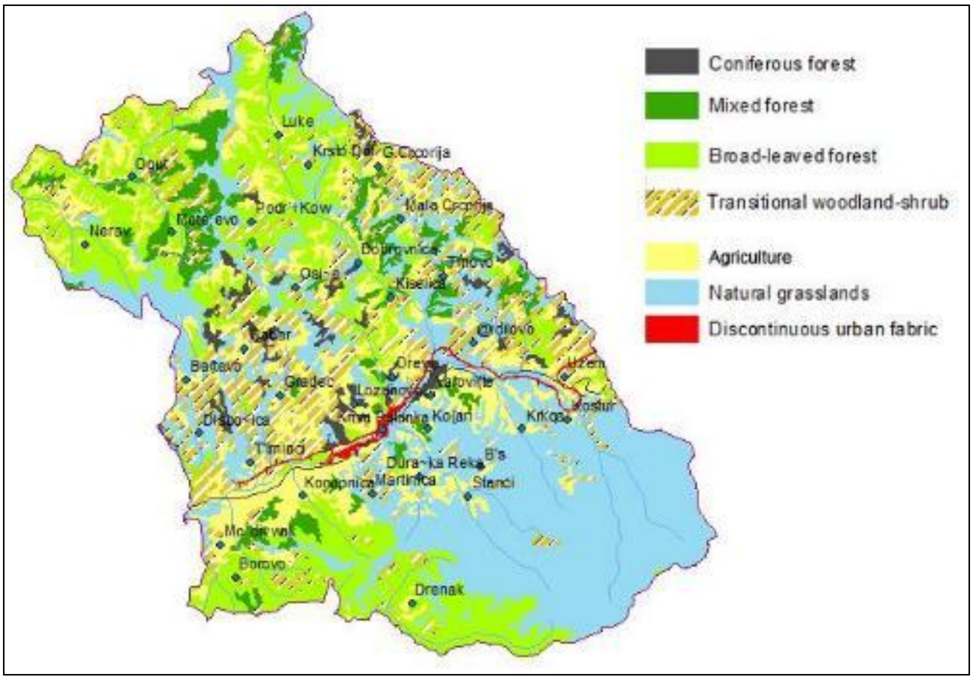


Figure 93 Forest and land types (Corine)

The forests in the Kriva Palanka region are a significant natural resource which is characterized by its wide surface presence and great significance to the local economic development. A portion of them are, for the most part, used for wood needs and other forest products, and the consequences form the intensive use are evident. In order to improve their structure and quality, as well as to protect the soil from erosion, in the past, over great swats of degraded and low productive broad-leaved plantation, as well as over eroded surfaces, coniferous types have been planted. Such activities are giving visible results, and in the field we can see greater and smaller areas under forests with different coniferous types, which have shown a greater productive value, in comparison to the autochthonous shoots and degraded forest stands. Alongside this, they possess a great anti-erosion function which positively affects the preservation of the land and the encouraging of the rejuvenation processes for the forest types over bare terrains.

6.3.2.1 State of forests in the Region

From and administrative view, the forests from the Kriva Palanka Region are divided into forest-economic units managed by the subsidiary for forestry “Osogovo” from Kriva Palanka, as part of the Public Enterprise “Macedonian Forests”, Skopje.

Table 35 Division of forests and forest land

No.	Subsidiary for forestry	Forestry unit	Total area (ha)	Overgrown with forest (ha)	Forest land (ha)	Land for other purposes (ha)
1	SF„OSOGOVO" KRIVA PALANKA	German-Chupino Brdo	4315,71	3959,61	309,54	**46,56**
		K. Palanka-Anishte	4263,06	4053,94	158,36	**47,68**
		Drenak-Lisec	7174,98	6338,10	329,90	**503,98**
		Kriva Reka-Stanecka Reka	8586,60	7147,90	1344,20	**94,50**
		Dlabocica-Kiselica	2743,30	2592,40	102,40	**48,50**
		Paklishte-Dlabocica	4980,32	4725,39	59,66	**195,27**
Total			**32063,97**	**28817,34**	**2304,06**	**936,49**

Source: Special plans for forestry

From the chart data, we see that the total area, consisting of the six forestry unit managed by SF "Osogovo" Kriva Palanka amount to 32 063,97 ha, from which 28 817,34 or 89,9% are overgrown with forest, 2 304,06 or 7,2% are forest land and 936,49 ha or 2,9% are land for other purposes.

The widely spread beech and oak forests for the most part present the structure of the forest fond. However, alongside these types, we meet other significant types such as: black pine, sycamore, oriental hornbeam, European hop-hornbeam, etc. In certain parts, mostly around inhabited areas, parts of the forests are degraded, and some parts are brought to the stadium of shrublands. Around the settlements, agricultural land is present, used very extensively or not at all. Over those surfaces we meet certain parts of forest trees and shrubs, used for their fruits, such as: cherry, hazel, juniper etc.

According to origin, the forests of the Kriva Palanka region are from a generative or vegetative origin. Most part of the forests are from a generative origin, i.e. 16 957,47 ha or 58,8%, whereas the rest 11 859,87 ha or 41,2% are from a vegetative origin.

6.3.2.2 Forest structure according to composition type

In the Kriva Palanka region, several types of trees are present, forming pure forests (comprised of a single type of tree) and mixed forests (comprised of two or more types of trees). The analysis shows that 18405,84 ha or 63,9% of the forests are pure, and 10411,5 ha or 36,1% mixed. The pure forests contain 3130899 m^3 or 76,9% of the wood mass and 58 834 or 73,6% in the total current growth, and the mixed forests contain 943 024 m^3 or 23,1% of the wood mass and 21 153m^3 or 26,4 % of the current growth. This points to the fact that the pure forests have a greater quality structure and are more preserved in comparison to the mixed ones. The total presence of the pure wood growth by types shows that 71,6% of the pure forests are under beech, 17,3 black pine, 5,5 sessile oak, 4,2 black locust, whereas the rest tree types are represented by under 1% of the total forest surfaces.

The total wood mass in the forest of the Kriva Palanka region is 4073923 m^3, and the average wood mass per hectare is 141,37 m^3/ha. The total current yearly growth is 79987m^3, and the yearly unit surface growth is 2,78 m^3/ha.

The allowed yearly quantity for cutting, i.e. wood pulp quantity in the Kriva Palanka region is 40981m^3, which represent 51,2% of the total current yearly growth by wood mass.

6.3.2.3 Description of the main forest ecosystems and habitats and an evaluation of the state

The beech and oak forest are spread the most and have the greatest significance for the Region. The oak forests are spread in the lower hill-plain parts, whereas the beech forests are over the higher hill-mountainous parts. In these two forest belts several forest communities are present, which are climactically-zonally scattered but anthropogenic forests created by reforestation could be found. The forests have a great significance to the environment and the overall biodiversity, because they are the habitat of different animal and plant species, they protect and maintain the biodiversity, protect the soil from erosion, alleviate the temperature extremes and fulfill a number of ecological, economic and social functions. Over the forest ecosystems in the Region, an extensive anthropogenic influences is noticeable. Because of that, parts of the forests, especially in the lower regions are turned into agricultural areas or replaced by autochthonous species.

Several different forest communities are present in the forests of the Kriva Palanka region, whose presence only enriches the forest diversity of the area. In the different forest communities, so far, different practices have been used which have influenced the current state in a different manner and have left a certain mark.

For the description of the forest communities, we use the current base of information from professional literature, mostly form the Special Plan for Forest Management and the field studies done, where the following forest communities have been registered:

- ass. *Qurco-Ostryetum carpinifoliae macedonicum* Ht.1938 - community of pubescent oak and European hop-hornbeam,
- ass. *Qurco-Carpinetum orientalis macedonicum* Rud.1939 ap.Ht.1946 - community of pubescent oak and oriental hornbeam,
- ass. *Quercetum frainetto-cerris macedonicum* Oberd. 1948 Em. Ht.1959 - community of Hungarian oak and Turkey oak,
- ass. *Orno-Quercetum petreae* Em 1968 - Community of sessile oak forests ,
- ass. *Festuco heterophyllae Fagetum* Em 1965 - community of foothill beech forest,
- ass. *Calimintho grandiflorae-Fagetum* Em 1965 - community of mountain beech forest,
- ass. *Fago-Pinetum nigrae* (Ht. Et Em 1963) Em 1981, community of mountain beech forest with black pine,
- ass. *Pinetum silvestris-nigrae macedonicum* Em 1965, community of scots pine and black pine forests.

6.3.2.3.1 Description and distribution of forrest communities

ass. *Querco - Ostryetum carpinifoliae macedonicum* Ht.1938 – **community of pubscent oak and European hop-hornbeam.**

This forest community is spread in the lower parts of the Kriva Palanka region and takes up the lower part of the forest belt. The soil is eutric cambisol, medium deep to shallow, sand-slit and dry. It develops over steep terrains with inclination from 20 to 30°. It belongs to the habitat of the European hop-hornbeam type (EUNIS 2004: G1.7C1). The ecosystem engineer of this forest community is the European hop-hornbeam *(Ostrya carpinifolia).*

In the canopy layer of trees, alongside the European hop-hornbeam, we meet also: *Quercus pubescens*, *Quercus cerris, Sorbus torminalis and others.*

In the shrub layer we meet: *Cornus mas, Crategus monogina, Juniperus oxycedrus, Juniperus communis, Malus silvestrus* etc.

In the herbaceous canopy layer we meet: *Lathirus inermis, Trifolium pignati, Potentila micranta, Luzula forsteri, Poa nemoralis* etc.

Due to the increased exploration by the domestic population, this forest community is degrade, has a poor quality and in some places has been brought down to the thicket stadium.

ass. *Qurco-Carpinetum orientalis macedonicum* Rud.1939 ap. Ht.1946 - **community of pubescent oak and oriental hornbeam.**

This forest community, just like ass. *Querco-Ostryetum carpinifoliae* spreads in the lower parts of the Kriva Palanka region, taking up the lower part of the forest belt. The soil is eutric cambisol, medium deep to shallow, sand-slit and dry. It develops over steep terrains with inclination from 20 to 25°. It belongs to the habitat type eastern (oriental) hornbeam forests (EUNIS 2004: G1.7C2). It has a rare density and large number of thermophilic species. It is a thermophilic and Xerophilic community and most often it develops over skeletal soils (silicate or carbonate). The main ecosystem engineers in these forests are the oriental hornbeam (*Carpinus orientalis*) and the pubescent oak (*Quercus pubescens).*

In the tree canopy layer we meet: pubescent oak *(Quercus pubescens),* oriental hornbeam *(Carpinus orientalis*)*,* South European flowering ash *(Fraxinus ornus)*

In the shrub canopy layer we meet: *Cornus mas, Crategus monogina, Juniperus oxycedrus, Juniperus communis, Malus silvestrus* etc.

In the herbaceous canopy layer we meet: *Lathirus inermis, Trifolium pignati, Potentila micranta, Luzula forsteri, Poa nemoralis* etc.

This forest community has been quite exploited in the past so in some places it is degraded and has a poor quality.

ass. *Quercetum frainetto-cerris macedonicum* Oberd. 1948 Em. Ht. 1959 – community of Hungarian oak and turkey oak.

The forest community of the Hungarian and turkey oak is equally spread in the middle part of the forest belt. The winters in this part are long and mildly cold, and the summers are warm with smaller quantity of rainfall. The soils are eutric cambisol, medium depth, sandy with a medium-thick layer of humus and litterfall. It belongs to the habitat type Helleno-Moesian forests (EUNIS 2004:G1.762). The Hungarian-turkey oak forests, together with the pubescent-hornbeam forests belong to the sub-Mediterranean Biome zone, mainly broad-leaved forests and thickets. These forests develop mostly in deep soils of silicate and sometimes carbonate substrate. In Macedonia, it is a climazonal community of the warm continental area. It could be found above 600 m.a.s.l. As ecosystem engineer we have the Hungarian oak (Quercus frainetto) and the turkey oak (Quercus cerris), and rarely in some open spaces we may encounter the pubescent oak (Quercus pbescens).

In the tree canopy layer of this forest community we find the following types: *Quercus frainetto, Quercus cerris, Quercus pubescens, Sorbus torminalis* etc.

In the shrub canopy layer we find the following types: *Cornus mas, Malus silvestris, Crataegus monogina, Juniperus communis, Juniperus oxicedrus* etc.

In the herbaceous canopy layer we find the following types: *Poa nemoralis, Lathirus inermis, Festuca Heterophyla, Luzula forsteri* etc.

The forests in this community are mostly coppice forest, with low coverage, poor quality, and in several places they are degraded.

ass.*Orno-Quercetum petreae* Em 1968 – **forest community of sessile oak**

The forest community of the sessile oak continues further above the Hungarian oak forests. It is spread at 880 to 1100 m.a.s.l. It belongs to the habitat type continental oak forests (EUNIS 2004: G1.7641) and belongs to the south-European biome zone, mostly broad-leaved forests.

This community is climazonally in the cold continental area in the elevation belt from 900 to 1100 m.a.s.l. and the sessile oak (*Quercus petraea*) is dominant in the area. It is spread over eutric cambisol soils which are medium deep to shallow, sand-slit and dry. The terrain inclination is up to 20°. According to the floristic composition this community is quite rich and is dominated by thermo-mesophilic elements. The ecosystem engineer is the sessile oak (*Quercus petraea*).

In the tree canopy layer we find the following types: sessile oak (*Quercus petraea*), turkey oak (*Quercus cerris*), Hungarian oak (*Quercus conferta),* oriental hornbeam (*Carpinus orientalis)*, etc.

In the shrub canopy layer we find the following types: *Fraxinus ornus Crategus monogina, Corilys avellana, Cornus mas, Juniperus communis, Rosa canina* etc.

In the herbaceous canopy layer we find: *Luzula forsteri, Lathyrus inermis, Festuca heterophyla* etc.

In this forest community, part of the forests are with a weaker quality from a vegetative origin, but there are also more preserved forest parts from a generative origin.

ass. *Festuco heterophyllae Fagetum* Em 1965 - **community of sub-montane beech forest**

The forest community of the sub-montane beech forest, continues in altitude above the sessile forest belt. It is spread over brown forest soils (dystric cambisol), with medium depth, rich in humus and litterfall. The terrain is medium-steep to steep, with inclination of 15 to 25°, intersected by short valleys and dales. The climate is alpine with cool summers and cold, snowy winters. It belongs to habitat type Southwestern Moesian beech forests (EUNIS 2004: G1.691).

The dominant tree type in the community is the beech (*Fagus moesiaca*) and in the tree canopy layer we meet the following types too: sessile oak (*Quercus petraea*)*,* aspen (*Populus tremula*)*,* turkey oak (*Quercus cerris*), wild cherry (*Prunus avium*) etc.

In the shrub canopy layer, which is not prominent due to the great shade cast by the beech, we meet the following types: *Corylus avellana, Cornus mas, Juniperus communis, Rosa canina etc.*

In the herbaceous canopy layer, the mesophilic types dominate, adapted to the place of growth and the beech shade. During the site investigation, the following species were recorded*: Festuca heterophilla, Dentaria bulbifera, Luzula silvatica, Asperula odorata,* etc.

This forest community, in regards to the place of growth and the practices applied in the past, in certain places is preserved in a coppice forest form, but in most places it is of vegetative origin, due to excessive use. This community has a great economic value and in it, intensive forest management activities are being carried out. In certain parts of this forest community, the following coniferous types have been artificially introduced: black pine, white pine, Douglass fir, larch and spruce.

ass. *Fago-Pinetum nigrae* (Ht. Et Em 1963) Em 1981 - **community of mountain beech forest with black pine**

We meet this forest community over an area of 478,18 ha over medium deep and fresh forest dystric cambisol soils. The terrain has medium-steep to steep inclination. In this forest community's past, major forest-management activities have been done, where the beech was cut, and black and white pine was artificially introduced.

In the tree canopy layer we meet the following types: *Fagus moesiaca, Pinus nigra, Quercus conferta* etc.

In the shrub canopy layer we meet the following types: *Crategus monogina, Corilus avelana, Rosa cannina, Juniperus communis,* etc.

In the herbaceous canopy layer we meet the following types: *Festuca heterophylla, Poa nemoralis, Potentila mycrantha, Robus ideus,* etc.

The stands in this forest community are mostly of young age and that is why nurturing measures are undertaken.

ass.*Calimintho grandiflorae-Fagetum* Em 1965 - community of mountain beech forest

The mountain beech forest spreads over the mountain, cold, continental plan area. It is a climazonal community which is formed on deep, fresh and loose brown forest soils. It could be found over terrains with different steepness and inclination, and it thrives best on colder expositions. It belongs to habitat type Southwestern Moesian beech forests (EUNIS 2004: G1.691).

In the tree canopy layer, the beech *Fagus moesiaca* is dominant, and separately we find the following types: *Acer pseudoplatanus, Acer platanoides, Populus tremula* etc.

In the shrub canopy layer we meet the following types: *Crategus monogina Corylus avellana, Cornus mas* etc.

In the herbaceous canopy layer we meet the following types: *Veronica officinalis, Actea spicata, Anemone nemorosa, Geranium roberianum, Calamintha grandiflora, Robus ideus, Dentaria bulbifera, Blechnum spicant* etc.

In this forest community, part of the forest is from a generative, part from a vegetative origin. They are characterized by a high wood mass production and have great economic value.

ass. *Pinetum silvestris-nigrae macedonicum* Em 1965-**community of black pine and white pine**

This forest community appears at secondary habitats of thermophilic and mesophilic biotope in the belt of sub-montane and mountain beech forest. The soil is light-brown and with medium depth.

In the tree canopy layer we meet the following types: *Pinus nigra, Pinus silvestris, Quercus conferta, Quercus cerris, Quercus petraea* etc.

In the shrub canopy layer we meet the following types: *Cornus mas, Crategus monogina, Corilus avelana, Rosa cannina, Juniperus communis, Juniperus oxicedrus* etc.

In the herbaceous canopy layer we meet the following types: *Lathyrus inermis, Luzula nemoroza, Euphorbia amygdaloides, Atropa beladona, Festuca heterophylla, Poa nemoralis, Potentila mycrantha, Robus ideus* etc.

It was created by reforestation with black pine over bare and degraded forest areas and has been developing successfully in the last 50 years, and is characterized by high productiveness.

-Area, wood mass and growth by forest communities

The area, wood mass and growth of the forest communities are important markers by which we can appreciate their structure, quality, conditions, diversity, meaning, etc. The basic data about the area, wood mass and the current growth by forest communities is presented in the following chart and graphically displayed in the next graph.

Table 36 Area, wood mass and growth by forest communities

Forest community	Area	Presence	Wood mass		Current growth	
	ha	%	m³	%	m³	%
Querco pubescentis-Ostryetum carpinifoliae	649,11	2,3	77823	1,9	1850	2,3
Querco carpinetum orientalis macedonicum	1020,28	3,5	43720	1,1	1156	1,5
Quercetum frainetto – cerris macedonicum	1905,82	6,6	120516	2,9	3605	4,5

Orno-Quercetum petreae	5442,64	18,9	338578	8,3	8003	10,0
Festuco heterophyllae-Fagetum	6615,65	22,9	1037295	25,5	18641	23,3
Fago-Pinetum nigrae	478,18	1,7	68532	1,7	2972	3,7
Calimintho grandiflorae – Fagetum	9356,82	32,5	2033632	49,9	32421	40,5
Pinetum silvestris-nigrae	3348,83	11,6	353827	8,7	11339	14,2
Total	**28817,33**	**100**	**4073923**	**100**	**79987**	**100**

Source: Special plans for forestry

Figure 94 Forest communities presence by area

The total area of forest communities of the Kriva Palanka region is 28817,33 ha. They contain 4073923 m³ wood mass, and the annual growth is 79987 m³.

The ass. *Calimintho grandiflorae-Fagetum* has the greatest share by area, spread over 9356,82 ha and taking 32,5% of the total forest area. Greater presence is notable by ass. *Festuco heterophyllae-Fagetum*, over 6615,65 ha or 22,9 % of the total forest area, as well as ass.*Orno-Quercetum petreae* over 5442,64 ha or 18,9% of the total forest area. The forest community *Pinetum silvestris-nigrae* spreads over 3348,83ha or 11,6% of the area. Other forest communities ass. *Quercetum frainetto-cerris macedonicum, Querco carpinetum orientalis macedonicum, Querco ostryetum carpinifoliae* and *Fago-Pinetum nigrae* are present with less than 10%, going from 6,6 to 1,7%.

Despite the different presence by area, we need to point out that all forest communities have their importance to the preservation of the forest biodiversity, because in all of them we find numerous different species searching for the optimal conditions for development in the different forest communities.

The ass. *Calimintho grandiflorae-Fagetum* possesses the greatest wood mass, which is 2033632m³, followed by ass. *Festuco heterophyllae-Fagetum* with 1037295m³. In these two forest communities, 3070927 m³ wood mass are concentrated, or 75,4% of the total wood mass. In ass. *Pinetum silvestris-nigrae* there is 353827 m³ wood mass or 8,7% wood mass, and in ass. *Orno-Quercetum petreae*, there is 338578 m³ or 8,3% of the wood mass. In the rest of the forest communities, a noticeably lower wood mass is concentrated, moving between 1,1 to 2,9% from the total wood mass.

The ass. *Calimintho grandiflorae-Fagetum* has the greatest annual growth with 32421 m³ annually and its share is 40,5% of the total current annual growth, followed by ass. *Festuco heterophyllae-*

Fagetum with 18641 m³ or 23,3%. In ass. *Pinetum silvestris-nigrae* there is 11339 m³ current growth or 14,2% of the total current growth, and in ass. *Orno-Quercetum petreae* there is 8003 m³ or 10% of the current growth. The rest of the forest communities have a significantly smaller share of the total current growth which moves between 1,5 and 4,5%.

The abovementioned forest communities belong to the following Special Plan for Forestry by Forest Units: Dlabočica-Kiselica, Kriva Palanka-Anishte and Kriva Reka-Stanecka Reka.

The community of pubescent oak and European hop-hornbeam, the community of pubescent oak and oriental hornbeam are highly sensitive habitats due to their degradation and fragmentation. All these communities are under zoo-anthropogenic influence thus making their revitalization even harder.

Although the Hungarian oak and turkey oak forests are included in Annex I EU Directive 92/43/EEC, in Macedonia they are wide spread. They even build a continuous climazonal belt between 700 and 900 m.a.s.l. The forests in the area are under the influence of direct economic activities, and under the influence of the local population. The Annex I EU Directive 92/43/EEC includes the sessile oak forests, as well as the sub-montane and montane beech forests. The sessile oak spreads over the upper part of the beech forest belt between 900 and 1100 m.a.s.l., and the sub-montane beech forest the lower part of the beech forest belt between 1100 and 1350 m.a.s.l. from 1350 to 1650 m.a.s.l. we have the mountain beech forests, which are also more preserved. The main forest management activities are concentrated in these three types of forests and they have a great importance over the wood economy because they contain the largest part of wood mass in the stands.

Due to the notable forest degradation processes in the past, and in order to improve the structure of the forest fond, to preserve the environment, increase erosion protection etc. in many places in the region reforestation with different species has been done. It has been done in the oak and beech forest region, also over barren and eroded forest land. Most of them were black pine seedlings, but also scots pine, larch, Douglass fir, spruce, black locust, etc. In that manner, greater areas of anthropogenic forest stands have been created where the black pine seedlings are dominant. These pine forests as anthropogenic creations do not have a great importance to the biodiversity in the region, but they have a great economic value, because they have great productive potential and better growth than the autochthonous trees, and great importance in erosion protection and environment conservation.

- **Description of the Corridor forests, 500 m left and right of the railroad axis**

In the researched corridor, we encounter heavily degraded pubescent-hornbeam communities, which often look like hill pastures with remains/elements of pubescent-hornbeam forests.

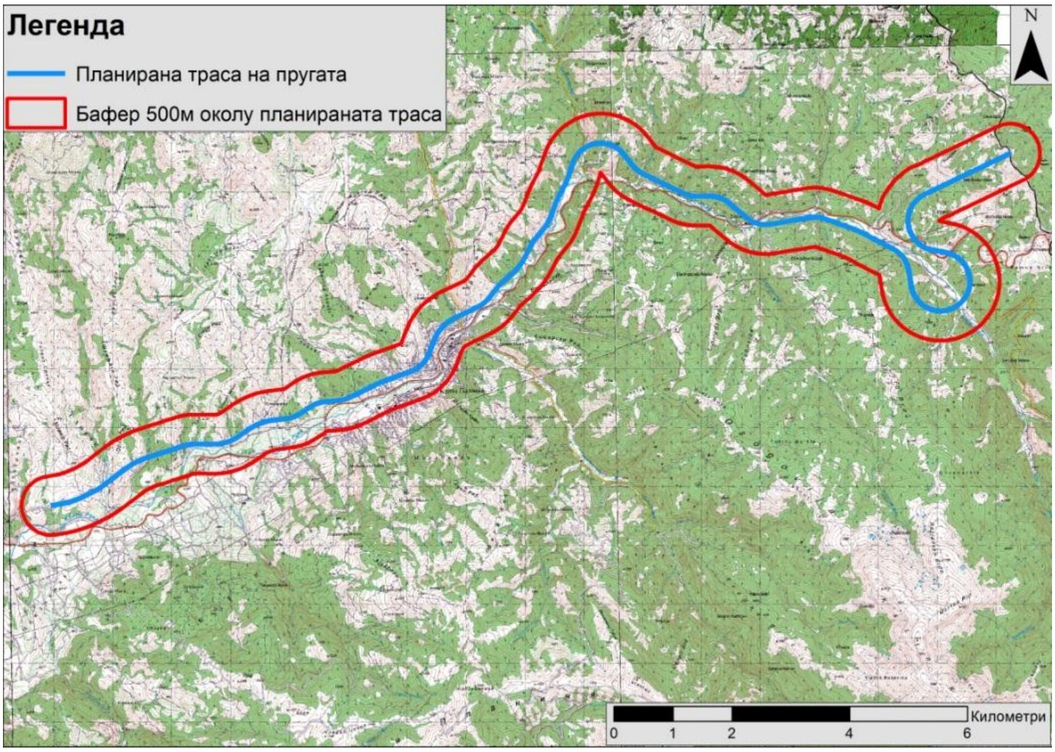


Figure 95 Display of the railroad line. Legend: *planned alignment, buffer 500 m around the alignment*

The sessile oak forests take up the highest parts of the oak forest belt. In some parts of this community, in a land protection effort, black locust reforestation has been done.

The most protected community is the community of sub-montane beech forest despite the fact that in some parts of it, certain disturbance could be noticed, mainly illegal deforestation. The community of pubescent oak and oriental hornbeam is the most degraded community, and in some places it is totally destroyed. The strong zoo-anthropogenic influence is noticeable, and the more preserved parts could be located fragmentally in separate and disconnected enclaves. The planted stands of black locust, black pine and others are in good condition.

For the current communities, a valorization according to the EUNIS habitat classification system has been done and the corresponding habitats according to the Directive for habitats and the Palaearctic classification.

Table 37 List of habitats that intersect with the project area

EUNIS		EU habitats directive			Palaearctic classification. (Code Palearctic)	Plant community (phytocoenosis)
Code	**Name**	**Code**	**Name**	**Priority**		
G1. 7C11	Thracio-Macedonian Oriental Hornbeam Thicket					*Querco-Ostryetum carpinifoliae* Ht.1938 – pubescent oak and European hop-hornbeam community
G1.762	Helleno-Moesian *Quercus frainetto* Forests	9280	*Quercus frainetto* woods		41.1B	*Quercetum frainetto-cerris macedonicum* Oberd. 1948 Em. Ht. 1959 – hunagarian oak and turkey oak community
G1.7641	Continental	91M0	Pannonia		41.7696	*Orno-Quercetum petreae*

	(*Quercus petraea*) Forests		n-Balkanic turkey oak-sessile oak forest			Em 1968 – sessile oak community
G1.691	Southwestern Moesian Beech Forests	91W0	Moesian Beech Forests		41.192	*Festuco heterophyllae Fagetum* Em 1965 2011– community of sub-montane beech forest
G1.691	Southwestern Moesian Beech Forests	91W0	Moesian Beech Forests		41.192	*Calimintho grandiflorae – Fagetum* Em 1965 - community of mountain beech forest
G1.11	Riverine (*Salix*) Woodland	92A0	Salix alba and Populus alba galleries	*		*Salicetum albae-fragilis* Soo (1930, 1934) 1958- community of riverine willow and poplar

Within the project area we find a low number of habitats which are included in the Annex I of the EU Directive 92/43/EEC which means that the EU member states or a candidate countries (such as Macedonia) are obligated to protect. Some of these habitats in Macedonia are frequent and widely spread. Despite that, some habitats have an EU priority protection (marked by a "*"), i.e. they require an assignment of special protection areas (Natura 2000).

The priority habitats **Subcontinental peri-pannonic scrub** and **Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior*** are present in the broader area. However, both of these habitats **are not present in the defined project area of 500 m width** (see Habitat map). Subcontinental peri-pannonic scrub occupies localities at lower altitudes and higher insulation and in the project area this vegetation type is replaced by the *Quercus frainetto* woods (degraded or preserved). Only few elements of the Subcontinental peri-pannonic scrub were observed in close proximity to the villages Mozdivnjak, Talminci and Dlabochica. Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior* are also present in the broader area, but not in the defined project area (see Habitat map). All of the riparian belts and woodlands in the project area are represented by the *Salix alba* and *Populus alba* galleries (Salicetum albae-fragilis).

Along the flow of Kriva Reka and the lower parts of its tributaries, we meet alder and willow belts. They are considered priority habitats for protection according to the EU Directive 92/43/EEC. These belts are remains of riverine forests and are considered under threat due to exploitation and fragmentation. They also have an important ecological function: to protect and mitigate floods, protect the riverine flora and fauna, and are highly sensitive habitats. The alder belts belong to habitat type (EUNIS 2004:G1.12) and the willow belts belong to habitat type (EUNIS 2004:G1.11). In the alder belts, the ecosystem engineer is the alder[11] (Alnus glutinosa). Alongside the alder, other tree and shrub types have been noted: *Carpinus betulus, Salix amplexicaulis, Juglans regia, Clematis vitalba, Sambucus nigra* and others. In the canopy layer of shrub plants we meet *Ranunculus ficaria, Lamium purpureum, L. maculatum* and others. The willow belts in the researched corridor are less prominent than the alder belts. They are spread near rivers i.e. places which are flooded during spring, and during summer the water descends to the deeper soil layers. The soil is sandy or alluvial, loose and

[11] An ecosystem engineer is any organism that creates, significantly modifies, maintains or destroys a habitat.

rich in mineral matter. The communities of willow belts belongs to the alliance Salicion albae Soô (1930) 1940 and the association Salicetum albo-fragilis Issler 26 em. Soô 57. In the tree canopy layer the white willow (*Salix alba*) dominates, and alongside it we find: *Salix fragilis, Populus alba, Salix amplexicaulis, Alnus glutinosa* etc. The willow and alder belts are threatened due to the high degree of engineering of riverbeds (river channelization) and intensive zoo-anthropogenic influence in the river basins.

From a forest-management aspect, the starting point of the line is in a clear part between subsection 10b and 10e from the forest management unit “Dlabočica-Kiselica”.

The subsection 10b is left (eastward) of the line and represents mixed coppice forest stand of pubescent oak and oriental hornbeam with poor quality. The trees are non-straight trunked, with poor quality trunks and medium-good developed crowns. The coverage is rare 0,3 to 0,4. In the stand, there is a natural renewal of pubescent oak and oriental hornbeam seedlings, which is manly from a vegetative origin with separate trees from generative origin. The stand is 50 years of age and has 20 m^3 wood mass per 1 ha, current growth of 4,0 m^3/ha and 1500 trees over 1 ha.

The subsection 10e is located right (eastward) of the line and represents a pure coppice forest, cultivated stand of black pine with medium-good quality. The trees are weak straight-trunked with medium-good quality and well developed crowns. The cover of the stand is incomplete 0,5 to 0,6. There is no natural renewal in the stand. The health condition is good. The stand is 30 years of age and has 52 m^3 wood mass per 1 ha, current growth of 4,0 m^3/ha and 1500 trees over 1 ha.

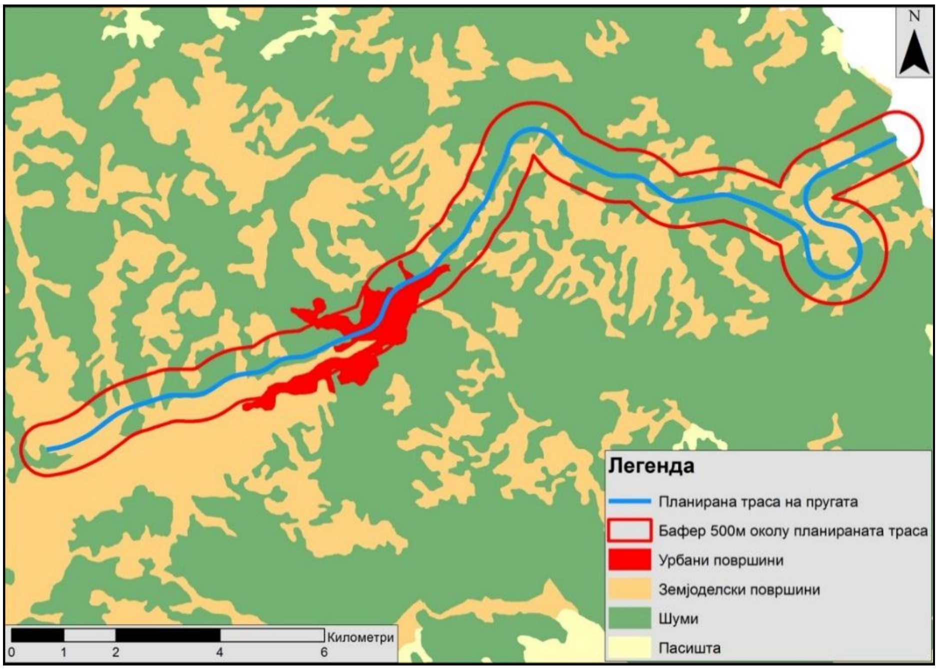


Figure 96 Display of the land use along the railroad line: *planned alignment, buffer 500 m around the alignment, urban fabric, agricultural land, forests, pastries*

The start of the line is the chainage 64+942,01, over a bare-unwooded forest area around which we encounter separate trees and shrubs: pubescent oak, wild pear, blackthorn, Common juniper, etc. then the line moves towards the chainage 66+1000 through a sparsely wooded parts of the sections 10, 11 and 23 of the forest management unit “Dlabočica-KIselica”. The chainage 66 is above the v. T’lminci and there we encounter riverine and agricultural vegetation, such as: black poplar, willow, separate oak trees, pear trees, apple trees, etc., as well as coppice forest vegetation of pubescent oak. At this location Bridge no. 2 will be constructed, an incision, than Bridge no. 3, after which the line need to pass through Tunnel 1 over Orov Rid. From the tunnel, the line moves to section 24a consisting of a mixed coppice forest stand of pubescent oak and oriental hornbeam with rare stand cover of 0,4. Separately, we meet the Hungarian oak too. The stand is 50 years of age and has a renewal from vegetative origin from pubescent oak and Hungarian oak in a seedling phase. In this stand there is 20 m^3 wood mass per 1 ha, current growth of 4,0 m^3/ha and 1100 trees over 1 ha. After the exit of Tunnel 1, the Bridge no. 4 will be constructed, and the line moves through forest encompassed by the section 24a all the way to Gradeshka Reka. Over Gradeshka Reka, Bridge no. 5 is planned to be constructed, and then the construction of Tunnel no. 2. These activities will be done in land of subsection 27a and subsection 27d. Subsection 27a is mixed coppice forest plant stand of pubescent oak and oriental hornbeam with stand cover of 0,4. The stand is 50 years of age and has a renewal of vegetative origin from pubescent oak and oriental hornbeam in a seedling phase. In this stand there is 20 m^3 wood mass per 1 ha, current growth of 0.20 m^3/ha and 1140 trees over 1 ha. Subsection 27d is planted stand of good quality black pine. They are straight trunked trees, with quality trunks and well developed crowns. The coverage of the stand is around 0,6 and the health condition is good. The stand is 35 years of age with 67 m^3 wood mass per 1 ha, current growth of 4,0 m^3/ha and 1500 trees over 1 ha.

After Tunnel no. 2 the construction of Bridge no. 6 and Tunnel no. 3 is planned, which begins in a black pine stand, and exits in a mixed black pine and oak stand, where the construction of Bridge no. 7 is planned. The line moves through subsections 28d and 28a and subsections 29a and 29d. The subsections 28a and 29a are mixed coppice forest stands from poor quality pubescent oak and oriental hornbeam. The trees are non-straight trunked with poor quality and medium-good developed crowns. The cover of the stand is rare 0,3 to 0,4. In the stands there is a natural renewal in a seedling stadium of pubescent oak and oriental hornbeam, which is of mainly vegetative origin with separate trees of generative origin. They are 50 years of age with 20 m^3 wood mass per 1 ha, current growth of 0,20 m^3/ha and 1142 trees over 1 ha. The subsections 28d and 29d are artificially planted cultivated coppice forest black pine stands. The trees are straight, with quality trunks and well developed crowns. The coverage of the stand is around 0,6 and the health condition is good. The stand is 35 years of age with 67 m^3 wood mass per 1 ha, current growth of 4,0 m^3/ha and 1500 trees over 1 ha.

After Bridge no.7 starts Tunnel no. 4, and then Bridge no. 8 which leads to Konopica, where the line moves throughout section 30 and encompasses the following subsections: 30a, 30d, 30e, 30f and 30g. The subsection 30a is a mixed coppice forest stand of pubescent oak and oriental hornbeam with rare stand cover up to 0,4. The stand is 50 years of age, and has renewal from vegetative origin from pubescent oak and oriental hornbeam in seedling phase. In this stand, there is 20 m^3 wood mass per 1 ha, current growth of of 0,20 m^3/ha and 1140 trees over 1 ha. The subsections 30d, 30e, 30f and 30g are pure coppice forest, cultivated good quality black pine stands. They are straight trunked trees with good quality and fully developed crowns. The stand cover is not full 0,5 to 0,6 at subsections 30e and 30g, and thick 0,8 to 0,9 at subsections 30d and 30f. There is no natural renewal in the stand, and the health condition is good. The stand is 40 years of age. The wood mass in the subsections 30d and 30f is 129 m^3/ha, current growth of 4,1 m^3/ha with 1504 trees/ha. In subsections 30e and 30g the wood mass is 87 m^3/ha, current growth of 3,1 m^3/ha with 1128 trees/ha. Between subsection 30d and 30e, the construction of Tunnel no. 5 is planned.

From section 30 the line moves to section 31, which consists of three different stands encompassed by subsections 30a, 30b, and 30c. The stands 31a and 31b are pure coppice forest, cultivated good quality black pine. The trees are straight trunked with good quality and good developed crowns. The stand cover is thick 0,8 to 0,9. There is no natural renewal in the stands, and the health condition is good. The stands are 40 years of age. The wood mass is 119 m^3/ha, current growth of 4,1 m^3/ha with 1504 trees/ha. The subsection 31v represents a pure culture medium good quality black locust. The trees are weak straight trunked with medium good quality and good developed crowns. The stand cover is incomplete 0,5 to 0,6. There is natural black locust renewal in the stand from a vegetative origin. The health condition is good. The stand is 25 years of age and has 28 m³/ha wood mass, current growth of 1,9 m³/ha with 1900 trees/ha. In this section, the construction of Tunnel no. 6 is planned, as well as the bridges number: 9, 10, 11, 12, 13 and even Bridge no. 14 by intersecting with the main road and continuing with Bridge no. 15, bridges 16, 17, 18 and 19 to the beginning of the Kriva Palanka station. The Corridor moves through the section 32a which is a mixed coppice forest even-aged stand of pubescent oak and turkey oak with rare stand cover. The tree-trunks have poor quality but are in good health condition. The stand is 50 years of age and has 119 m³/ha wood mass, current growth of 4,1 m³/ha with 1504 trees/ha. There is renewal from Hungarian oak and Turkey oak in seedling phase. After this, the corridor takes up a small area of the subsection 33b which is a pure coppice forest cultivated good quality black pine. Is has well developed, quality crowns, straight-trunks and good health condition. The stand is 40 years of age, and has 145 m³/ha wood mass, current growth of 4,1 m³/ha with 1504 trees/ha. The line further passes through barren forest area encompassed by section 34 and moves through the northern peripheral parts of the town, where housing objects have been constructed. In such environment the construction of Bridge no. 20 and Bridge no. 21 is planned, as well as the tunnels 7 and 8, whereby Tunnel no. 8 is characterized by a greater length. The terrain is rocky, steep with low shrub vegetation. Tunnel no. 8 moves through the lower parts of section 35d which is a black locust forest culture 25 years of age. The trees are weak-straight trunked with medium-good quality and good developed crowns. The coverage is incomplete 0,5 to 0,6 and there is black locust renewal from vegetative origin. In this stand there is 40 m³/ha of wood mass, current growth of 1,9 m³/ha with 1850 trees/ha. The corridor line encompasses the subsection 35b also, which is a pure coppice forest cultivated good quality black pine and thick stand cover of 0,8 to 0,9. It is characterized by good quality, well developed crowns, straight-trunks and good health condition. The stand is 40 years of age and has 119 m³/ha wood mass, current growth of 4,1 m³/ha with 1500 trees/ha.

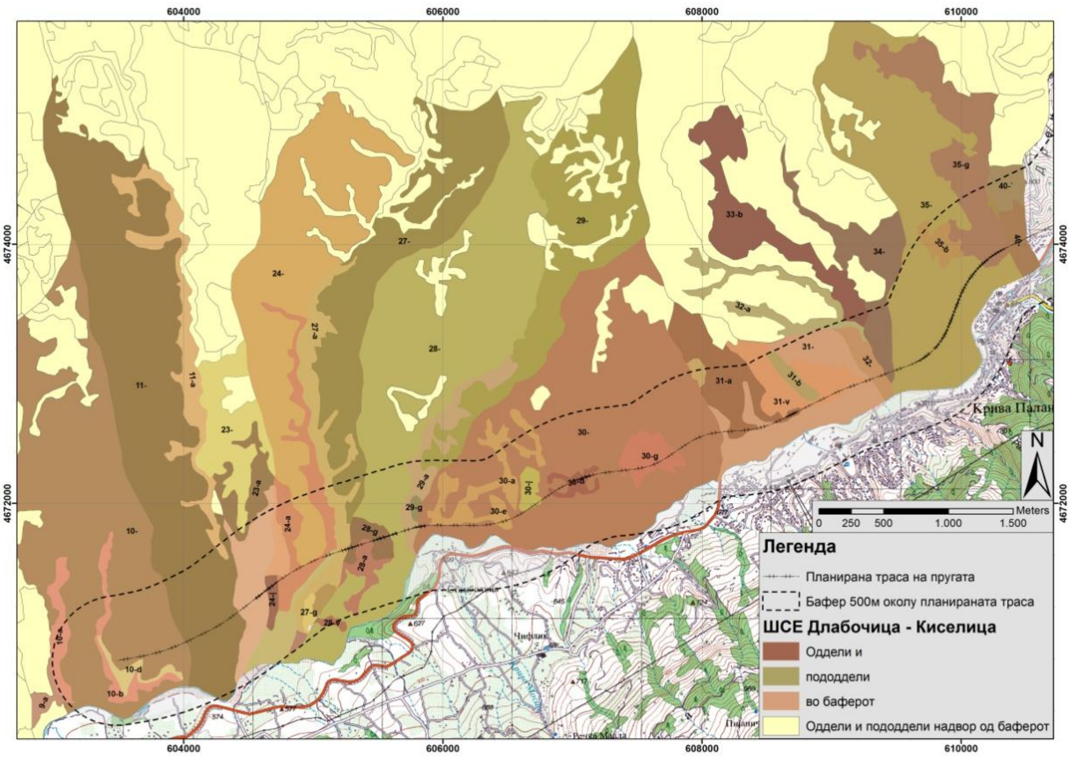


Figure 97 A display of the line axis with the corridor around it in the forestry unit Dlabočica – Kiselica. Legend (up to down): *planned alignment, buffer 500 m around the planned alignment,* ***forest unit Dlabochica – Kiselica,*** *sections, subsections, within the buffer, sections and subsections outside the buffer*

After exiting from Tunnel no. 8 through subsection 35d, the line moves to Domački Dol where it continues with Bridge no. 23 and Bridge no. 24. In this part, alongside the earthen construction works, there will be a demolition of certain housing objects, and the bridges will be constructed above parts of forest and riverine vegetation. From Domački Dol the line moves to Drenje, in the immediate vicinity of constructed houses and under the lower parts of section 40h which is represented by forest culture from black locust with the same characteristics as the black locust in section 35d. The line exits Kriva Palanka and along the hill and the flow of Kriva Reka, continues towards Židilovo.

From the site “Drenje” the line enters into the forest management unit “Kriva Palank-Anishte” in section 1 where Tunnel no. 9 will be constructed. The line moves through subsections 1a, 1b, and 1d. The subsections 1a and 1d consist of artificially planted black pine stands with pubescent oak, oriental hornbeam and other deciduous tree additions. The coverage is 0,8 and the black pine trees are full-stemmed, with well-developed crowns and good health condition. There is separate seedling and in groups of black pine, pubescent oak and other deciduous species. The stands are 45 years of age, with wood mass of 154m^3, current growth of 5,6 m^3/ha and 1350 trees/ha. The subsection 1b is artificially planted black locust stand with pubescent oak, oriental hornbeam and black pine additions. The trees have medium quality and in good health condition. The stand is 25 years of age with coverage 0,8. It has a wood mass of 40 m^3/ha, current growth of 2,8 m^3/ha and 3930 trees/ha. The subsection 1c is a coppice forest degraded stand of pubescent oak, oriental hornbeam and other deciduous species with separate addition of black pine. The trees have poor quality and medium good developed crowns. The stand is 40 years of age with 0,7 stand cover. It has 20 m^3/ha wood mass, current growth of 0,7 m^3/ha и 1830 trees/ha.

From section 1 the line moves to section 2 where Tunnel no. 10 and Tunnel no. 11 will be constructed. The line moves through the subsections 2a, 2b and 2c. The subsections 2a and 2b are coppice forest planted black pine stands with added pubescent oak, oriental hornbeam and other deciduous species. The cover of the stand is 0,8 and the black pine trees are full-stemmed trunks, well developed crowns and in good health condition. There are separate seedlings and in groups with black pine, pubescent oak and other deciduous species. The stands are 45 years of age, with wood mass of 160 m^3/ha, current growth of 5,6 m^3/ha and 1300 trees/ha. The subsection 2c is a coppice forest degraded stand of pubescent oak, together with some oriental hornbeam and other deciduous species. The trees are branched with crooked trunks and weak quality. There is vegetative renewal, and the stand coverage is 0,8. The wood mass is 25 m^3/ha, current growth of 0,7 m^3/ha and 1800 trees/ha.

From section 2 the line moves to section 3 through the subsection 3a, 3b, 3c. The subsection 3a is a coppice forest black pine planted stand with pubescent oak, oriental hornbeam and other deciduous types of trees added. The coverage of the stand is 0,8, and the black pine trees are with straight-trunk, well developed crowns and in good health condition. There are separate seedlings and in groups with black pine, pubescent oak and other deciduous species. The stand is 45 years of age, with wood mass of 170 m^3/ha, current growth of 6,0 m^3/ha and 1220 trees/ha. The subsections 3b and 3c are coppice forest stands of degraded pubescent oak and added oriental hornbeam and black locust. The trees are branched with crooked trunks and poor quality. There is vegetative renewal and the stand cover is 0,8. The wood mass is 45 m^3/ha, current growth of 0,9 m^3/ha and 1150 trees/ha.

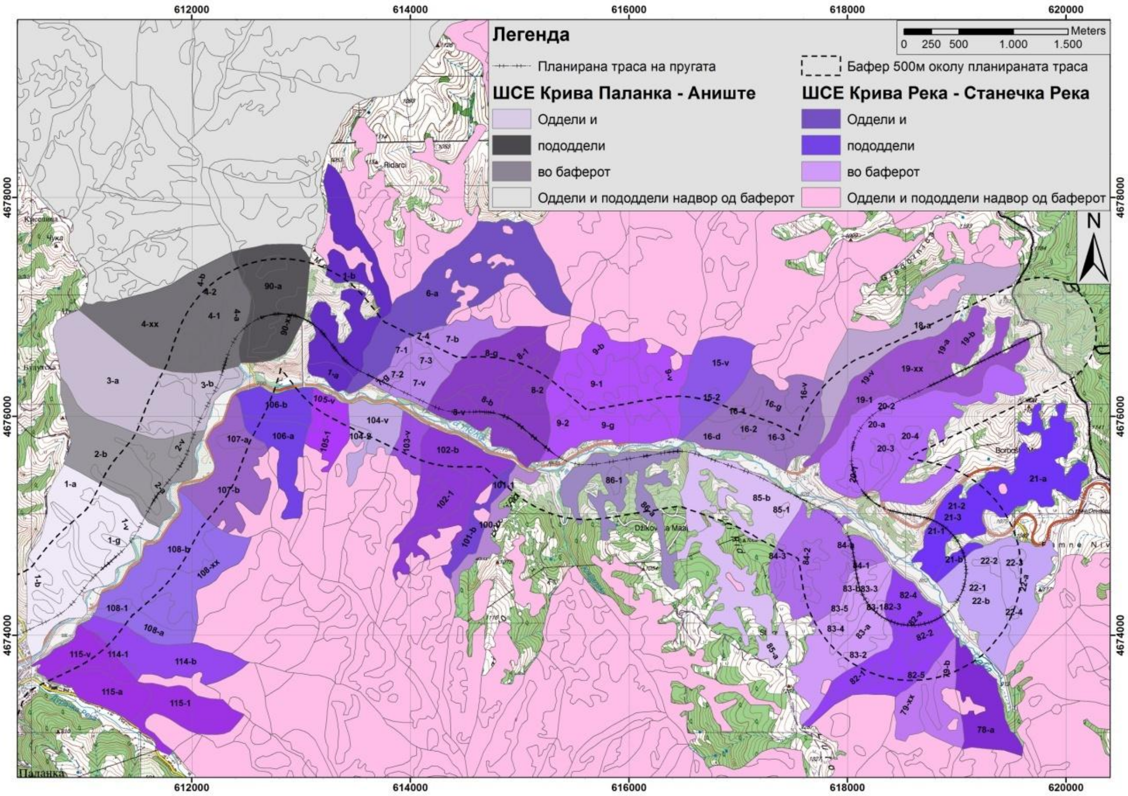


Figure 98 Display of the line axis with the corridor around it in the forestry units Kriva Palanka-Anishte and Kriva Reka-Stanecka Reka. Legend (up to down): *planned alignment, **forest unit Kriva Palanka – Anishte**, sections, subsections, within the buffer,sections and subsections outside the buffer, buffer 500 m around the alignment, **forest unit Kriva Reka – Stanechka Reka**, sections and subsections, within the buffer, outside the buffer*

From section 3 the line moves to section 4 through the subsection 4a and 4b. In this section, the construction of Tunnel no. 12 is planned. The two stands are coppice forest degraded stands of pubescent oak with oriental oak and other deciduous species added. The trees are branched with crooked trunks and poor quality. There is vegetative renewal, and the coverage is from 0,8 to 0,9. The stand in section 4a is 50 years of age, with wood mass of 72 m³/ha, current growth of 2,8 m³/ha and 1010 trees/ha, and the stand in 4b is 60 years of age, has 166 m³/ha wood mass, current growth of 2,9 m³/ha and 1000 trees/ha.

From section 4 the tunnel turns semi-circularly over Kiselicka Reka and moves to section 90a where the construction of Tunnel no. 13 is planned. This section is a mixed stand of black pine with pubescent oak and European hop-hornbeam. The tree-trunks are with good quality and branched crowns. There is separate and group renewal. The coverage is 0,9 and the age is 40 years. The wood mass is 145 m³/ha, current growth of 5,6 m³/ha with 1660 trees/ha.

From section 4 through Tunnel no. 13 the line moves in the forestry unit “Kriva Palanka-Stanecka Reka” through the subsections 1b and 1a. The subsection 1b is a mixed stand of pubescent oak and black locust with added hazel, turkey oak, hornbeam, South European flowering ash etc. The trees have poor quality and branched crowns with the exception of some trees which have higher quality and could mostly be found around boundaries and private properties. In this stand we find fruit trees too. There is separate and group renewal. The coverage is 0,6 and the age is 40 years. The wood mass is 34 m³/ha with current growth of 0,6 m³/ha and 1762 trees/ha. The subsection 1a is coppice forest artificially planted black pine stand with separate trees from added pubescent oak, hornbeam, hazel, birch and other deciduous species. The coverage is 0,7, and the black pine trees have poor quality and branched crowns due to the growth conditions of the poor location. There is separate and rare renewal. The stand is 37 years of age, the wood mass is 38 m³/ha with current growth of 2,1 m³/ha with 1670 trees/ha.

After exiting Tunnel no. 13 over the bridge on Židilovski Dol, the line enters Tunnel no. 14 which is located in section 6a, which is a mixed coppice forest stand of sessile oak with added: hornbeam, turkey oak, South European flowering ash, birch, hazel, etc. The tree-trunks have poor quality, they are short and branched with the exception of separate trees. Illegal logging is noticeable. There is renewal in good health conditions in seedling stadium. The age of the stand is 40 years, wood mass of 45 m³/ha, current growth of 0,8 m³/ha with 1203 trees/ha.

Through Tunnel no. 14 the line moves through subsections 7g and 7c, and the corridor from 500 m encompasses the subsection 7b too. The subsection 7c is a pure coppice forest stand of black locust where clear logging has been done 20 years ago. The whole stand is very thick and barely traversable with good health condition. The wood mass is 28 m³/ha, the current growth is 2,1 m³/ha with 2420 trees/ha.

The subsections 7d and 7b are coppice forest planted black pine stands with medium quality. The stand coverage is 0,9 and the black pine trees are with medium quality and good health condition. There is no renewal. The stands are 35 years of age, the wood mass is 69 m³/ha, the current growth 2,5 m³/ha with 1800 trees/ha

From subsection 7c the line moves through subsections 8d, 8c and 8b. In one part of the line through these sections, the construction of two tunnels is planned: Tunnel no. 15 and Tunnel no. 16. The subsection 8d is a pure coppice forest sessile oak stand with separate species added, such as hornbeam, black pine, South European flowering ash, hazel, etc. The stand has poor quality and coverage of 0,5 to 0,6. There is renewal in good health condition. The age of the stand is 45 years, the wood mass is 34 m³/ha, the current growth is 0,4 m³/ha with 680 trees/ha. The subsection 8c is a pure coppice forest black locust stand with separate additions of hornbeam, pubescent oak, hazel, etc. The stand is with medium quality and stand cover of 0,8 to 0,9. There is vegetative renewal in good health condition. The age of the stand is 20 years and clear logging has been done. The wood mass is 28 m³/ha, the current growth is 2,1 m³/ha with 2100 trees/ha. The subsection 8b is a planted pure black pine stand. Beside black pine, there are trees from these species too: sessile oak, South European flowering ash, hazel, etc. The stand has medium-quality and stand cover of 0,8 to 0,9. There is renewal in good health condition. The age of the stand is 32 years, the wood mass is 65 m³/ha, the current growth is 2,5m³/ha with 1780 trees/ha.

From the great Tunnel no. 16, the line moves out of the subsection 9d above v. Židilovo. Here, the construction of a bridge is planned, over which the line will move through Kriva Reka on the right side of the road towards Bulgaria. The stand 9d is mixed coppice forest stand of black locust and black pine. Separately we find other species, such as: sessile oak, birch, hazel, etc. Clear logging has been done in the black locust 20 years ago, and the black pine has been artificially planted. The stand has medium quality and good health condition. There is numerous vegetative renewal. The stand contains wood mass of 43 m³/ha, current growth of 1,8 m³/ha with 2045 trees/ha. The corridor spread over small areas in subsections 9b and 9c.

Across the bridge at Kriva Reka, the line moves into section 86a. The construction of Tunnel no. 17 and Tunnel no. 18 is planned in this section. The stand 86a is mixed coppice forest stand of beech, hornbeam, sessile oak, and birch with a separate presence of turkey oak and hazel. The trees are thin, branching with poor quality. There is renewal in good health condition. The stand is 40 years of age and has a wood mass of 36 m³/ha, current growth of 1,2 m³/ha with 1500 trees/ha.

After exiting Tunnel no. 18, the line moves into subsection 85b, which is a mixed coppice forest stand of hornbeam, pubescent oak, beech and black pine with separate presence of turkey oak, birch, hazel, etc. The stand has poor quality, and reforestation has been done over the barren areas with black and scots pine. There is renewal in good health condition. The stand is 40 years of age and has a wood mass of 42 m³/ha, current growth of 1,25 m³/ha with 1760 trees/ha.

From subsection 85b the line moves to section 84a, which is a mixed coppice forest stand of beech and sessile oak with separate presence of turkey oak, aspen, hazel, etc. The stand is of medium quality with 80 years of age. There is renewal in good health condition. It has a wood mass of 104 m³/ha, current growth of 1,1 m³/ha with 730 trees/ha. The start of the construction of the larger tunnel no. 19 is planned in this section, which will move under the following subsection too: 83b, 83a and 82a. The 83b stand is a mixed coppice forest stand of sessile oak, turkey oak and beech, with separate presence of birch, aspen and hazel, with medium quality and individual renewal in good health condition. The stand is 65 years of age with wood mass 83 m³/ha, current growth of 1,00 m³/ha with 685 trees/ha. The subsection 83a is mixed coppice forest stand of beech and sessile oak with separate presence of turkey oak, aspen, birch, hazel, etc. the stand has medium quality, and 80 years of age. There is separate and group renewal in good health condition. The wood mass is 170 m³/ha, current growth of 3,5 m³/ha with 1240 trees/ha. The section 82a is a mixed coppice forest stand of beech and sessile oak with separate presence of aspen, birch, hornbeam, haze, etc. The stand has medium quality and coverage of 0,6 at an age of 80 years. There is renewal with poor quality due to the damage done by cattle grazing. The wood mass is 105 m³/ha, the current growth is 1,9 m³/ha with 608 trees/ha.

After exiting Tunnel no. 19 in the lower part of section 82a the line crosses Kriva Reka over bridges and enters the subsection 22b where the construction of Tunnel no. 20, which will further move through the following subsections: 22b, 21b and 21a, exiting in the vicinity of the road to Bulgaria, where over a bridge at v. Uzem will enter section 20a. The subsection 22b is a pure coppice forest sessile oak stand with separate presence of turkey oak, black locust, hazel, etc. The stand has medium quality and coverage of 0,6-0,7, at an age of 50 years with poor quality renewal due to cattle grazing damage. The wood mass is 45m³/ha, the current growth is 0,55 m³/ha with 940 trees/ha. East of the line at 400 to 500 m lies subsection 22a through which the line with the tunnel does not pass, but this part of the subsection enters the corridor borders from 500 m. It is a mixed coppice forest stand with sessile oak, turkey oak and beech with separate presence of hornbeam and hazel with 65 years of age. Is has medium quality and group renewal with good health condition. The wood mass is 92 m³/ha, the current growth is 0,90 m³/ha with 590 trees/ha.

The construction of part of the bridge above the highway and the construction of Tunnel no. 21 is planned in section 20a, as well as other construction works along the line towards the border of Bulgaria. The section 20a is a mixed coppice forest stand of sessile oak and black pine with separate presence of hazel, aspen, hornbeam, etc. The trees have poor to medium quality with separate renewal in good health condition. The stand is 50 years of age with wood mass of 38 m³/ha, the current growth is 0,50 m³/ha with 786 trees/ha.

After exiting from 20a, the line enters the subsection 19b through Tunnel no. 23 which should be constructed from Mandalska Maala to the border of Bulgaria at the border crossing Ramna Niva. The 500 m corridor along the line on the north side encompasses the subsections: 19a, 19c, 18a, 16c, 16d, 16e, 15c and 9c. The subsection 19b is a mixed coppice forest stand of sessile oak and turkey oak with beech in the higher parts and separate presence of hornbeam, aspen, hazel, etc. The trees have poor to medium quality with separate renewal in good health condition. The stand is 40 years of age with coverage 0,5-0,6. It has wood mass of 30 m³/ha, the current growth is 0,60 m³/ha with 450 trees/ha. The subsection 19a is a mixed coppice forest stand of black pine and white pine with medium quality and no renewal. The black pine is 30 years of age, and the white pine is 37 years of age. It has wood mass of 78 m³/ha, the current growth is 3,35 m³/ha with 2440 trees/ha. The subsection 19c is a mixed coppice forest stand of black pine and black locust with medium quality and no renewal. The black pine is 30 years of age and the black locust 27. It has wood mass of 96 m³/ha, the current growth is 3,40 m³/ha with 3230 trees/ha.

The section 18a is a mixed coppice forest stand of sessile oak and turkey oak with separate presence of hornbeam, aspen, black pine, etc. The stand is 45 years of age with poor to medium quality, with great area renewal in good health condition. The wood mass is 55 m³/ha, the current growth is 1,20 m³/ha with 855 trees/ha. The subsection 16c is a pure coppice forest black locust stand with separate presence of sessile oak, hornbeam and hazel. Clear logging has been done in it and the has good renewal with vegetative origin. It has good health condition and is 17 years of age, with wood mass of 28 m³/ha, the current growth is 2,10 m³/ha with 2150 trees/ha. The subsection 16e is a mixed coppice forest cultivated black and white pine stand with medium to good quality. The trunks are straight with good developed crowns and in good health condition. The stand is 40 years of age and has no renewal. The wood mass is 145 m³/ha, the current growth is 3,10 m³/ha with 2600 trees/ha. The subsection 16e is a mixed coppice forest sessile oak, black pine and black locust stand with separate presence of birch, aspen, hornbeam, etc. The stand has medium to good quality and numerous renewal with good health condition aged 30. The wood mass is 45 m³/ha, the current growth is 3,50 m³/ha with 915 trees/ha.

The subsection 15c is a mixed coppice forest cultivated black and white pine stand with medium to good quality and separate additions of Douglass fir, black locust, sessile oak, etc. The trunks are straight with good developed crowns and good health condition. The stand is 35 years of age with black and white pine renewal. The wood mass is 95 m³/ha, the current growth is 3,70 m³/ha with 2300 trees/ha.

The subsection 9c is a mixed coppice forest cultivated black and white pine stand with medium to good quality and separate additions of black locust, aspen, birch, etc. The trunks are straight with well developed crowns and good health condition. The stand is 35 years of age with black and white pine renewal. The wood mass is 90 m³/ha, the current growth is 2,70 m³/ha with 1930 trees/ha.

The corridor of 500 m, besides the line on the northern side, from the opposite southern side over Kriva Reka touches parts of the following subsections: 100c, 101b, 102b, 103c, 104c, 105c, 106b, 106a, 107a, 107b, 108b, 108a, 114b, 115c and 115a. The subsection 100c is a mixed thicket of hornbeam with added sessile oak, aspen, birch and hazel. The trees are short, thin and branching. There is illegal logging in the stand, leaf-gathering, and cattle grazing. There is renewal, but with poor quality due to the cattle. The stand is 30 years of age with wood mass is 15 m³/ha, current growth of 0,75 m³/ha with 2435 trees/ha. The subsections 101b, 102b, 103c, 104c, 105c, 106b are mixed thickets of hornbeam with added sessile oak, turkey oak, hazel, aspen, birch and beech. The trees are short, thin with vegetative renewal. There is renewal, but with poor quality due to the cattle. The stands are 30 years of age with wood mass is 16 m³/ha, the current growth is 0,60 m³/ha with 2130 trees/ha. The subsection 106a is a pure coppice forest sessile oak stand with medium quality. It has separate sessile oak renewal, 70 years of age, with wood mass 87 m³/ha, the current growth is 1,30 m³/ha with 475 trees/ha. The subsection 107a is a pure coppice forest black pine stand, 35 years of age with medium quality and stand cover of 08-09, but no renewal. The wood mass is 101 m³/ha, the current growth is 2,90 m³/ha with 2650 trees/ha. The subsection 107b is a mixed coppice forest sessile oak and hornbeam stand with separate presence of black locust, aspen, hazel and turkey oak. The stand has medium quality, 45 years of age, with renewal in good health condition. The wood mass is 43 m³/ha, the current growth is 0,90 m³/ha with 1217 trees/ha. The subsection 108b is a mixed coppice forest sessile oak and hornbeam stand with separate presence of turkey oak, aspen, hazel, etc. the stand is of poor quality, 45 years of age with renewal in good health condition. The wood mass is 52 m³/ha, the current growth is 3,30 m³/ha with 1190 trees/ha. The subsection 108a is pure coppice forest black pine stand, with separate addition of sessile oak, aspen, hornbeam and hazel, at 35 years of age with medium quality and coverage 08-09, but no renewal. The wood mass is

62 m³/ha, the current growth is 2,10 m³/ha with 2350 trees/ha. The subsections 114b and 115c are mixed coppice forest hornbeam and sessile oak stands with separate presence of sycamore, turkey oak, birch, aspen and beech. The stands have poor quality at 35 years of age and renewal in good health condition. The wood mass is 45 m³/ha, the current growth is 1,30 m³/ha with 2100 trees/ha. The subsection 115a is an artificially planted mixed coppice forest black and white pine stand. Separately, we find black locust, aspen, sessile oak and hazel in it. The stand age is 35 years, and it has renewal in good health condition. The wood mass is 71 m³/ha, the current growth is 2,10 m³/ha with 1727 trees/ha.

Annex 14 shows the forestry units and subunits within the project area.

6.4 Hydrography and hydrology

6.4.1 Physical-geographical and hydrographical characteritics of the Kriva Reka basin

The main river and the recipient of the largest part of the waters in the area is Kriva Reka. Part of the watercourses flow into the Pčinja river source part and flow towards Serbia, whereas in the southern area, a smaller part of the area belongs to the Zletovska Reka drainage basin.

The hydrographical network of Kriva Palanka Municipality is comprised of torrential watercourse, numerous dry valleys and gullies. The numerous diluvial deposit fans in the lower streams of these torrents are a sign that the erosive processes in the basin are still strong (more detailed information is presented in the hydrology part.

The railroad line Kriva Palanka-Border of Republic of Bulgaria is located in the drainage basin of Kriva Reka.

The drainage basin of Kriva Reka is part of the drainage basin of Pčinja River, as its left tributary. It is located in the northeastern part of the Republic of Macedonia and stretches with complete northeastern exposition from the border to Republic of Bulgaria, and all the way to the mouth of the river Pčinja, at the village Klecovce at 296 m.a.s.l. elevation. In the north, through its right tributary-Kiselicka reka, it borders the territory of Republic of Serbia. In the west, it borders the drainage basin of the river Pčinja, and in the south with the drainage basin of the river Bregalnica. The area of the Kriva Reka drainage basin is A=968 km^2, and in terms of elevation, the drainage base spreads from the highest elevation peak at the Osogovo Mountains, the peak Ruen at 2252 m.a.s.l., to 296 m.a.s.l. elevation point where Kriva Reka flows into the river Pčinja.

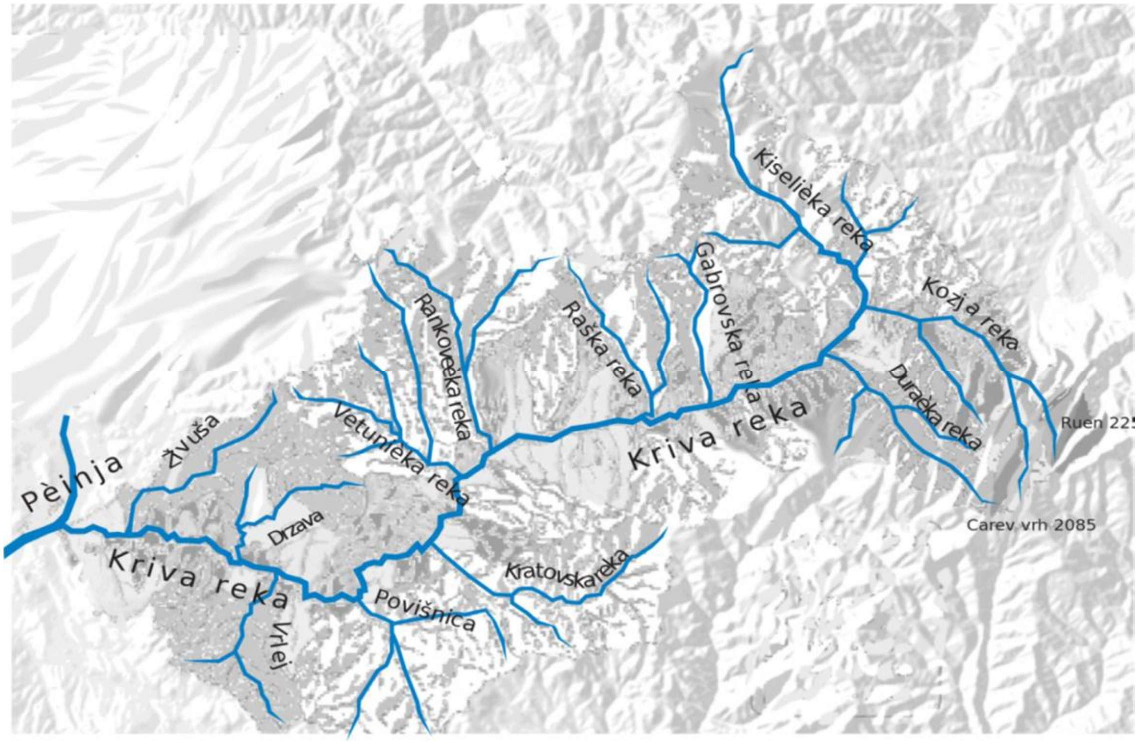


Figure 99 Kriva Reka drainage basin

Kriva Reka, with its left and right tributaries, gives symmetry to the drainage basin, and in the upper part, together with the left tributary Kiselicka Reka, the drainage basin receives a mushroom shape with a symmetrical head. Kriva Reka rises in the foothills of the Osogovo Mountains, at elevation point 1800 m.a.s.l., and flows into the river Pčinja at elevation point 296 m.a.s.l. at v. Klecevce.

In the river source, the river is named Kozja Reka, however the name Kriva Reka is mostly used as well in this area, considering that the highest springs are located here, richest with water. They form the greater water potential of Kriva Reka. From the river source and all the way to where it receives the greatest left tributary Kiselicka Reka, the Kriva Reka river flows from southwest towards northwest, and after their joining and all the way to the where it enters the river Pčinja, it flows east-west.

The total length of the river, from the river source at elevation point 1800 m.a.s.l. to the mouth of the river Pčinja, is 78.8 km. In the Kriva Palanka drainage basin we notice a developed hydrographical network, thicker in the source part, whereas along the river flow, almost symmetrically we encounter left and right tributaries – constant watercourses and number of dry valleys, especially on the right side where the railroad line moves for the most part.

6.4.2 Hydrological characteristics

6.4.2.1 Available hydrological and meteorological data about Kriva Reka

The description of the hydrological characteristic of Kriva Reka is based on the values of the average flow for a period of 40 years 1961-2000 measured in the hydrological stations, described below.

As it is shown in Figure 99, in the Pčinja drainage basin, there are several hydrological stations, where hydrological measurements are performed, as well as research of the hydrological parameters. In the

Kriva Reka drainage basin three hydrological stations (HS)[12] function, which are part of the national network, and those are:

- **HS "Židilovo" –** a Kriva Reka hydrological station at elevation point 786 m.a.s.l. It covers a basin area of A=78,6 km^2, which spreads from elevation point 786 m.a.s.l. to the highest point of the Kriva Reka basin, the peak Ruen at 2252 m.a.s.la. It controls the water quantities forming in the river source (head) part of the basin. It is equipped with a staff gage, where the measurements are taken by a freelance observer.[13] The station is constructed in the beginning of the eighties and possess its own data about the volume flow of Kriva Reka for a period of 30 years. This period is extended with the data for the period from 1961 with the help of established correlative connections between the run-off of the Main hydrological station in Kriva Palanka by using simultaneous run-off measurements of the both stations at the same time.

Furthermore, the characteristic run-off (tabularly and histographically) for Kriva Reka "HS Židilovo" for the period 1961-2000 are given. This data has been done for the reqirements of the Tender documentation of the small hydroelectric power plant MHE-123 on Kriva Reka in Židilovo, which is already taken under concession by the German company RSS. The undertaking of MHE-123 is supposed to be right after the flow point of the left tributary, the river Krklanska, at elevation point 786 m.a.s.l[14]. Also, the hydrograph for the average annual run-off is given, which show the water quantities trend in the period accepted as authoritative and which encompasses all most significant extreme waters, such as floods in the sixties and seventies and the extreme prolonged droughts in the nineties. Taking into consideration that this station shows the water quantity of the Kriva Reka river source, it will serve to transfer data upstream to the profiles cut by the line, as well as defining the flow regime of the largest right tributary, the river Kiselicka. The module of Kriva Reka inflow of the Židilovo profile looks like this (relation 1):

$$\mathrm{M} = \frac{Q}{A} = \frac{1260}{78.6}$$

$$\mathbf{M = 16} \quad / s / km^2$$

[12] All these stations are part iof the national network of Hydrological and metereological stations where permanent measuremnts and observations have been done for a number of years, by professional and freelance observers.

[13] At this site of the Kriva Reka, a bridge is planned (B37), bridging the river so the Corridor 8 railorad line could pass.

[14] Downstream from the planned bridge no. 32 of the railroad.

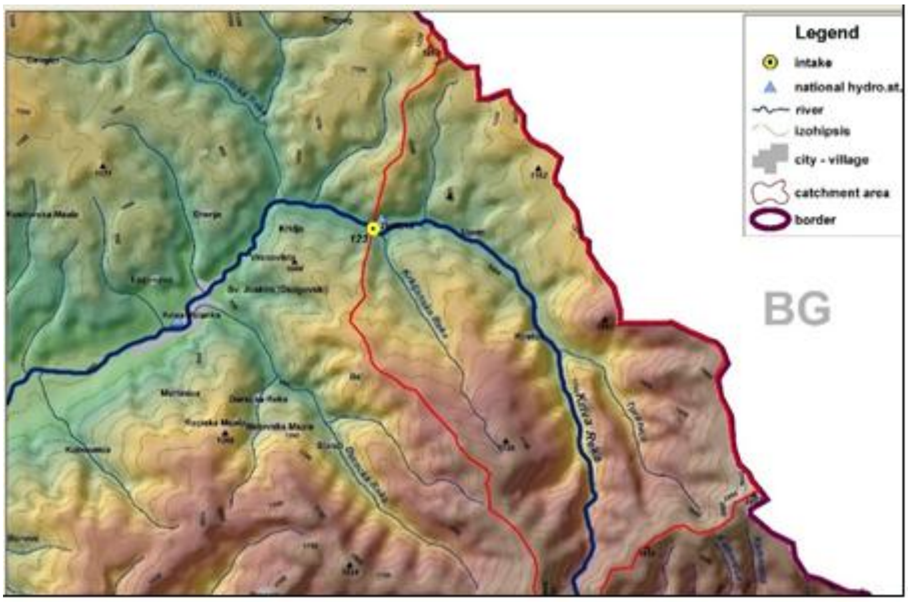


Figure 100 MHE-123 и HS "Židilovo" in the river source part of Kriva Reka

River: Kriva Reka, drainage basin area:78.6 km^2 period 1961-2000 г.

Profile (Z-123) " Elevation 786.00 mm^2

месец	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Qgod (m^3/s)
Qmin	0.208	0.188	0.354	0.370	0.280	0.140	0.069	0.081	0.070	0.133	0.200	0.165	**0.069**
Qsr	1.126	1.377	1.646	1.796	2.060	1.727	0.966	0.690	0.580	0.841	1.130	1.223	**1.26**
Qmax	52.65	48.60	37.94	26.65	89.64	35.36	172.15	171.60	94.05	43.07	27.72	18.99	**172.2**

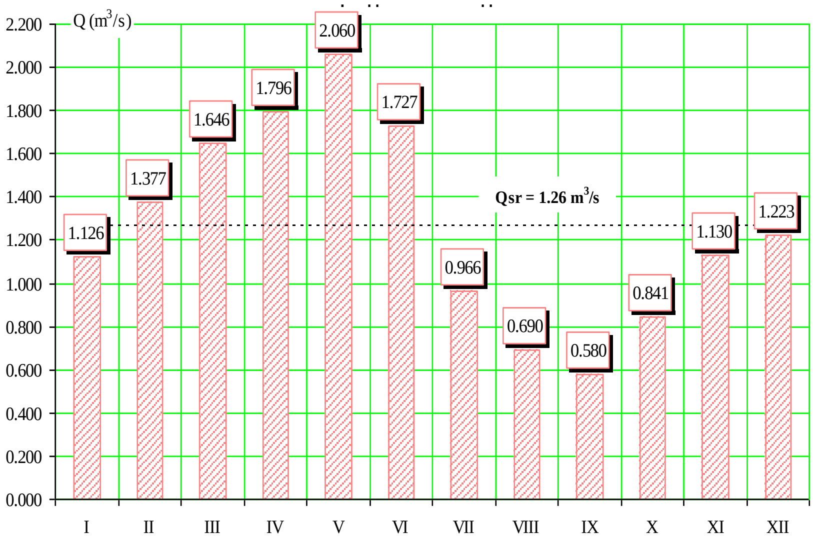


Figure 101 A graph of the average monthly run-off data of Kriva Reka ("HS Židilovo ")

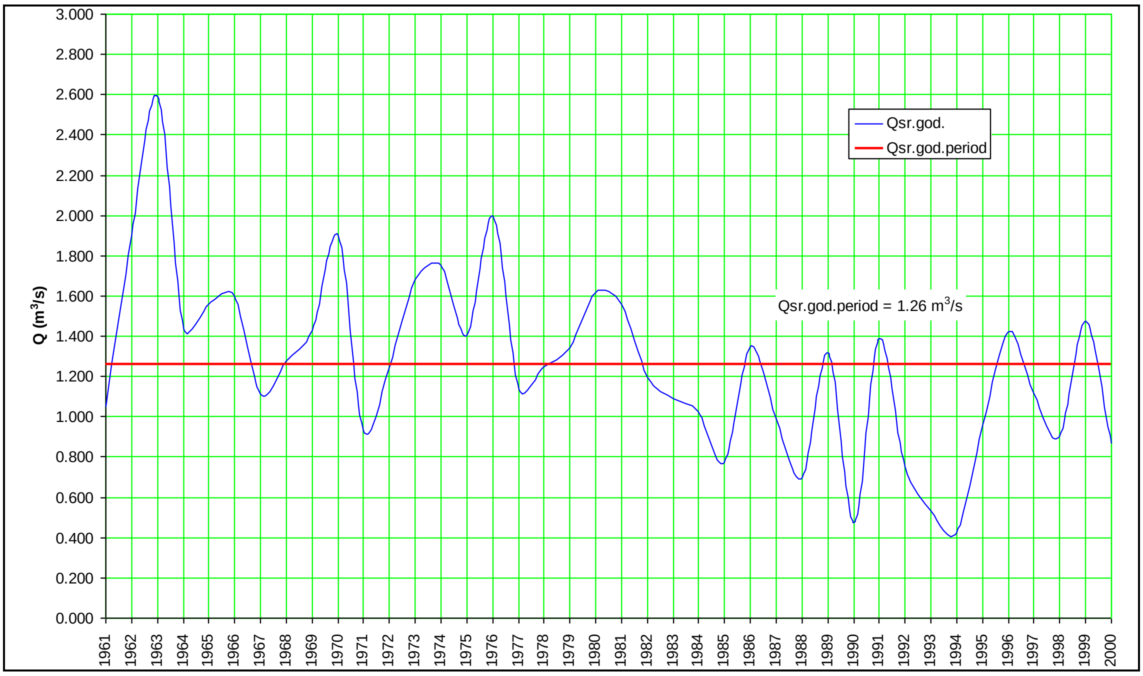


Figure 102 Hydrograph of the mean annual run-off -Kriva Reka (Židilovo), period 1961-2000

Hydrograph of the average annual run-off -Kriva Reka (Židilovo), period 1961-2000

- **HS "Kriva Palanka"** is the main hydrological station for the complete Kriva Reka drainage basin, which is located upstream of elevation point 632,15 m.a.s.l. This station has been functioning for years with no interruptions all the way to the start of the riverbed regulation in the middle of the nineties, when the station is moved downstream to the Dlabočica profile, right in the direction of the start of the third section of the Corridor 8 railroad line. The basin area, which includes this measurement station is A=262,4 km^2, stretching from the basin's highest elevation point at 2252 m.a.s.l. to the lowest point in the station profile at 632.15 m.a.s.l. The river length to this profile, measured along the flow, is 22.1 km. This hydrological station is a base station for the defining of the hydrological parameters in the Kriva Reka drainage basin. *The average long-term annual water run-off of the hydrological station's profile is Q=2,62 m^3/s, and the inflow module M=10 l/s/km^2*. We need to mention that on the right riverbank, right next to the hydrological station, the Main Meteorological station is located. It is especially important concerning hydrology, that this station measures the rainfalls on an ombrographic record and processes them by intensity with different duration.
- **HS "Trnovec"** is located in the lower part of the Kriva Reka drainage basin, immediately above Kratovo at elevation point 440,.28 m.a.s.l., with basin area of 614.4 km^2. The length of the river to the measurement profile, measured from the source of Kriva Reka at 1800 m.a.s.l. along the flow of the river to the measurement profile is 46.1 km^2. *The average long-term annual water run-off of the hydrological station's profile is Q=3.12 m^3/s, and the inflow module M=5.1 l/s/km^2*.
- **HS "Trnovec"** is located in the lower part of the Kriva Reka drainage basin, immediately above Kratovo at elevation point 440,.28 m.a.s.l., with basin area of 614.4 km^2. The length of the river to the measurement profile, measured from the source of Kriva Reka at 1800 m.a.s.l. along the flow of the river to the measurement profile is 46.1 km^2. *The average annual water run-off of the hydrological station's profile is Q=3.12 m^3/s, and the inflow module M=5.1 l/s/km^2*.

For two key profiles of Kriva Reka – profile Židilovo and profile Kostur, a more detailed hydrological parameters have been given, due to the fact that they could be influenced by the future construction activities, especially at the hydro-technical objects which are located in the Židilovo profile, whereas at the Kostur profile, the line is open with a 360° curve, and thus is directly exposed to eventual natural hazards.[15]

The Židilovo profile data is relevant in determining the flow regime for Kriva Reka at the profile upstream of the village Uzem, where the line is planned to turn for 360°. In this section, the line is in the open and could suffer from natural hazards and water influences, and therefore, a special hydrological and meteorological base should be constructed, upon which all the construction activities planned for this section will be done, as well as the other key points at watercourses which the line cuts.

Using the measurement data for the right tributaries of Kriva Reka, outside of the project surrounding of the railroad Section 3-Kriva Palanka-Border of the R. of Bulgaria (i.e. are in the project area of the section 2-Beljakovci-Kriva Palanka, and refers to river Otočnica and river Orel) is in the direction of solving the hydrology of the right tributaries in the interest section (Section 3), for which there is no hydrological data available.

6.4.3 Defining the water regime of Kriva Reka and the tributaries crossed by the railroad line

Alongside the three mentioned hydrological stations in the Kriva Reka drainage basin, for the requirements of creating a hydrological basis for the watercourses of the wider region Osogovo-2, numerous other measuring points have been established, where frequent measurements have been done. In this manner, and with the help of the established correlative relations, the regimes and characteristic values have been defined for the run-off of many watercourses in the Kriva Reka drainage basin for the period of 10 years (1975/76-1984/85). The cited study[16] has been published in 1997 as book 1. However, in book 1 the watercourses on the right side of Kriva Reka have not been treated (which are cut by section 3 of Corridor VIII), but here have been numerous measurements done on theses watercourses, which could provide enough relevant correlative relations to solve these problems. With several series added, simultaneous hydrometrical measurements of the run-off, could this project be completed which is needed for the planned railroad line, because it will rest on real data coming from the drainage basin measurements, not from theoretical data taken from other drainage basins. Because the watercourses on the right side are positiond at a distance of around ten kilometers, the average multi-annual flow will be solved with enough precision over the flow of the greatest right tributary, the river Kiselicka. In this river, immediately at the meeting point with Kriva Reka at the location Samokov at 700 m.a.s.l., a measuring point was established and several-year simultaneous measurements have been done at the same time with the Hydrological station Židilovo. A special correlative relation has been established, i.e. regime relation with the regime coefficient.

$$R_k = \frac{Q_1}{Q_2} \qquad R_k = f(t)$$

This way, a multi-annual average run-off for Kiselicka river has been defined, directly above the merging point with Kriva Reka, at the measurement point Samokov EP-700 m.a.s.l., which is:

$$Q_{sr} = 0.800\ m^3/s$$

$$M = 7.2\ L/s/km^2$$

This proves the fact that the right side tributaries, which are on the shaded north side, are much poorer with water. The same is confirmed for the river Kiselicka which, at the merging point with Kriva

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[15] We need to mention that the hydrology of these profiles has been revised by the European Bank for Reconstruction and Development (EBRD), i.e. their hired company FIHTNER from Germany which traveled to our country and performed assessments of the methodology for creation of hydrological bases of the watercourses profiles in our country, where the small hydroelectric power plants where planned.

[16] Hydrological basis of the watercourses of the region 2-Osogovo, book 1, National hydrometeorological service, Skopje

Reka, has almost twice smaller flow compared to Kriva Reka, despite having somewhat larger drainage basin area.

To apply the average flow value of *river Kiselicka-Samokov* to the downstream watercourse, as well as the average flow from *Kriva Reka-Židilovo* at the upstream watercourses, on the basis of certain measurements taken during the research period, the following relation (2) has been obtained:

$$Q_x = \frac{A_x}{A_y} \cdot Q_y \cdot K$$

where:

Q_x – average flow for watercourses being calculated (L/s);

A_x – drainage basin area of the calculated watercourse (km^2);

Q_y – average flow at river Kiselicka-Kriva Reka (Q_y = L/s);

A_y –river Kiselicka-Kriva Reka drainage basin area (A_y = km^2);

K – coefficient depending on the gradient of increase/decrease of swelling modules, ranging between 0.8-1.12;

$M = \frac{Q_x}{A_x}$ is inflow module (L/s/km^2).

By using the relation 2, the average multi-annual flow for the watercourses cut by the railroad line of Corridor VIII have been calculated. The results are shown furtherer in the text, and for all watercourses or dry valleys which are calculated with bridges, viaducts or passages (Table 38).

Table 38 Calculation of multi-annual flows

Profile	Planned object	Chainage (km) (a starting and ending chainage has been given for the bridges)	Watercourse name (some watercourses are seasonal)	A_x *km²*	A_y *km²*	K	Q_y *L/s*	Q_x *L/s*	M *L/s/km²*
Ba. B01	Bridge	65+095,735 to 65+155,280	Unnamed watercourse	0.103	110.9	0.86	800	0.64	6.2
Ba. C01	Culvert	65+421,50	Unnamed watercourse	0.085	110.9	0.86	800	0.52	6.2
Ba. B02	Bridge	65+605,724 to 65+758,346	Unnamed watercourse	0.030	110.9	0.86	800	0.19	6.2
Ba B03	Bridge	65+841,065 to 66+106,750	Gabarska Reka	20.78	110.9	0.86	800	129	6.2
Ba. C02	Culvert	66+366,47	Unnamed watercourse	0.015	110.9	0.86	800	0.10	6.2
Ba. B04	Bridge	66+447,279 to 66+516,721	Unnamed watercourse	0.074	110.9	0.86	800	0.45	6.2
Ba. B05	Bridge	66+742,660 to 66+884,280	Gradečka Reka	11.30	110.9	0.87	800	70	6.3
Ba. B06	Bridge	67+068,750 to 67+128,250	Unnamed watercourse	0.046	110.9	0.87	800	0.30	6.3
Ba B07	Bridge	67+360,246 to 67+455,813	Rangel	3.88	110.9	0.87	800	24	6.3
Ba. B08	Bridge	67+596,622 to 67+630,125	Unnamed watercourse	0.091	110.9	0.87	800	0.57	6.3
Ba. C03	Culvert	67+835,75	Unnamed watercourse	0.153	110.9	0.87	800	0.96	6.3
Ba. B09	Bridge	68+167,685 to 68+273,442	Unnamed watercourse	0.237	110.9	0.87	800	1.50	6.3
Ba. B10	Bridge	68+457,248 to 68+636,856	Unnamed watercourse	0.289	110.9	0.87	800	1.80	6.3
Ba. B11	Bridge	68+738,717 to 68+814,348	Unnamed watercourse	0.166	110.9	0.87	800	1.04	6.3
Ba. C04	Culvert	68+970,75	Unnamed watercourse	0.009	110.9	0.87	800	0.00	--
Ba. B12	Bridge	69+066,200 to 69+193,750	Unnamed watercourse	0.735	110.9	0.87	800	4.61	6.3
Ba. B13	Bridge	69+250,000 to 69+273,500	Unnamed watercourse	0.025	110.9	0.88	800	0.16	6,4
Ba.B14	Bridge	69+402,142 to 69+478,073	Unnamed watercourse	0.381	110.9	0.88	800	2.42	6.4
Ba.B15	Bridge	69+683,217 to 69+778,911	Unnamed watercourse	0.088	110.9	0.88	800	0.56	6.4
Ba.B16	Bridge	69+965,189 to 70+070,852	Unnamed watercourse	0.475	110.9	0.88	800	3.01	6.4
Ba.B17	Bridge	70+159,478 to 70+343,707	Unnamed watercourse	0.195	110.9	0.88	800	1.24	6.4
Ba.T01	*Diversion of watercourse*	70+521.72	Unnamed watercourse	0.058	110.9	0.89	800	0.37	6.5
Ba. C05	Culvert	70+732,00	Unnamed watercourse	0.121	110.9	0.89	800	0.78	6.5

Ba. B18	Bridge	70+889,500 to 70+923,000	Unnamed watercourse	0.064	110.9	0.89	800	0.41	6.5
Ba. B19	Bridge	71+038,977 to 71+127,140	Unnamed watercourse	0.101	110.9	0.89	800	0.65	6.5
Ba B20	Bridge	71+323.500 to 71+419.000	Unnamed watercourse	6.86	110.9	0.89	800	44	6.6
Ba. B21	Bridge	71+569,000 to 71+602,502	Unnamed watercourse	0.146	110.9	0.90	800	0.95	6.6
Ba. C06	Culvert	71+781,63	Unnamed watercourse	0.817	110.9	0.90	800	5.30	6.6
Ba B23	Bridge	72+804,013 to 72+935,520	Domački Dol	10.10	110.9	0.90	800	66	6.6
Ba.C07	Culvert	73+129,22	Unnamed watercourse	0.043	110.9	0.92	800	0.30	6.8
Ba. C08	Culvert	73+248,77	Unnamed watercourse	0.032	110.9	0.92	800	0.22	6.8
Ba. B25	Bridge	73+329,000 to 73+398,753	Unnamed watercourse	0.133	110.9	0.92	800	0.93	6.8
Ba.B26	Bridge	73+558,500 to 73+721,265	Unnamed watercourse	0.046	110.9	0.93	800	0.32	6.8
Ba. B27	Bridge	73+766,218 to 73+815,775	Unnamed watercourse	0.273	110.9	0.93	800	1.78	6.8
Ba. T02	*Diversion of watercourse*	74+012.35	Unnamed watercourse	0.018	110.9	0.94	800	0.14	6.8
Ba. C09	Culvert	74+150,87	Unnamed watercourse	0.094	110.9	0.94	800	0.61	6.8
Ba. B28	Bridge	74+195,656 to 74+409,944	Unnamed watercourse	0.177	110.9	0.95	800	1.21	6.9
Ba. T03	*Diversion of watercourse*	74+585.44	Unnamed watercourse	0.306	110.9	0.95	800	2.09	6.9
Ba. B29	Bridge	74+767,234 to 74+842,762	Unnamed watercourse	0.363	110.9	0.97	800	2.54	7.0
Ba. B30	Bridge	75+187,692 to 75+473,294	Unnamed watercourse	0.839	110.9	0.98	800	5.96	7.1
Ba. B31	Bridge	75+667,100 to 75+952,510	Unnamed watercourse	0.576	110.9	0.98	800	4.09	7.1
Ba B32	Bridge	76+402,00 to 76+611,500	Kiselicka Reka	110.9	110.9	1.00	800	800	7.2
Ba B33	Bridge	77+698,75 to 77+789,25	Židilovski Dol	8.94	110.9	1.02	800	66	7.3
Ba.B34	Bridge	78+078.739 to 78+200.239	Unnamed watercourse	0.150	110.9	1.02	800	1.4	7.4
Ba. B35	Bridge	78+417.444 to 78+492.991	Unnamed watercourse	0.768	110.9	1.02	800	7.2	7.5
Ba.C10	Culvert	78+772,78	Unnamed watercourse	0.053	110,9	1.04	`800	0.4	7.6
Ba. B36	Bridge	78+783.458 to 78+842.958	Unnamed watercourse	0.045	110.9	1.08	800	0.36	8.0
Ba. T04	*Diversion of watercourse*	79+088.78	Unnamed watercourse	0.283	110.9	1.12	800	2.23	8.2
BaB37	Bridge	79+785.906 to 80+068.737	Kriva Reka	66.29	78.6	1.0	1260	1083	16.4

Ba. C11	Culvert	80+198,00	Unnamed watercourse	0.079	78.6	1.0	1260	1.3	16.4
Ba.B38	Bridge	80+314.800 to 80+338.300	Unnamed watercourse	0.271	78.6	1.00	1260	4.5	16.4
Ba. B39	Bridge	80+670.300 to 80+745.800	Unnamed watercourse	0.387	78.6	1.00	1260	6.4	16.4
Ba.B40	Bridge	80+959.858 to 81+164.750	Unnamed watercourse	1.056	78.6	1.02	1260	17.2	16.4
BaS01	*Regulation of riverbed*	Near bridge B40	Kriva Reka	55.40	78.6	1,06	1260	964	17.4
Ba.B41	Bridge	81+947.750 to 81+971.250	Unnamed watercourse	0.013	78.6	1.06	1260	0.22	17.4
Ba. B42	Bridge	82+056.250 to 82+177.750	Unnamed watercourse	0293	78.6	1.06	1260	5.00	17.4
BaB43	Bridge	84+094.529 to 84+107.459	Kriva Reka	44.90	78.6	1.12	1260	780	17.4
Ba. B46	Bridge	85+698.471 to 85+882.732	Unnamed watercourse	0.581	78.6	1.06	1260	9.91	17.0
Ba. B47	Bridge	86+262.000 to 86+311.614	Unnamed watercourse	0.057	78.6	1,06	1260	0.96	17.0
Ba. B51	Bridge	87+023.890 to 87+032.970	Unnamed watercourse	1.28	78.6	1.06	1260	21.7	17.0

In the hydro-technical report[17], the maximal waters and the probability of maximal flow occurrence period have been calculated, in accordance to established world methodologies. However, in the Report, there is no elementary hydrological base of the rivers and watercourse in the Section 3 region, which would contain:

- Basic hydrological data about the run-off regime for the rivers or dry valleys,
- Certain run-off durations in the course of the year with greatest frequency, which is important for regulations of certain watercourse sections (alongside maximal waters),
- Complete image of the river sources, yields and means of usage, in order to determine their protection, during construction along the line (especially during excavation, embankments, blasting),
- Historical data about the sites in the drainage basins where landslides have been recorded when great waters have occurred.

6.4.4 Floods and other meteorological phenomena

In the Kriva Reka drainage basin, in the past 60 years, frequent occurrence of flooding waves created along the flow of Kriva Reka and its larger tributaries have been noticed.

The following chart shows the maximum waters of Kriva Reka and its smaller or larger tributaries, registered by the Hydrological station-Kriva Palanka:

Table 39 Maximum waters of Kriva Reka and its tributaries

Year	Month	Maximum water
1964	May	Q = 200 m^3/s
1966	August	Q = 264 m^3/s
1970	July	Q =313 m^3/s
1971	July	Q =158 m^3/s
1975	September	Q =171 m^3/s

This data clearly shows that the occurrence of maximum waters is most frequent in the summer months and as a result of bad weather and intensive rainfall. The right tributaries have been more active, especially from Kiselicka Reka and all the small rivers including Domački Dol, whose waters could be registered by the hydrological station Kriva Palanka. Of course, the tributaries of Kriva Reka take part in the great waters too, upstream of Kriva Palanka, such as Duračka Reka, river Krkla, Toranička Reka, etc.

6.4.5 Water quality in Kriva Reka

In municipality Kriva Palanka, despite the water quality in Kriva Reka, the quality of the rest of the surface waters is not monitored. The Kriva Reka water quality is analyzed at the village Trnovec, at the exit from municipality Rankovci, as one of the twenty measure points of the RIMSYS network (River Monitoring System), managed by the National hydrometeorological service of RM.

In accordance to the Decree on Categorization of Water Courses, Lakes, Accumulations and Water Resources (“Official Gazette of the Republic of Macedonia” no. 18/99 and 71/99), Kriva Reka has class II water quality.

The following picture shows the measure point Trnovec, as one of the measure points for monitoring surface waters in the Republic of Macedonia.

[17] Preliminary Hydrology Design, Version A, 06h December 2016, EuropeAid/136050/IH/SER/MK

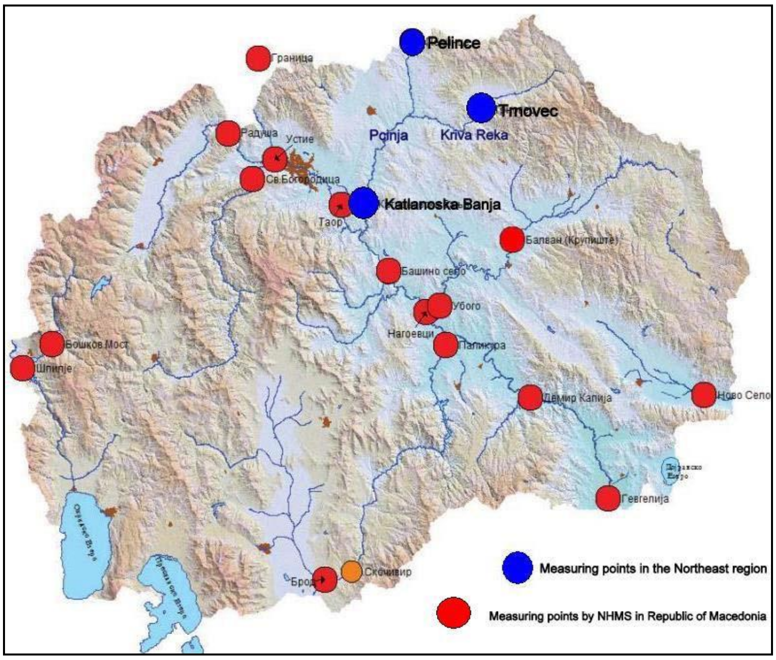


Figure 103 Measure points for surface water quality in the Republic of Macedonia

In the Annual Report from calculated data for environment quality for 2014, depending on the concentration of the researched parameters, the water class of Kriva Reka has been defined at the measure point Trnovec:

Table 40 Concentration of researched parameters and Kriva Reka water class, at the measure point Trnovec for 2014

Parameter	Measured concentration	Class
Concentration of dissolved oxygen	> 8 mg/l	class I
BOD 5	2.01-4 mg/l	class II
COD	5.01-10 mg/l	class III
Nitrates	< 10.000 µg/l	class I-II
Nitrites	10.1-500 µg/l	class III-IV
Iron	< 300 µg/l	class I-II
Manganese	< 50 µg/l	class I-II
Lead	< 10 µg/l	class I-II
Cadmium	0.1-10 µg/l	class III-IV
Zink	< 100 µg/l	class I-II
Chrome	< 50 µg/l	class I-II
Nickel	< 50 µg/l	class I-II
Copper	< 10 µg/l	class I-II

In regards to the results shown in the chart, received from water quality measurements done for the watercourse Kriva Reka-measure point Trnovec, in accordance to the Decree on Categorization of Water Courses, Lakes, Accumulations and Water Resources, Kriva Reka belongs to class I in relation to the concentration of dissolved oxygen, wheareas in relation to the measured parameters: Nitrates, Nitrites, Iron, Manganese, Lead, Cadmium, Zink, Chrome, Nickel and Copper, it belongs to class I-II, whereas in relation to the biochemical oxygen demand for 5 days (BOD 5), it belongs to class II, and) belongs to class III in relation to measured concentration of chemical oxygen demand (COD. The watercourse Kriva Reka in relation to the parameters Nitirites and Cadmium belongs to class III-IV.

In 2014, the annual average values of the saprobic index of all controlled watercourses was moving in the second class limits. At the measure point Trnovec-Kriva Reka, a minimal value of saprobic index has been registered.

The Annual Report of processed environment quality data for 2015 shows the following conditions:

Table 41 Concentration of researched parameters and water class of Kriva Reka, at the measure point for 2015

Parameter	Measured concentration	Class
Concentration of dissolved oxygen	8-20 mg/l	class I
BOD 5	0-2 mg/l	class I
COD	0-2,5 mg/l	class I
Nitrates	0-10.000 µg/l	class I-II
Nitrites	10.1-500 µg/l	class III-IV
IronWha	< 300 µg/l	class I-II
Manganese	< 50 µg/l	class I-II
Lead	< 10 µg/l	class I-II
Cadmium	0.1-10 µg/l	class III-IV
Zink	< 100 µg/l	class I-II
Chrome	< 50 µg/l	class I-II

In accordance to the Annual Report of processed environment quality data for 2015, i.e. according to the measured concentration of the Kriva Reka watercourse at the measure point Trnovec, the water in the river belongs to class I for the parameters: concentration of dissolved oxygen, biochemical oxygen demand for 5 days (BOD 5) and chemical oxygen demand (COD). In relation to the measured concentrations for the parameters: nitrates, iron, manganese, lead, zinc and chrome, Kriva Reka belongs to class I-II, and in class III-IV for the parameters: nitrites and cadmium.

6.5 Groundwater

On the National and local level, there are not continious data from the monitoring of groundwater table and quality. The relevant data on the baseline conditions regarding groundwater in the project area and its quality are obtained from the geotechnical investigations for the purpose of this current Project. The results are presented in subchapters 6.2.4 and 6.2.5

6.6 Air quality

There is no monitoring station for tracking the air quality in municipality Kriva Palanka.

The main factors influencing the air quality in the Municipality are: the population, the traffic and industry, but other pollutants which negatively affect the health of the people and the environment could not be neglected.

<u>Traffic as an air pollutant</u>

In the municipality Kriva Palanka, the number of registered motor vehicles is increasing every year. As a result of the increased frequency of vehicles, especially on the road leading to the Republic of Bulgaria, we could say that the traffic in the Municipality is one of the reasons for disturbing the air quality.

Air pollution from the local communal landfill

The communal landfill in the Municipality accepts not only communal waste but also industrial and medicinal waste. The landfill is located at an inappropriate location, in the immediate vicinity of Kriva Reka, at 5 km distance of the Town.

The unpleasant smell of the spontaneous combustion of the landfill is felt in the morning and evening in radius of 800 to 1500 m, and depending on the weather conditions and wind direction, the landfill smell could be felt much further.

The industry as an air pollutant

The air quality is disturbed by certain economic and industrial objects, most notable: the lead and zinc mine “Toranica” and its flotation tailing landfill which is in the immediate vicinity of Kriva Reka, 17 km away from the Town.

The area around the tailings dump is polluted by small fractions of dust, heavy metals, radioactive materials and aggressive toxic materials which in conditions of strong wind, as barren parts, are being carried out to greater areas.

The population as an air pollutant

The overextensive and uncontrolled use of wood as an energy fuel or a material for warming individual and collective apartments, as well as certain number of smaller companies and institutions, is a serious air pollution source. The research shows that 90% of the population uses wood to heat their homes in the September-May period. By burning wood, enormous quantities of smoke, carbon dioxide and incombustible particles are being released in the atmosphere. On the other hand, the disturbance of air quality is increased by decreased forest areas, due to excessive and unplanned logging by the local population.

Forest fires as a cause for air pollution

The number of fires on the territory of municipality Kriva Palanka in the past several years is increasing, and the most frequent reason is negligence by the local population.

6.7 Noise

The noise conditions in municipality Kriva Palanka have not been monitored and analyzed so far. In the municipality we meet noise sources, especially in separate locations with increased frequency of traffic, manufacturing and business objects, noise from housing objects, business-economy objects, etc. The main noise source is the increased traffic frequency. The main road leading to the Republic of Bulgaria runs thorough the territory of the municipality.

In accordance to the Decision on Determining the Cases and Conditions in which the Peace of Citizens is Regarded Disturbed by Harmful Noise (“Official Gazette of the Republic of Macedonia” No. 1/09) and the Rulebook for Limit Values of the Noise Level in the Environment (Official Gazette of RM No. 147/08), the peace of the citizens is disturbed by harmful noise where the limit values of noise in the environment, caused by different sources, are higher than those presented in the following chart:

Table 42 Noise levels above which values the peace of citizens is regarded disturbed

Area according to the level of noise protection	Noise level expressed in dB(A)		
	L_d	L_e	L_n
First degree area	50	50	40
Second degree area	55	55	45
Thrid degree area	60	60	55
Fourth degree area	70	70	60

- **Project area**

Same as in the municipality Kriva Palanka, the main noise sources in the project area are traffic, manufacturing and business objects, noise from housing objects, business-economy objects, etc. Because there is no prior data about the noise level in the environment along the planned railroad line, for that purpose, during the visit to the future railroad Section 3 line of Corridor VIII, on the 12.12.2016, measurements of the noise levels at sensitive locations had been done. The measurements are short-term and reflect the day period (07-19 h.). The results of the measurements are shown in the following chart.

Table 43 Noise levels in the proximity of the line at Section 3

Chainage proximity	Description of the measure point	LAeq dB(A)	LAmax dB(A)	L_{90}	L_{10}
65+800	In the v. Tlminci area	51,5	70,5	47,7	53,8
70+0	Kriva Palanka	62,6	78,7	39,1	65,8
71+260	Kriva Palanka	49,1	64,8	43,3	51,7
71+360	Kriva Palanka	48.9	68,7	43.1	50.6
73+240	Exit from Kriva Palanka	45,2	60.5	38,0	48,1

Part of the measurements have been done in the open, i.e. not in proximity of the houses, and thus a minimal correction of 1dB(A) for façade reflection has been made.

6.8 Vibrations

To identify the present condition and define the sensitive zones and receptors which could be potentially threatened by the increased vibration influence in the course of the constructive and operational phase of the railroad line Section 3-Kriva Palanka-border of the Republic of Bulgaria, on April 8th 2017 a visit and insight into the railroad line was done.

The following chart shows an overview of the sensitive zones, which require further research, i.e. measurements to determine the level of possible vibrations, determining of attenuation curves and comparing the precise measures for protection and alleviation of vibration effects in the constructive and operational phase. Thirteen sensitive zones have been defined along the line. The zones 3, 4 and 5 have been noted as the most sensitive zones.

Table 44 The defined vibration sensitive zones along the railroad line Kriva Palanka-Border of the Republic of Bulgaria

Sensitive zone	Zone description
1	T'lminci (several houses with ancillary objects)
2	Individual object in construction, in front of Kriva Palanka
3	**Plateau 1- railroad station Kriva Palanka (in the immediate proximity, under and above the plateau, there are houses for individual housing with number of floors P and P+1, as well as several ancillary objects)**
4	**Plateau 2- railroad station Kriva Palanka (immediate proximity, around the plateau, there are groups of houses for individual housing with number of floors up to P+2)**
5	**Hill above a small tunnel (groups of houses, private, with number of floors P to P+2)**
6	Hill above a large tunnel (densely placed houses present, number of floors up to P+2)
7	Domački Dol (large tunnel exit, a group of houses exists, P to P+2 and ancillary objects)

8	Drenje (line of several new houses, number of floors up to P+2)
9	Pašina vodenica (2 existing houses with ancillary objects, by the river)
10	Židilovo (group of older houses with number of floors P to P+2 and ancillary objects)
11	Uzem 1 (several houses with ancillary objects)
12	Uzem 2 (several older houses and a new one)
13	Uzem 3 (in front of entrance to border tunnel, 2 ground floor houses and ancillary objects-barns)

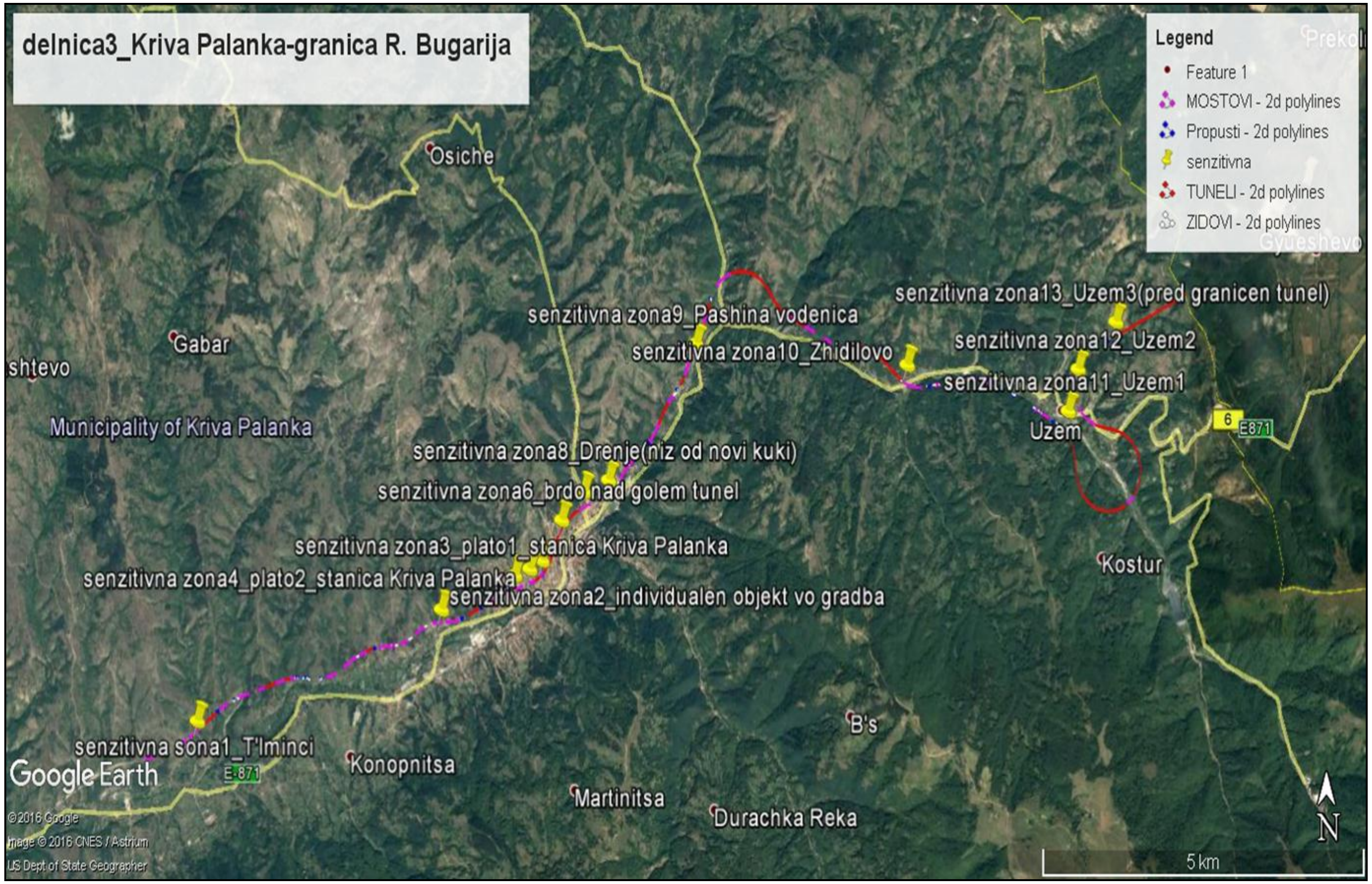


Figure 104 Sensitive zones along the railroad line

The following pictures show the sensitive zones separately, with photographs of the existing objects.

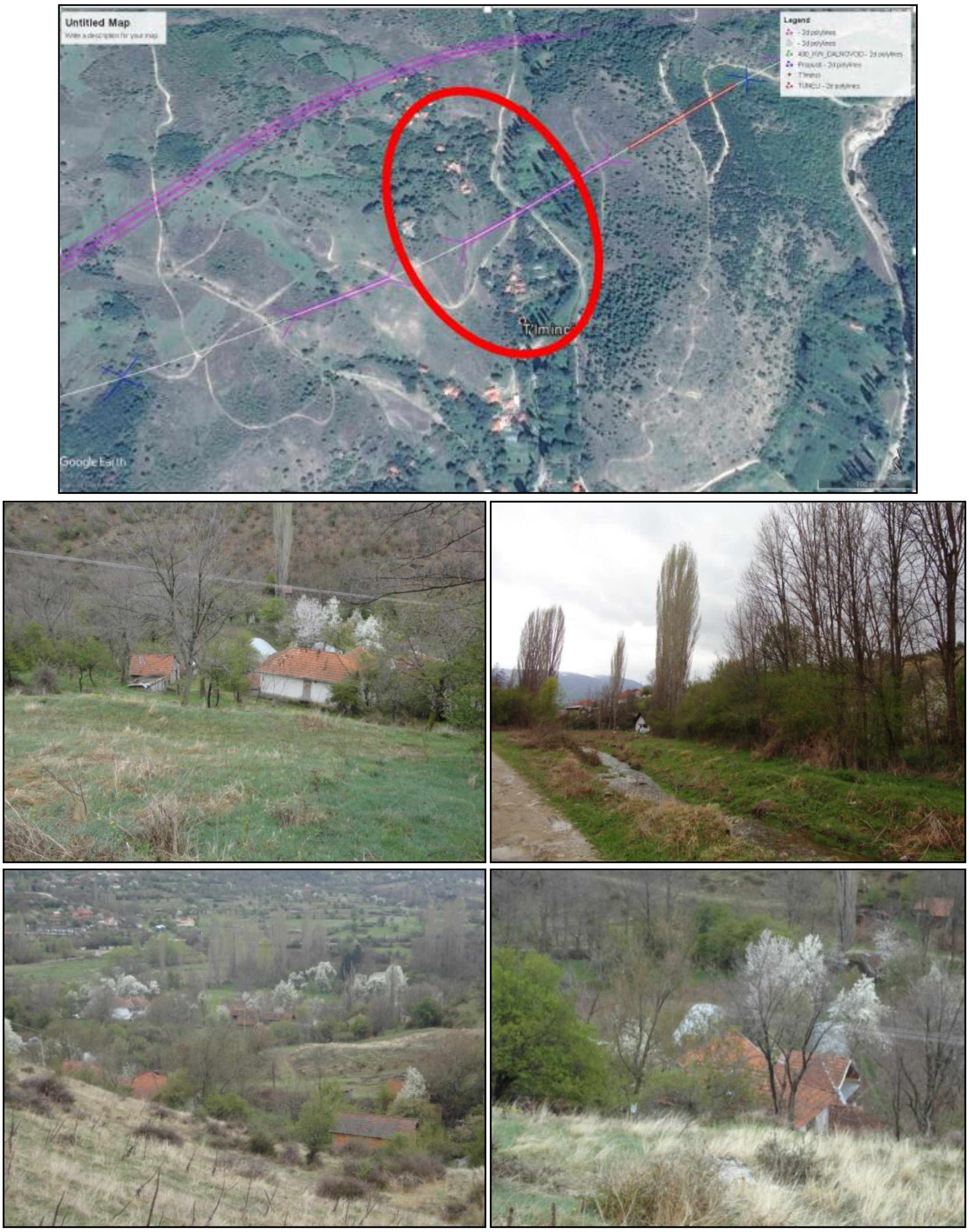


Figure 105 Sensitive zone 1- village T'Iminci

Figure 106 Sensitive zone 2- Individual object in construction, in front of Kriva Palanka

Figure 107 Sensitive zone 3-PLATEAU 1 (Railroad station Kriva Palanka)

Figure 108 Sensitive zone 3 (continuation Railroad station Kriva Palanka)

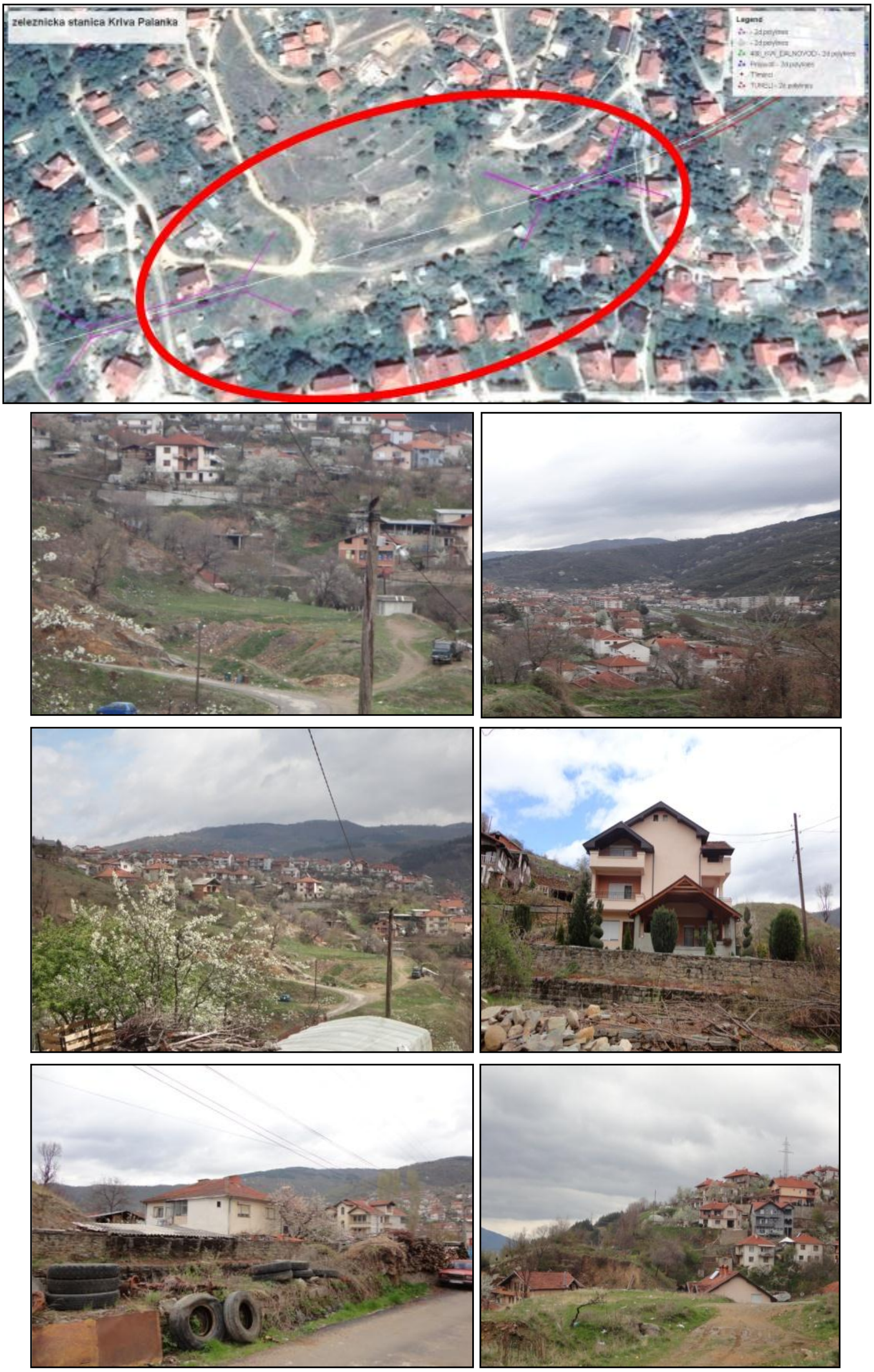


Figure 109 Sensitive zone 4-PLATEAU 2 (Station Kriva Palanka)

Figure 110 Sensitive zone 4-PLATEAU 2 (Railroad station Kriva Palanka continuation

Figure 111 Sensitive zone 5-Hill above a small tunnel

Figure 112 Sensitive zone 6-Hill above a large tunnel

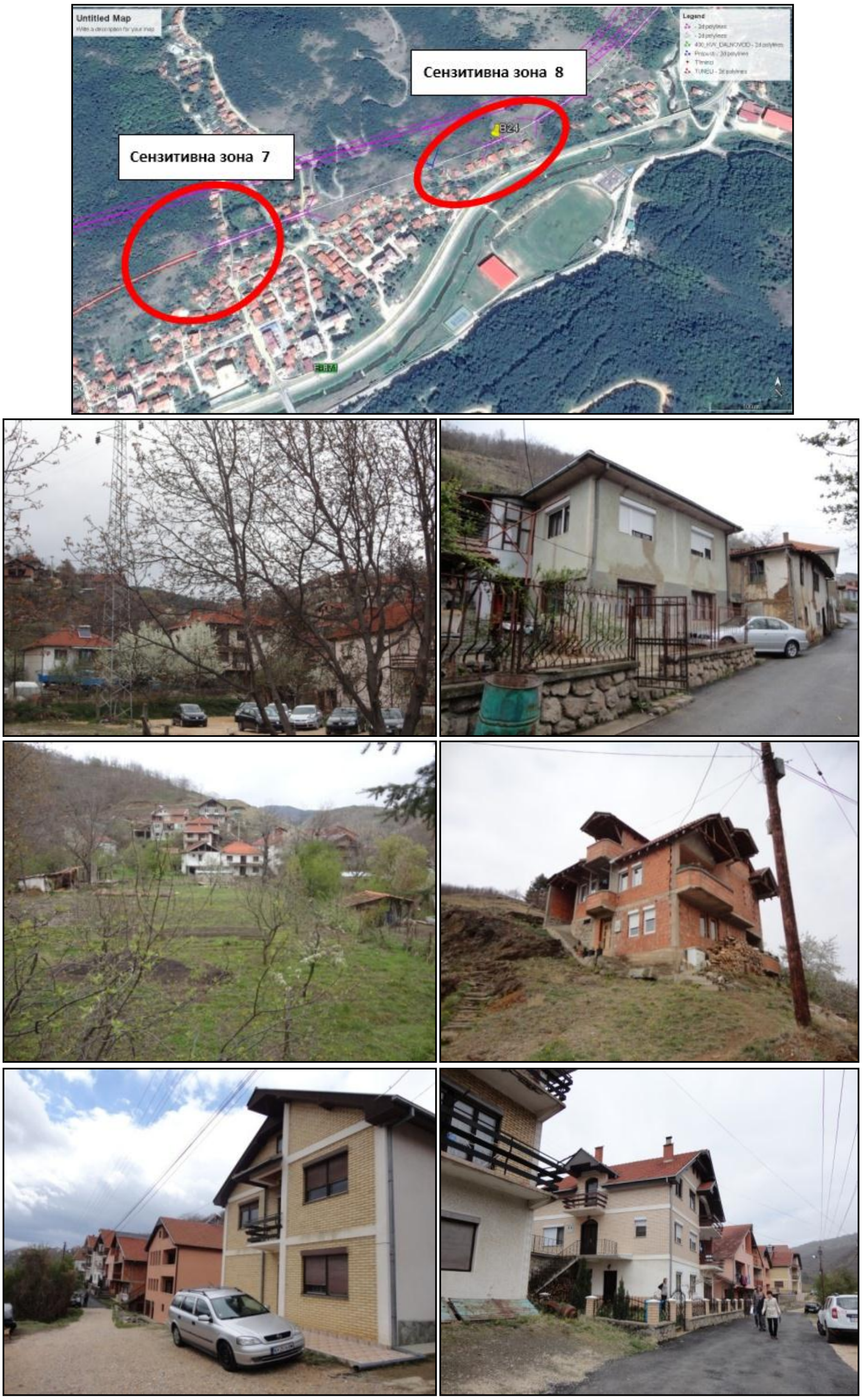


Figure 113 Sensitive zone 7 and 8 - Domački dol (large tunnel exit) and Drenje (a line of new houses)

Figure 114 Sensitive zone 9-“Pašina Vodenica”

Figure 115 Sensitive zone 10-v. Židilovo

Figure 116 Sensitive zone 10-v. Židilovo (continuation**)**

Figure 117 Sensitive zone 11-v. Uzem 1

Figure 118 Sensitive zone 12-v. Uzem 2

Figure 119 Sensitive zone 13-v. Uzem 3 (tunnel before the border)

6.9 Climatic-meteorological characteristics

The climate of the region is mostly humid continental climate to alpine. The temperature varies according to elevation. The lower areas have mildly cold winters, mildly warm summers, fresh spring and relative warm autumn. On the other hand, the higher parts of the Osogovo Mountains have steppe climate.

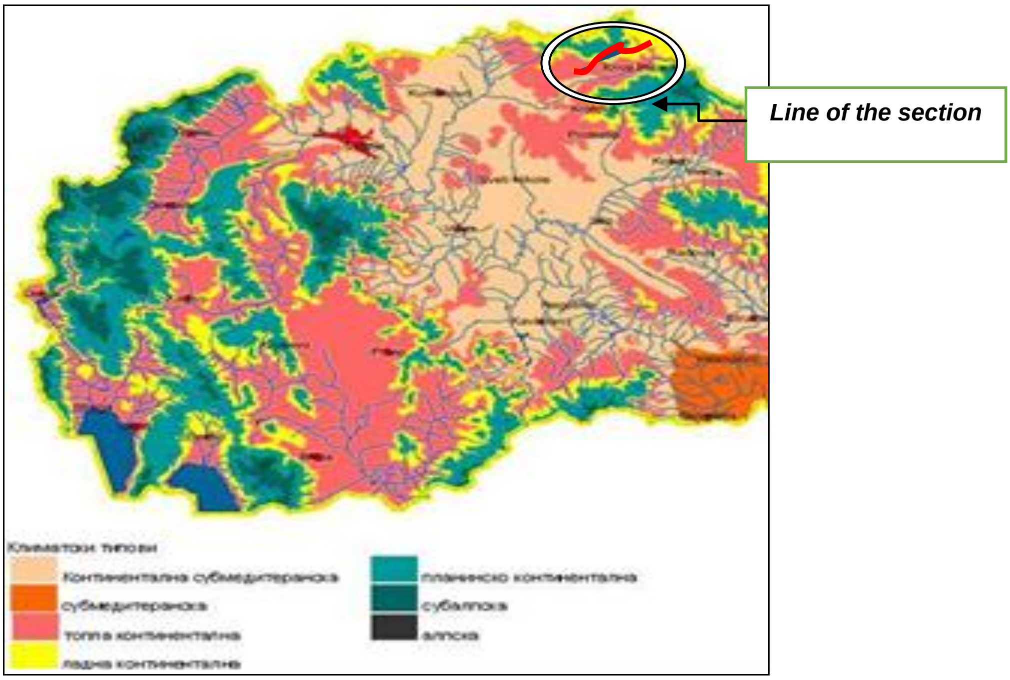


Figure 120 Climate map of the Republic of Macedonia

The climate in the lower mountain zone is continental, whereas in the transitional zones towards the higher parts, the climate is characterized by fresh summers, cold springs, cold and snowy winters and a large rainfall quantity. In the higher parts, the low temperatures are present in all seasons.

The average annual temperature in Kriva Palanka is 10,2 °C. The absolute minimal temperatures move from -21 °C in Kriva Palanka. The absolute maximal air temperature in Kriva Palanka, during the summer period (August), goes up to 36,6 °C. Obviously, the summer temperatures could increase in the lower valley areas (Lazarevski, 1993).

The region is characterized with many sunny periods, with average span of 2291 hours (in Kriva Palanka) annually.

Maximum sunlight is achieved during the summer months, especially in July, and the minimum in the winter months (December and January).

The average amount of rainfall in the municipality Kriva Palanka is 622 mm. Compared to the surrounding areas, the Kriva Palanka area receives significant rainfall. This is a result of the absolute high elevation, which is a natural condenser for water steam, brought by the western and southern winds.

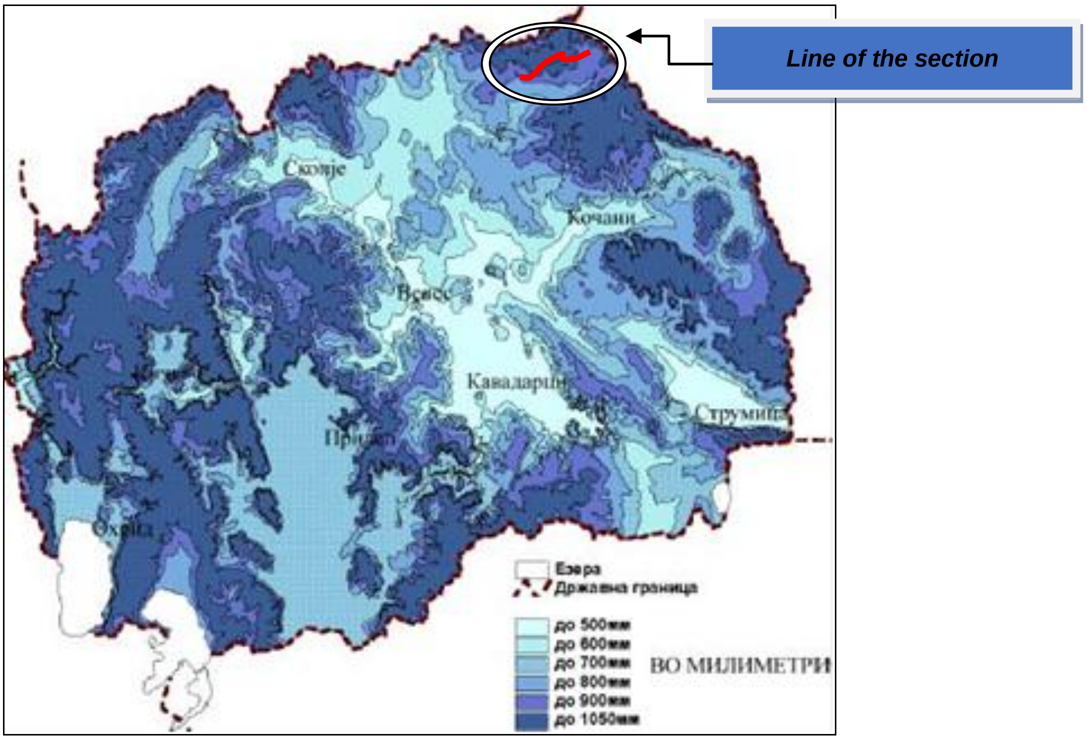


Figure 121 Rainfall map of the Republic of Macedonia

The data about the temperatures and rainfalls measured by the meteorological station “Kriva Palanka” are presented in the following charts:

Table 45 Average monthly and annual temperatures by decades (^{o}C)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	average
51/60	0,6	1,7	4,6	9,8	14,3	18,4	20,7	21,0	16,6	10,8	5,5	3,4	10,6
61/70	-1,3	1,2	4,7	10,3	14,6	17,8	20,3	20,3	16,7	11,4	7,3	1,4	10,4
71/80	-0,1	2,0	5,2	9,2	14,1	17,7	19,3	18,8	14,8	9,9	6,0	1,1	9,8
81/90	-0,4	0,8	5,1	10,0	14,3	17,4	19,8	19,3	16,1	10,6	4,1	1,3	9,9
91/00	0,4	1,5	4,4	9,6	14,7	18,8	20,6	20,4	15,8	11,2	5,7	1,4	10,4
51/00	-0,2	1,5	4,8	9,8	14,4	18,0	20,1	19,9	16,0	10,8	5,7	1,7	10,2

The average annual temperature is 10,2^{o} C. July is the warmest month with 20,1 ^{o}C average temperature, and the coldest month is January with an average temperature of -0,2^{o} C.

Table 46 Average monthly and annual sums of rainfall by decades (mm)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	average
51/60	50,5	45,3	40,7	56,7	91,5	82,5	48,3	40,6	38,5	61,6	61,6	46,5	664,4
61/70	47,4	50,0	50,4	54,1	74,1	75,9	54,3	34,5	27,5	38,4	66,3	62,6	635,3
71/80	41,9	32,9	45,1	48,7	79,0	73,6	61,1	62,0	66,8	64,4	58,4	45,1	678,8
81/90	31,1	41,5	40,8	52,2	64,9	48,5	54,1	47,1	42,0	27,6	65,2	43,9	558,9
91/00	25,9	39,5	36,2	66,9	58,9	60,4	48,9	33,7	49,3	50,3	53,3	52,5	575,7
51/00	39,4	41,8	42,6	55,7	73,7	68,2	53,3	43,6	44,8	48,5	60,9	50,2	622,7

The average annual sum of rainfall by decades varies from 558,9 mm (1981-90) to 678,8 mm (1971-1980). In comparison to the neighboring region, the Kriva Palanka area receives significant rainfall, up to 1.000 mm. This is the result of the high elevation position. The average date of the first snow cover in this area is 30th of November. The areas above 1700 m.a.s.l. have quite a low-average annual temperatures, therefore the peaks Ruen and Carev Vrv are under snow from October to the beginning of June/July.

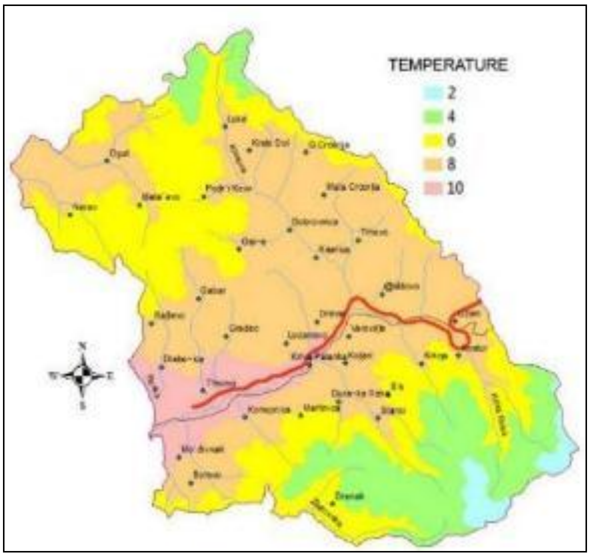


Figure 122 Isothermal map

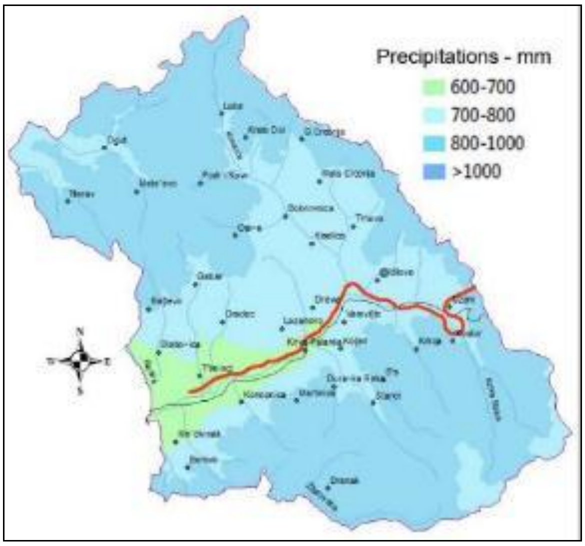


Figure 123 Isohyetal map

The following chart shows the rainfall, duration and the occurrence probability of rainfall. From the chart we can observe that in this area during the summer period, highly intensive rainfalls are to be expected, especially with duration shorter than 60'. These values are among the highest in the country.

Table 47 Rainfall with different duration and occurrence probability

Probability	Quantity	5'	10'	20'	40'	60'	90'	150'	300'	720'	1440'	24 h
	mm	18.51	29.99	41.22	45.81	52.25	62.16	76.67	102.82	128.38	142.01	113.20
0,1%	mm/min	3.70	3.00	2.06	1.15	0.87	0.69	0.51	0.34	0.18	0.10	0.08
	l/s ha	616.83	499.82	343.48	190.85	145.13	115.11	85.19	57.12	29.72	16.44	13.10
	mm	14.03	22.73	31.42	35.46	40.45	47.66	57.97	76.31	94.89	105.18	85.81
1 %	mm/min	2.81	2.27	1.57	0.89	0.67	0.53	0.39	0.25	0.13	0.07	0.06
	l/s ha	467.60	378.88	261.82	147.75	112.35	88.26	64.41	42.39	21.97	12.17	9.93
	mm	12.67	20.54	28.45	32.33	36.88	43.28	52.31	68.28	84.76	94.03	77.52
2 %	mm/min	2.53	2.05	1.42	0.81	0.61	0.48	0.35	0.23	0.12	0.07	0.05
	l/s ha	422.43	342.28	237.11	134.70	102.43	80.14	58.12	37.94	19.62	10.88	8.97
	mm	11.31	18.33	25.47	29.18	33.28	38.86	46.60	60.20	74.55	82.80	69.17
4 %	mm/min	2.26	1.83	1.27	0.73	0.55	0.43	0.31	0.20	0.10	0.06	0.05
	l/s ha	376.93	305.42	212.21	121.56	92.44	71.95	51.78	33.44	17.26	9.58	8.01
	mm	9.47	15.34	21.44	24.92	28.43	32.90	38.92	49.30	60.78	67.66	57.92
10 %	mm/min	1.89	1.53	1.07	0.62	0.47	0.37	0.26	0.16	0.08	0.05	0.04
	l/s ha	315.60	255.72	178.65	103.85	78.97	60.92	43.24	27.39	14.07	7.83	6.70
	mm	8.01	12.98	18.25	21.56	24.59	28.18	32.83	40.68	49.89	55.68	49.01
20 %	mm/min	1.60	1.30	0.91	0.54	0.41	0.31	0.22	0.14	0.07	0.04	0.03

	l/s ha	267.03	216.38	152.08	89.83	68.31	52.19	36.48	22.60	11.55	6.44	5.67
	mm	5.81	9.42	13.44	16.48	18.79	21.06	23.64	27.65	33.44	37.58	35.55
50 %	mm/min	1.16	0.94	0.67	0.41	0.31	0.23	0.16	0.09	0.05	0.03	0.02
	l/s ha	193.73	156.97	111.97	68.65	52.21	39.00	26.27	15.36	7.74	4.35	4.11

The Kriva Palanka area is a windy area. The winds in Kriva Palanka blow from almost every direction and at any time of the year. The winds blow with an average annual rate of 2,9 m/s, and most common are the winds from northwestern direction.

Due to the great frequency of winds in this area, fog is a rare occurrence. On average, annually 10-12 days with fog are recorded, mainly from November to February, and some years from September to May.

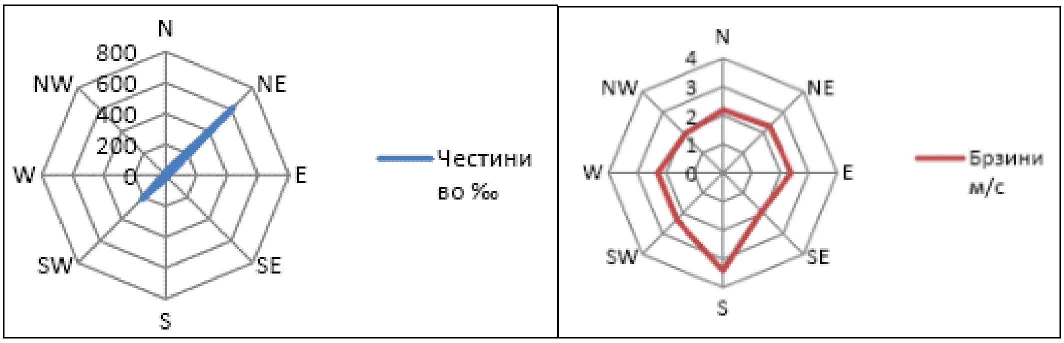


Figure 124 Frequency and speed of winds in municipality Kriva Palanka

6.10 Climate change

Macedonia is part of the countries which do not belong in Annex I, i.e. countries which do not have quantified obligations for reduction of greenhouse gas emissions, however, as a EU membership candidate country, it must be included in the joint European efforts and goals in regards to climate change.

The Republic of Macedonia has created a national inventory of anthropogenic emissions by sources and carbon sinks of all greenhouse gasses (GHG). The goal of the inventory is to identify the main sources and carbon sinks of greenhouse gases with greater reliability, to align the goals and informing the decision-makers. The inventory consists of a database for six direct gases: CO_2, CH_4, N_2O, PFCs, HFCs и SF_6, and four indirect gasses: CO, NOx, NMVOC и SO_2.

The five key categories of source emissions in Macedonia are:

- CO_2 emissions from the energy industries (coal, lignite) (49,5%);
- CH_4 emissions from solid waste landfills (11,7%);
- CO_2 emissions from mobile sources, including road motor vehicles (11,6%);
- Production and construction industries (8,8%); и
- CH_4 emissions from enteric fermentation of domestic livestock (3,9%).

Generally, the share in the emissions of greenhouse gasses by sectors for the period 1990-2012 is shown in the following figures.

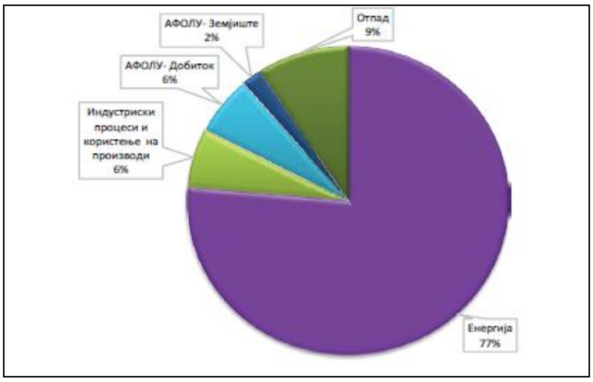


Figure 125 Share by sectors in emissions of Greenhouse gasses for 1990-2012[18]

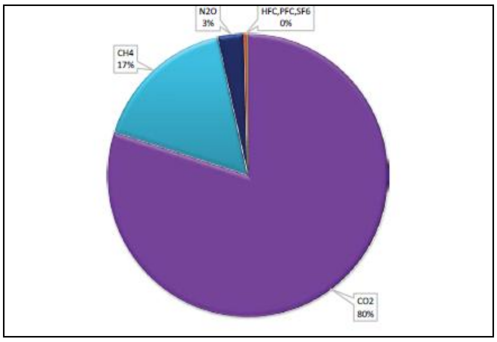


Figure 126 Greenhouse emissions by gas (1990-2012) [19]

The analysis of the key emission sources by subcategories shows that the energy industries subsector is the most dominant source of emissions in the whole inventory period, with an annual share of 50,2 % in 1990 and 49,5% in 2012.

The production industries and the construction subsector are second by share in the country emissions with and average share of 13,6% in 1990. In the last inventory period year, 2012, this sector was responsible for 8,82% of the greenhouse emissions in the country, and with that is considered fourth by share. So, the emission of the production subsector have a decreasing trend, which is a result of the decreased industrial activity in the country, which is partially explained by the closing of the production lines for aluminum, lead and zinc in 2003.

Contrary to that, the emission of the road traffic subsector have a significant increase in relation to the overall national emissions in the period 1990-2012, with the average share in emission by this subsector in 1990 being 6,2% from the total national emissions or 76-,85 Gg of CO_2-eq, and in 2012 this subsector was responsible for 11,6 of the total national emissions or 1415,14 Gg of CO_2-eq.

Similar to this, the emissions of the subsector for removal of solid waste are significantly increased for the period 1990-2012, due to the increase in population, which brings about greater spending and waste creation.

In the category of land usage and changes in land usage and forestry, the emissions are relatively unchanged, except in 2007, 2008 and 2012 when the carbon sinks are significantly lowered, due to great forest fires.

In the agricultural sector, the greatest share of the CH_4 emissions (89%) is produced by enteric fermentation of domestic livestock and these emissions are constantly dropping in parallel to the

[18] First Biennial Update Report Executive Summary, September 2014

[19] Annual report on the quality of environment, 2014

reduction in livestock population. The emissions of manure make up 8% of the greenhouse gas emissions, whereas the rest of the emissions come from rice fields and burning waste.

In accordance to the First Biennial Update Report Executive Summary, the total emissions of greenhouses gases will increase from 9,030 kt in 2012 to 18,340 kt in 2035, i.e. increase of 100% according to the scenario without measures.

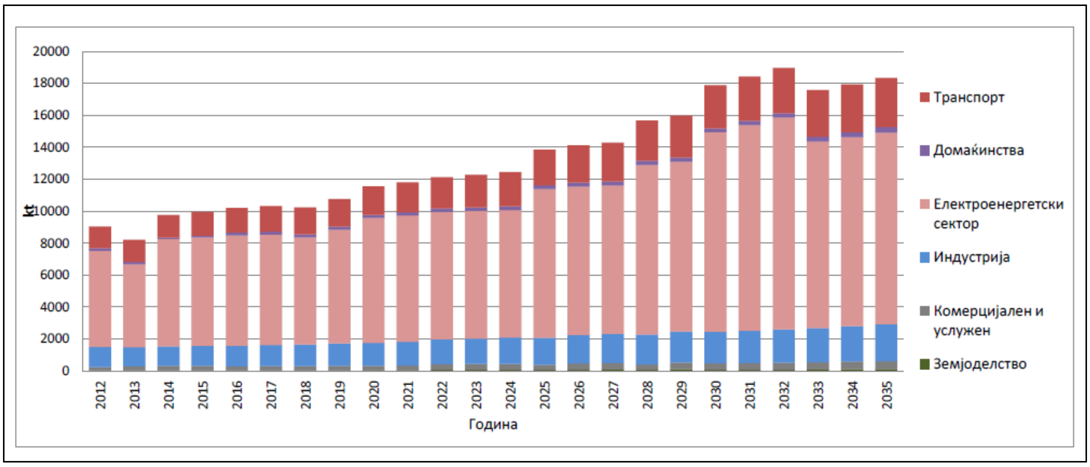


Figure 127 Greenhouse gas emission according to the scenario without measures

To decrease the greenhouse gas emissions originating from different sectors, reducing measures are planned. The transportation sector as the fastest growing sector and one of the sectors which contributes mostly in increasing greenhouse gas emissions, is subject to greatest efforts, where most measures are undertaken to decrease the CO_2 emissions.

In the direction of reducing the greenhouse gas emissions, numerous measures were considered, among which is the greater usage of the railroad, as well as increasing the number of trains and construction of a railroad towards Bulgaria, which is traditionally one of Macedonia's greatest economic trade partner. By constructing the railroad, it is assumed that half of the present economic trade with the neighboring country would be done using the railroad, with a tendency of increasing in the future. The construction of the railroad towards Bulgaria, according to the prediction of the Government, should be completed around 2022. Because this measure starts after 2020, the comparisons to the WOM[20] scenario are done only for 2030 and cumulatively to 2030. This points to the expectations that the cumulative savings of CO_2 emissions in 2030 to be 229 kt, and the total expenditures would be 56 M€ higher than the scenario without measures. Consequently, the specific expenditures are 246 €/t, which makes this one of the more expensive measures. Despite that, it is important to note that this measure would have other benefits as well.

Table 48 Economic and environmental grade of the measure railroad towards Bulgaria

Railroad Bulgaria	2030	Cumulatively 2030
Reduction of CO_2 emissions (kt)	27	229
Difference of total expenditures (mil €)	4	56
Specific expenditures (€/t)	168	246

In the Third National Communication on Climate Change (2014), the predictions for climate changes from the main climate elements (temperature and rainfall) have been made for 2100, i.e. for periods from 1996-2025 (labeled for 2025), 2021-2050 (labeled for 2050), 2050-2075 (labeled for 2075) and 2071-2100 (labeled for 2100) in comparison to 1961-1990 (labeled for the reference period for 1990).

[20] Referent scenario without measures

The results of the four global circulation models (GCMs) have been used together with NCEP/NCAR for a second data analysis (Kalnay et al., 1996; Kistler et al., 2001). Upon that basis, for the first time, according to the national climate sub-regions, local climate scenarios have been developed.

According to the results, the average increase in temperature is between 1,0°C in 2025, 1,9°C in 2050, 2,9°C in 2075, and 3,8°C in 2100, whereas the average rainfall reduction is within the range of -3% in 2025, -5% in 2050, -8% in 2075 to -13% in 2010 compared to the referent period.

The greatest increase in temperature in the Republic of Macedonia is expected in the summer seasons, connected to the strong rainfall decrease. There will be almost no change in the winter rainfall, but change is expected in the other seasons.

According to the results of the empirical scale and the direct GCM results, the local predictions show a more intensive increase in temperature during winter and spring. Further, the local predictions show less decrease in summer rainfall. The predicted temperature changes are intensive in the three climate subtypes in the northwestern part of the country which is under alpine climate influence, shown by the meteorological stations at Lazaropole, Popova Shapka and Solunska Glava.

6.11 Landscapes and biodiversity

The reailway corridor stretches almost entirely through an area with characteristics of mountainous rursl landscape knokwn as **Osogovo mountain rural landscape** (Melovski et al. 2015). Only small part of the corridor (km 71 to km 73) lies in the **Roling rural landscape with hedges**. However, this part of the roling rural landscape is not typical since it encompases the town of Kriva Palanka (which due to its dimensions cannot be identified as individual landscape). Thus, this landscape does not have any particular value for the railway corridor under consideration and it will not be described in more details (Figure 128).

6.11.1.1 Osogovo mountain rural landscape

This landscape is typical for the north-eastern part of Macedonia, including the mountain chain Kozjak-German-Bilina Planina along the Maceonian-Serbian border. The lower part of Osogovo Mountains shows the most typical characteristics of this landscape type, so the landscape was called "Osogovo landscape". Typical features of this landscape type can be observed along the part of the railway corridor from Kriva palanka to Bulgarian border.

The relief is rather uniform, represented by moderate to steep slopes, ravines and valleys. Brown forest soils predominate and there are frequent rocky spots, too. Geological ground is the compsed of mostly silicate rocks. Owing to higher altitudes of this landscape compared to other rural landscape types in Macedonia (1000-1400 m above sea level), climate is warm continental (on south exposed slopes) and sub continental to continental (north). Italian and Turkey oak forests (and Sessile oak in the upper part of the belt) spread over southern expositions (oak forests of oriental hornbeam and pubescent oak can be also found in lower parts). Submontane beech forests occur in ravines. Beech ecosystems occur most often on northern expositions. Southern and western slopes are under strong anthropogenic pressure and are more or less altered, natural or semi-natural. Agriculture is extensive and livestock breeding is the main occupation of the local population. There are only small areas under potato and rye fields since most of the former areas under these crops have been abandoned. The area is sparsely populated and settlements are of scattered type. It is actually the scattered formation of the settlements that gives the distinctive appearance of this landscape.

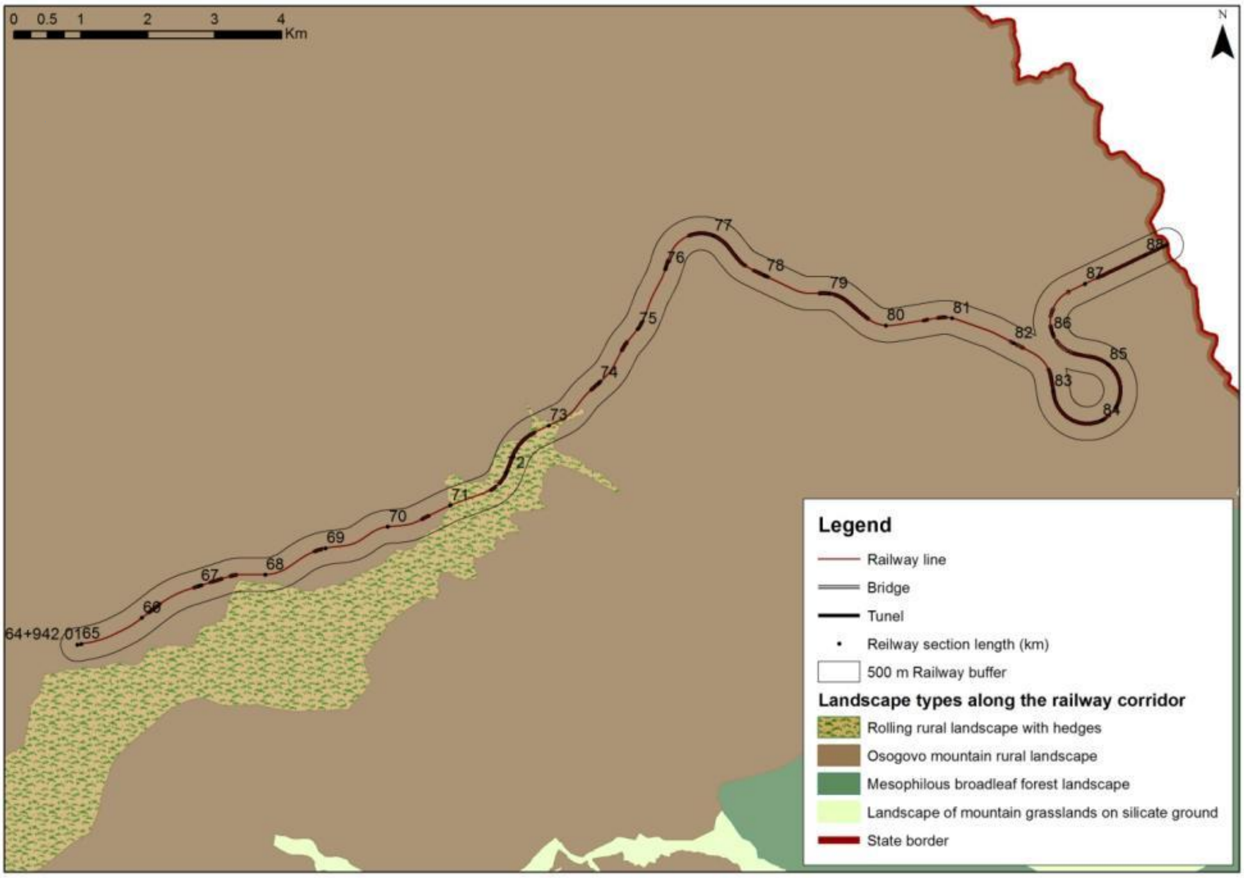


Figure 128 Landscape types in the broader area of the railway corridor

Rural nature of the landscape is attributed by the share of CORINE Land Cover classes - 'Land principally occupied by agriculture, with significant areas of natural vegetation' (tan), 'Pastures' and 'Transitional woodland-scrub' (light yellow), while domination of 'broadleaf forests' (dark teal) (Table 49) gives specific feature to the landscape. The matrix is composed of broadleaf forest, mostly of oak forests of Turkey and Italian or Sessile oak, as well as beech forests. However, forests often lack fully closed arrangement and are rather sparse at spots (in the railway corridor the sessile oak forest at v. Uzem shows such fieature), though visually they do not appear degraded. There are many patches of more or less abandoned populated places, meadows and minor fields.

Table 49 Basic structural characteristics (land cover - CLC) of Osogovo mountain rural landscape (the absolute values – hectars – refer to the whole area of this landscape type in Macedonia; the coloured cells in the table represent CLC classes that give the landscape appearance to Osogovo landscape)

Osogovo mountain rural landscape	Area (ha)	Area (%)
Broad-leaved forest	16060	64.80
Complex cultivation patterns	328	1.33
Coniferous forest	120	0.48
Construction sites	74	0.30
Land principally occupied by agriculture, with significant areas of natural vegetation	2395	9.66
Mixed forest	401	1.62
Natural grassland	517	2.09

Pastures	1851	7.47
Transitional woodland-scrub	3040	12.26
Total	24785	

From aesthetic point of view, this landscape possesses great value and therefore great potential for rural tourism development. Visual features of this landscape are presented on Figure 129. In relation to the foreseen railway construction and operation the most attractive parts of the landscape are sitated in the upper part of the corridor, from Kriva Palanka till Bulgarian border.

Furthermore, the landscape bears great importance for biodiversity, although more precise definition of the form and potential of forest corridors connecting major forest areas (core areas on Osogovo Mts. and restoration area on Bilina Planina), see Figure 161 (chapter on Biocorridors) is required for accurate establishment of the conservation significance of the landscape. The overall significance of the landscape for biocorridor function was described and presented in Chapter 6.11.2.4.2.

Figure 129 Osogovo rural landscape

6.11.2 Biodiversity - Habitats and Species

6.11.2.1 Physico-geographic features as related to biodiversity

The investigated area along the railway line (section v. Dlalbochica to Deve Bair) is characterised by composite geology. Geological substrates are disjointed and many types are altering: alluvial deposits and lower river terraces along the river beds (along Kriva Reka till km 72); amphibolites rocks and metabasites as an inclusions in albite-chlorite schists (dominating in the first half of the railway section); then albite-quartz-muscovite schists till Deve Bair and finally Eocene conglomerate and volcanogenic sediments next to the Oligocene quartzlatite till the border with Bulgaria. It is obvious that different type of siliceous minerals dominate while limestone is not characteristic for this railway section.

The climate in the area of interest is moderate-continental. According to the meteorological station Kriva Palanka, the average annual temperatures is 10,2 ^{o}C, the average annual minimum temperature is 5,5 ^{o}C, and the average annual maximum temperature is 15,9 ^{o}C. On average during the year, there are 79 warm and 20 hot days in Kriva Palanka. It is to be expected that the valleys of the river Kriva Reka along the railway line would be characterised by a slightly warmer climate. Another important point about climate conditions in this area is the the fact that the influence of the Mediterranean climate is negligible, unlike the most of the territory of the country. The average precipitation sum for the same meteorological station is 565.5 mm. Maximum precipitation is in May-June and the second maximum in November, while the minimum is in August-September and February. The continental climate in Kriva Palanka, for example is reflected on the precipitation as well. However, 73 % of dry periods were registered during the vegetation period which shows certain Mediterranean influence anyway.

Different inclination and exposition of the slopes from both sides of the river valleys, the presence of river terraces (elevated flat areas in the broader parts of the river valleys), smaller or bigger hills, plateaus, alteration of broader valleys with gorges and canyons along the river Kriva Reka, are sites with very diverse microclimatic conditions. River valleys have humid soil while upper flat areas and hills are very dry. The whole area is crossed by streams with permanent or intermittent flow, creating in this way deeper or shallower dales and ravines with specific microclimatic conditions. The difference between the lowest (560 m) and the highest (1180 m) elevation of the corridor is 620 m.

Historically, the investigated area was populated permanently for millennia. The area is hardly urbanised: only one urban system touches the investigated corridor – the town of Kriva Palanka but the area is more or less regularly sparsly populated. The strong and long-lasting human impact on the environment, especially forests, resulted in different kinds of changes in the sense of degradation of natural environment and the production of new, amn-managed ecosystems. These are very diverse, mainly small fields and acres, vineyards, orchards, meadows and others. They are developed according to the traditional, more or less extensive way of crop growing which in some areas is still practiced while on many area it was abandoned during last few decades.

The dispersed type of village settlements in North-East Macedonia causes distribution of very sparse small groups of houses over large areas representing a village. The presence of isolated houses is also common. They are surrounded by fields, acres, vineyards, orchards, meadows, natural vegetation and individual trees. All this arable land presents a series of habitats.

It is obvious, according to the elaborated characterisation of the area that the railway line passes through very diverse and interesting rural region.

6.11.2.2 Habitat maping and description

The following Report presents the summarised results of habitat types mapping (December 2016 and previous studies conducted during May-June 2011), field observations, and literature data on the flora and fauna composition of the corridor along the planned railway line, starting from the v. of Dlabochica up to Deve Bair (the border between Macedonia and Bulgaria). It contains the habitats description, their distribution and importance on the local and regional scale.

The aim of the habitat mapping and flora and fauna composition investigation was to recognise the existing habitats, inventory the habitats and present them on the map with the scale 1:25000. The goal was finally to evaluate the biodiversity of existing ecosystems and different sites and localities, (in the following text - habitats) along the railway alignment on the basis of identified and described habitats, than to recognize the sites of special importance concerning the biodiversity and natural heritage - all this in order to prevent ecosystems and species populations from disturbance, damage or destruction during the construction works and operation of the railway.

The study concerns single examined **corridor of 500 m width** (250 m from both sides of the railway alignment axis). The examined corridor follows a completely new alignment, designedin course of this project, from Kriva Palanka (v. Dlabochica, km 64+942) up to Deve Bair at the Bulgarian border (km 88+364).

Five hundred meters wide corridor was considered as sufficiently wide to encompass all impacts during construction works and operational needs on the projected railway alignment, especially because most of the works will be performed along the existing alignment at the most of its length. The already built up alignment could serve as access road for the construction of the new railway sections, while in the area without existing alignment, existing road network (mostly composed of village non-paved roads) can be used as access roads. In the area of sensitive localities and in the area where protected areas exist the wider surrounding was considered and examined as well.

As far as biodiversity (and supporting physic-geographic characteristic – geology, geomorphology, climate and biogeography) is concerned, the whole alignment is more of less homogenous. Shortly, the alignment stretches through the gorge area of the river Kriva Reka from the village Psacha through the town Kriva Palanka till the village Uzem (up to the Bulgarian border), which is hilly or mountainous, mostly forested, area with steep to very steep slopes toward Kriva Reka and very sparsely populated. In sense of human impacts, part of the valley where the town of Kriva Palanka is situated is different than the rest of the alignment – more dansly populated and quite urbanized.

The habitats in the area of railway corridors can be divided into two main categories according to their origin: natural and anthropogenic habitats. Natural habitats include forests and shrublands, grasslands (which are seminatural), rocky sites and water habitats. The division inside these categories followed criteria such as presence of different plant communities, distribution, degradation level and geomorphologic features, but the main criterion was the division proposed by EUNIS Habitat Classification (European Commission, DG Environment).

Description of the habitats follows this pattern: description of the plant community (if any), dominant and most common plant species and characteristic fungi species. Fauna of the habitats is presented by vertebrates (amphibians, reptiles, birds and mammals) and selected groups of invertebrates (dragonflies, ground beetles and daily butterflies). Fish species and some other groups of invertebrates are analysed in the description of wetlands. At the end of the description of habitats, their general distribution range and distribution in the railway corridor is presented.

More comprehencive lists of species by habitats (based on literature data and limited field survey) are presented in appendices: Plant species; Vertebrates (Amphibians, Reptiles, Birds, Mammals); Invertebrates (Ground beetles, Dragonflies, Daily butterflies).

6.11.2.3 Natural Forests and Shrublands

Forests and shrublands are divided into three habitat types: oak forests (remnants of pubescent oak and oriental hornbeam forest, Italian or Hungarian oak and Turkey oak forest and sessile oak forest), beech forest and riparian habitats. Almost the whole area of interest is situated in the oak forest belt.

Willow woodlands and belts are developing in the valleys of streams as well as dales and ravines in the area of oak forest. These habitats penetrate from the lowest parts of the railway corridor area up to 1000 m a.s.l. (alder woodland belts at this elevaton). All of the three main habitat types have been under strong anthropogenic pressure for many centuries. Almost all of them are in different stages of degradation. The degradation level was second criterion for further division of forest and shrubland habitats, especially the oak shrubland (preserved, sparse and degraded).

6.11.2.3.1 Oak Forest Belt

6.11.2.3.1.1 Degraded Xerothermophillous Oak Forests - Pubescent Oak and Oriental Hornbeam

Reference to EUNIS habitats: G1.7C2 [*Carpinus orientalis*] woods - **G1.7C22 Helleno-Balkanic oriental hornbeam woods**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **41.7 Thermophilous and supra-Mediterranean oak woods**

and

Reference to EUNIS habitats: **F5.16 Deciduous [*Quercus*] matorral**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

and

Reference to EUNIS habitats: F6.66 Balkan peninsula supra-Mediterranean garrigues **- F6.661 Balkan Peninsula supra-Mediterranean shrub garrigues**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: The plant community that characterises this habitat is not typical and bears characteristics of the forest type from which it originate. In the railway corridor, it usually occupies south exposed slopes where oak-oriental hornbeam forest should normally occur. Thus, Oriental hornbeam (*Carpinus orientalis*), pubescent oak (*Quercus pubescens),* (Figure 130) are common tree species. Beside these, tree species *Fraxinus ornus*, *Colutea arborescens*, *Coronilla emeroides*, *Acer monspessulanum*, *Rhamnus rhodopaea* are frequent in the tree and shrub layers. *Cyclamen neapolitanum*, *Carex halleriana* and many other herb speces are characteristic for the herb layer. The difference between fprest and shrubby habitat results from the lower percentage of deciduous species (*Carpinus orientalis, Quercus pubescens, Fraxinus ornus,* and others) in degraded oak habitat due to its overexploitation in the past but also at present, so the physiognomy of the community has been changed (Figure 131). Degraded natural stands representing this habitat are usually invaded by *Paliurus spina-christi*, *Pyrus amygdaliformis*, *Prunus spinosa* etc. The plant association that represents this habitat is **Paliuretum submediterraneum** Rizovski prov. It differs from the other associations by the domination of *Paliurus spina-christi* in different succession stages (Figure 132). Other features that distinguish this habitat from the forest one are as follows: much better developed herb layer due to the presence of open spots and clearings between the evergreen shrubs, then shallow, eroded soil, dense ravine system, smaller or bigger bare rocks etc The most important plant species in the tree layer of this association are *Paliurus spina-christi, Quercus pubescens, Fraxinus ornus, Juniperus oxycedrus,* and some others. The herb layer is composed of *Minuartia glomerata, Euphorbia myrsinites, Ajuga laxmanii, Knautia orientalis, Tunica illyrica, Althea sp.* etc.

Figure 130 Pubescent oak (*Quercus pubescens*)

Distribution: This habitat is widespread in the Adriatic and Aegean sub-Mediterranean region. In Macedonia it is climazonally distributed up to about 600 m a.s.l., and on the southern slopes of the mountains it reaches up to 1,000 m altitude.

Distribution in the area of the railway corridor: There is a well-developed forest of pubescent oak and oriental hornbeam on the right side of the Kriva Reka River near Dlabocica village, but it is out of the defined corridor of interest for this railway section. The degraded stages of this forest type does not have a regular distribution but they are connected to village surroundings, and are located near the agricultural land and the existing roads. Fragmens occur in close proximity to the villages Mozdivnjak, Tlminci and Dlabochica. (see Annex 16 - Habitat Map).

Figure 131 Degraded natural stand of pubescent oak and oriental hornbeam mixed with planted pine

Figure 132 *Paliurus spina-christi* – commonly known as Christ's Thorn

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this biotope is given in Annex 15.

Fungia: The fungal composition is very similar to the similar forest habitat since it represents its degradation stage and same host tree and shrub species. The characteristic lignicolous fungal species for the biocoenosis defining this habitat do not occur here due to the absence of adequate hosts, but new tree species such as *Paliurus spina-christi, Juniperus* spp. and *Pyrus amygdaliformis* enable development of other fungal species such are *Peniophora cinerea* on *Paliurus spina-christi*, *Peniophora junipericola* on *Juniperus* spp. and *Peniophora incarnata, Laeticorticium polygonioides* etc. on *Pyrus amygdaliformis*. Compared to the similar forest habitat, there is greater diversity of non-mycorrhizal terricolous fungi here owing to the larger proportion of grass areas. Among others, some typical meadow species such as *Bovista plumbea, Hygrocybe conica, Marasmius oreades* etc. are found in this habitat.

Mammals: The most common species for this habitat are: eastern hadghog (*Erinaceus concolor),* Marbled polecat (*Vormela peregusna*)*,* Guenther's vole (*Microtus guentheri*)*.* Also, presence of *Apodemus flavicolis, Apodemus agrarius, Rattus rattus, Mus macedonicus, Lepus europeus, Canis lupus, Vulpes vulpes, Mustela nivalis, Meles meles, Felis sylvestris, Sus scrofa, Capreolus capreolus* is expected as these species live in a diverse variety of habitats.

Birds: This habitat provides greater diversity of microhabitats, ecological niches and breeding sites. The number of breeders (25) is higher than in the well-preserved forests of Pubescent oak and Oriental hornbeam, but the number of residents is lower. The number of breeders is higher due to the presence of species such as: *Hippolais pallida,* some *Sylvia* species*, Lanius collurio, Lanius minor, Lanius senator, Passer hispaniolensis* and some *Emberiza* species characteristic for the hill pastures. However, the total number of bird species is almost the same as in the similar forest habitat (~60).

Reptiles and amphibians: The species of amphibians and reptiles in this habitat are the same as for the forest of pubescens oak and Oriental hornbeam. The amphibians found in this habitat are**:** Fire Salamander (*Salamandra salamandra*), Common Newt (*Lissotriton vulgaris*), Yellow Belied Toad (*Bombina variegata),* Common Toad (*Bufo bufo*), Green Toad (*Pseudepidalea viridis*).The reptiles found in this habitat are Hermann's Tortoise (*Eurotestudo hermanni*), Erhard's Wall Lizard (*Lacerta erhardii*), Green lizard (*Lacerta viridis*), Balkan Green Lizard (*Lacerta trilineata*), Slow Worm (*Anguis fragilis),* Aesculapian Snake (*Zamenis longissimus*).

Butterflies: Degraded oak and hornbeam forest offer diverse oopen sites and shady spots. Butterfly diversity in this habitat is consisted of both: typical species found in dry, bushy vegetation like: *Thymelicus sylvestris, Phengaris arion, Melitaea phoebe*, *Arethusana arethusa,* as well as species common for a variety of diverse habitats: *Iphiclides podalirius, Papilio machaon, Aporia crataegi, Carcharodus alceae, Gonepteryx rhamni, Limenitis reducta, Nymphalis antiopa, N. polychloros, Brintesia circe, Erebia medusa, Argynnis niobe, Aglais io, Plebeius agestis, Vanessa cardui, V. atalanta, Melanargia larissa, Coenonympha pamphilus, Leptidea sinapis, Colias crocea, Satyrium acacia, Hamearris lucina* etc*.*

Ground beetles: The fauna of Ground beetles (Carabidae) is represented by species of hill pastures and pubescent oak forests (see Annex 15). There are no specific species for the habitat of degraded Pubescent oak forests.

Longhorn beetles: The fauna of Longhorn beetles in this habitat is similar to the previous one. Open terrain with low vegetation allow species which only in larval stage develop in wood (amost all species of Lepturinae subfamily, such as *Stenurella bifasciata, S. melanura, S. nigra, S. septempunctata, Pseudovadonia livida* and others) to stay in same area as imago since they can feed on nearby flowers.

Orthoptera: Due to the presence of open surfaces with sparse vegetation a significant number of orthopteroid species live here. Most common are *Tylopsis lilifolia, Ancistrura nigrovittata, Poecilimon thoracicus, Polysarcus denticauda, Tettigonia viridissima, Decticus albifrons, Platycleis affinis, Odontopodisma decipiens, Omocestus rufipes, Chorthippus bornhalmi, Euchorthippus declivus* etc.

6.11.2.3.1.2 Thermophilous Oak Forest – Mixed Italian Oak and Turkey Oak Forest

Reference to EUNIS Habitats: G1.76 Balkano-Anatolian thermophilous [*Quercus*] forests - **G1.762 Helleno-Moesian [*Quercus frainetto*] forests**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **41.7 Thermophilous and supra-Mediterranean oak woods**

General characteristics: In the upper parts of the oak forest belt there are stands of Italian oak (*Quercus frainetto*). These stands represent small patches of the forest belt **Quercetum frainetto-cerris** community, which is normally above the lower pubescent oak and oriental hornbeam belt (Figure 133). The edifier species are Italian oak (*Quercus frainetto* - Figure 134*)* and Turkey oak (*Quercus* cerris). Beside these tree species, *Cornus mas, Carpinus orientalis, Crataegus monogyna, Rosa galica, Rosa arvensis* etc. represent the subdominant tree layer and shrub layer. *Danaa cornubiensis, Trifolium pignantii, Inula salicina, Lathyrus inermis, Stachys scardica, Crocus veluchensis* etc. are the most common plants in the herb layer. The elements from more xerothermic forest (Querco-Carpinetum orientalis) such as *Quercus pubescens, Carpinus orientalis, Pyrus amygdaliformis, Fraxinus ornus, Colutea arborescens, Coronilla emeroides* etc. are usually mixed with *Quercus frainetto* forest.

Distribution: Italian and Turkey oak community, which comprises the largest part of oak forests in Macedonia, is a climazonal community in all valleys in Macedonia, usually developing at an elevation of 800-1100 m. Very similar forests develop in all valleys of the central region of the Balkan Peninsula.

Distribution in the area of the railway corridor: The habitat is distributed intermittently on a number of locations along the Kriva Reka river. The better-preserved associations are near the town of Kriva Palanka, namely, in the surroundings of Tlminci and Drenjevo villages. In addition, it occurs on minor surfaces along the right course of the Kriva Reka river, on the Drenjevo-Uzem stretch (see Annex 16 - Habitat Map).

Figure 133 Forest of Italian oak and Turkey oak in the area of Kriva Palanka

Figure 134 Italian oak (Quercus frainetto)

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this biotope is given in Annex 15.

Fungia: In the oak forests many macromycete species, both lignicolous and terricolous, are noted. The most common species are *Armillaria mellea, Boletus aestivalis, Cantharellus cibarius, Clitocybe gibba, Hydnum repandum, Lactarius zonarius, Stereum hirsutum, Trametes hirsuta* and *T. versicolor.* Certain species such as *Boletus aereus B. luridus, B. quelletii, Hygrophorus chrysodon, Lactarius piperatus, Russula cyanoxantha* and *Xerocomus chrysentheron* are known mycorrhizal fungi associated with oak. Some of the lignicolous species usually grow as saprobes on fallen branches, stems and stumps of oak and other deciduous trees such as *Polyporus arcularius, Daedalea quercina*, *Exidia truncata, Hapalopilus rutilans, Hymenochaete rubiginosa, Radulomyces molaris, Peniophora quercina* and *Vuilleminia comedens.*

Mammals: Mammal fauna is similar to the one of forests of pubescent oak and Oriental hornbeam (see Annex 15).

Birds: Bird fauna is almost the same as in the forest of pubescens oak and Oriental hornbeam (see Annex 15).

Reptiles and amphibians: The species of amphibians and reptiles: In this habitat are the same as the forest of pubescens oak and Oriental hornbeam (see Annex 15).

Butterflies, longhorn beetles and orthopterans: The fauna similar to the one of forest of pubescens oak and Oriental hornbeam (see Annex 15).

Ground beetles: This fauna is similar to the one of the pubescent oak forests (see Annex 15). However, some mesophyle species were also recorded: *Molops rufipes denteletus* (stenoendemic subspecies) and *Tapinopterus balcanicus* (Balkan subendemic). *Carabus intricatus* and *Carabus montivagus* are common in this habitat, as well. In total, 16 species were recorded.

6.11.2.3.1.3 Degraded Thermophilous Oak Forest - Italian and Turkey Oak

Reference to EUNIS Habitats: G1.76 Balkano-Anatolian thermophilous [*Quercus*] forests - **G1.762 Helleno-Moesian [*Quercus frainetto*] forests**

and:

Reference to EUNIS Habitats: **F5.16 Deciduous [*Quercus*] matorral**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: In the aspects of vegetation, fauna and fungi, this habitat is identical with the previous one. Degradation here is a result of excessive forest exploitation, which has given rise to occurrence of grassland species of plants, animals and fungi. For more detailed data on the species composition, refer to Annex 15.

Distribution in the area of the railway corridor: The habitat stretches on several localities along the right course of the Kriva Reka river, on the Kriva Palanka-Drenjevo stretch (see Annex 16 - Habitat Map).

6.11.2.3.1.4 Mesophilous Oak Forests - Flowering Ash and Sessile Oak Forest

Reference to EUNIS Habitats: G1.76 Balkano-Anatolian thermophilous [*Quercus*] forests - **G1.763 Helleno-Moesian [*Quercus dalechampii*] forests**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **41.7 Thermophilous and supra-Mediterranean oak woods**

General characteristics: In the upper parts of the oak forest belt, there are stands of ass. **Orno-Quercetum petraeae** Em 1968. It grows on a base of phylitoids, covered by medium-deep to deep forest brown soil (Figure 135). The following species dominate in the tree stratum: *Quercus petraea, Quercus cerris, Fraxinus ornus, Carpinus betulus* and *Acer campestre*. *Corylus avellana, Cornus mas, Ligustrum vulgare, Crataegus monogyna, Evonymus verrucosa, Mallus silvestris* occur in the bush stratum. The most frequent in the herb layer are: *Festuca heterophylla, Lathyrus niger, Lathyrus venetus, Campanula persicifolia, Melica uniflora, Pulmonaria officinalis, Cyclamen neapolitanum, Scilla bifolia, Poa nemoralis, Sanicula europea*, *Stellaria media* etc.

Distribution: The sessile oak community has a climazonal distribution in Macedonia and occupies a clearly defined belt between 800 and 1,250 m.

Distribution in the area of the railway corridor: In the area of the railway corridor, it does not have a regular distribution. As an intermittent belt, it stretches along the left course of the Kriva Reka river between Kriva Palanka and Uzem village. The best preserved association with older trunks is found in the area of the v. Kostur - Janchevci (see Annex 16 - Habitat Map).

Figure 135 Forest of flowering ash and sessile oak near the Bulgarian border

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this habitat is given in Annex 15.

Fungia: The fungal composition is very similar to the previous habitat. Due to the higher altitude, some thermophilic species are missing. In some places where there are well-developed birch stands, many associated species occur. Some of the species such as *Leccinum scabrum* and *Lactarius torminosus* are known as mycorrhizal partners of birch, while *Piptoporus betulinus* is a typical lignicolous species that usually grows as a parasite or saprobe on living or dead trees of birch.

Mammals: Mammal fauna is similar to the one of the forests of Pubescent Oak and Oriental Hornbeam.

Birds: Bird fauna is almost the same as in the Forests of Pubescent Oak and Oriental Hornbeam and forests of Italian and Turkey oak.

Reptiles and amphibians: This habitat is with similar composition as the Forest of Pubescens Oak and Oriental Hornbeam regarding the amphibian. Two reptile species less because of the higher altitude (in total 7 reptile species). The reptiles found in this habitat are**:** *Wall lizard (Podarcis muralis)*, Green lizard (*Lacerta viridis*), Slow Worm (*Anguis fragilis),* Aesculapian Snake (*Zamenis longissimus*), Smooth Snake (Coronella austriaca).

Butterflies and orthopterans: Butterfly fauna similar to the other oak forests.

Ground beetles: Sessile oak forests hold more mesophyle species than the lower oak forests. Thus, the fauna of Sessile oak forests is a mixture of the faunas of submontane beech forests and Italian and Turkey oak forests. Although the lists of the species are very similar, the structure of the communites slightly differ. *Carabus montivagus, Carabus convexus dilatatus, Tapinopterus balcanicus* and *Notiophilus substriatus* are the most abundant ground beetle species.

Longhorn beetles: Because of similar altitude, species that feed (or only develop) in different deciduous forests sush (oak, beech), like *Morimus funereus, Rutpela maculata, Cerambyx scopolii*, can be found here.

6.11.2.3.1.5 Degraded Mesophilous Oak Forests - Flowering Ash and Sessile Oak

Reference to EUNIS Habitats: G1.76 Balkano-Anatolian thermophilous [*Quercus*] forests - **G1.763 Helleno-Moesian [*Quercus dalechampii*] forests**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **41.7 Thermophilous and supra-Mediterranean oak woods**

General characteristics: In the aspects of vegetation, fauna and fungi, this habitat is identical with the previous one. Due to intense anthropogenic impact, the forests are degraded in a number of locations, which has resulted in growth of grassland species of plants, animals and fungi. For more detailed data on the species composition refer to Annex 15.

Distribution in the area of the railway corridor: This forest type begins at the v. Uzem (near Vitanovci) and goes all the way to the Bulgarian border (see Annex 16 - Habitat Map).

6.11.2.3.2 Beech Forest Belt

6.11.2.3.2.1 Beech Forests - Submontane

Reference to EUNIS Habitats: G1.69 Moesian [*Fagus*] forests - **G1.691 Southwestern Moesian beech forests**

Reference to EU HD Annex I: **91W0 Moesian beech forests**

Reference to CoE BC Res. No. 4 1996: **41.1 Beech forests**

General characteristics: The belt of beech forests is represented by the ass. **Festuco heterophyllae-Fagetum** Em 1965 (**Figure 136**). It grows on a base of mica minerals and gneisses covered by forest brown neutral to sparsely acid soil. The tree belt is absolutely predominated by *Fagus silvatica*, and there are individual growths of *Quercus petraea, Sorbus torminalis, Ostrya carpinifolia* etc. From a diagnostic point of view, the most relevant in the bush belt is *Corylus avellana*, while in the ground floor those are *Festuca heterophyllae, Cyclamen neapolitanum, Danaa cornubiensis, Lathyrus venetus, Pteridium aquilinum, Stellaria holostea, Luzula silvatica* etc.

Distribution: The submontane beech forest prevails in the mountainous regions of Macedonia, and it occupies a clearly defined belt between 1,000 and 1,200 m altitude but in its shadow expositions it lowers down to 700 m.

Distribution in the area of the railway corridor: The beech forests occupy the highest elevations of the corridor, and the northern and north-eastern expositions on the left side of the Kriva Reka river. They develop only in the area between the villages of Uzem and Kostur (see Appendix IV - Habitat Map).

Figure 136 Submontane beech forest around v. Kostur

<u>Flora, fungia and fauna</u>

The extended list of plant, fungal and animal species growing in this biotope is given in Annex 15.

Fungia: There are approximately 80 fungi species, recorded in the beech forest in this corridor. Part of the recorded species, such as *Bertia moriformis*, *Fomes fomentarius, Hypoxylon fragiforme, Marasmius alliaceus, Mycena renatii,* etc. Certain species such as *Amanita citrina, A. rubescens, Hygrophorus chrysodon, Lactarius blenius, Lactarius piperatus* and *Russula cyanoxantha* are mycorrhizal fungi known to associate with beech. The rest of the species are saprobes. The species *Ganoderma applanatum, Polyporus squamosus, Trametes gibbosa* and *Fomes fomentarius* are established as parasites on beech trunks.

Mammals: Most common and typical inhabitants of this habitat are the Fat dormouse (*Glis glis*) and the beech marten (*Martes foina*). Other frequently registered forest species are: the wild cat (*Felis sylvestris*), badger (*Meles meles*), roe deer (*Capreolus capreolus*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), wild boar (*Sus scrofa*), western polecat (*Mustela putorius*), yellow-necked mouse (*Apodemus flavicollis*) and red squirrel (*Sciurus vulgaris*). Again, presence of the brown bear (*Ursus arctos*) is very sporadic. In the investigated area, probable corridors occupied by bears are the eastern-most parts of the railway, close to the Bulgarian border, between the Osogovo Mt. and Bilina Mt.

Birds: The fauna of birds is poorer compared to the previously described oak forests. All of the resident species can be found in the previosly described oak forests. The only difference in the breeding bird fauna is the presence of *Parus ater* and *Pyrrhula pyrrhula*.

Reptiles and amphibians: The beech forest habitat is more favourable for amphibians than for reptiles as a result of higher humidity. In total, eight amphibian and five reptile species are found in this habitat. The amphibian species are: Fire Salamander (*Salamandra salamandra*), Common Newt (*Lissotriton vulgaris*), Yellow Belied Toad (*Bombina variegata),* Common Toad (*Bufo bufo*), Green Toad (*Pseudepidalea viridis*), European Tree Frog (*Hyla arborea*), Balkan Stream Frog (*Rana graeca*) and Marsh Frog (*Pelophylax ridibundus*). The reptile species are: Wall Lizard (*Podarcis muralis*), Slow Worm (*Anguis fragilis), Grass Snake (Natrix natrix),* Aesculapian Snake (*Zamenis longissimus*).

Butterflies: As mentioned previously, butterflies rarely inhabit forested areas. The butterflies most often avoid beech forests, although they can be densely distributed in the clearings, openings or edges of beech forests.

Ground beetles: Submontane beech forests hold the highest diversity of ground beetles of all forest habitats. The number of endemic and subendemic species is the highest in the submontane beech forests (*Molops rufipes denteletus, Tapinopterus balcanicus, Pterostichus brucki, Platynus scrobiculatus serbicus*, *Aptinus merditanus* etc.). Almost exclusively, these are typical forest dwellers with occasional intruders from the neighboring grasslands. Dominant species are: *Abax carinatus carinatus, Abax ovalis, Amara convexior, Aptinus merditanus, Carabus convexus dilatatus, Carabus coriaceus cerisyi, Carabus hortensis, Carabus intricatus intricatus, Carabus montivagus montivagus, Harpalus rubripes, Harpalus rufipalpis rufipalpis, Molops rufipes denteletus, Myas chalybaeus, Notiophilus substriatus, Pterostichus brucki, Pterostichus oblongopunctatus oblongopunctatus* and *Tapinopterus balcanicus*. Most of these species are carnivores, feeding on soil animals, or they feed on dead leaves. *Carabus* species in these forests have larger individual areas (they can cover distance of up to 50 meters per day). The rest of the species have very small individual areas (movements of few meters per day).

Longhorn beetles: Compared with oak forests, the presence of Longhorn beetles in submontane beech forests is lower, although here can be found almost the same species that develops in different deciduous forests, often feeding on flowers or flying through the meadows. Most common are *Alosterna tabacicolor, Rutpela maculata, Cerambyx scopolii, Xylotrechus rusticus, Morimus funereus.*

Orthoptera: The number of orthopteran species in the submontane beech belt is low, but worth mentioning are mesophilous species like Balkan endemites *Isophya speciosa* and *Pholidoptera rhodopensis*.

6.11.2.3.3 Riparian forests, woodlands and shrublands

These forests and shrublands develop along the riverbanks and streams everywhere in the area under consideration. Well-preserved forests of this type are very rare nowadays. People were clearing these stands for providing fertile alluvial soil for agriculture. In this area, the forest communities belong to **Salicion albae** Soó (30) 1940 alliance.

6.11.2.3.3.1 Riparian Willow-Poplar Woodland

Reference to EUNIS Habitats: G1.11 Riverine [Salix] woodland - **G1.112 Mediterranean tall [*Salix*] galleries** (G1.1121 Mediterranean white willow galleries)

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

Reference to CoE BC Res. No. 4 1996: **44.1 Riparian willow formations**

General characteristics: The willow-poplar woodlands in the studied area develop on alluvial sandy soils on the riverbank terraces. The ground is flooded regularly during the wet period. The biotope is characterised by permanent humidity, light structure and texture of the soil. In the wider areas along the rivers, open terrain and small meadows are often present.

This woodland type belongs to the **Salicetum albae-fragilis** Issler 1926 association (Figure 137). The most typical tree species are *Salix alba*, or mixed *Salix alba* and *Salix fragilis*. *Populus nigra*, *Salix triandra*, *Sambucus nigra*, *Viburnum opulus*, *Cornus sanguinea*, *Rhamnus frangula*, alien and invasive *Amorpha fruticosa* etc. occur in small groups or individually. In the herb layer the most characteristic species are: *Poa trivialis*, *Poa palustris*, *Carex otrubae*, *Polygonum lapatifolium*, *Polygonum hidropiper*, *Rumex sanguineum*, *Veronica anagalis-aquatica*, *Scirpus lacustris* etc.

Distribution: This biotope is common for almost all lowland rivers in Macedonia, but only small remnant grooves have remaind to date. Thus, it is highly threatend in Macedonia as it is at European level (HD Annex I habitat).

Distribution in the area of the railway corridor: Well-preserved riparian willow-poplar woodlands have very limited distribution along the railway corridor of interest for this study. It occurs on a number of localities along the Kriva Reka river, particularly close to the villages Konopnica - Stambolica, Drenje, Uzem and other localities along the Kriva Reka river (see Annex 16 - Habitat Map). At the upper part of the Kriva Reka valley alder is more frequent and it replaces willows.

Figure 137 Degraded willow belt along the Kriva Reka river

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this biotope is given in Annex 15.

Fungia: A considerable number of species were registered in this habitat. The majority of the known species are lignicolous, and they are found as parasites and saprobes on *Salix alba, Populus tremula* and *Alnus glutinosa.* Part of the recorded species, such as *Laetiporus sulphureus, Phellinus igniarius* and *Panus tigrinus* are species characteristic of *Salix*. It is particularly important to underscore the parasitic species in this association such as the following species: *Phellinus igniarius, Ph. tremulae, Ganoderma applanatum, Polyporus squamosus, Pleurotus cornucopiae* and *Laetiporus sulphureus*. The species *Phellinus igniarius* and *Laetiporus sulphureus* are established only as parasites on *Salix alba,* while *Phellinus tremulae* is a dangerous parasite on aspen.

Mammals: Common species for this habitat are the lesser white-toaded screw (*Crocidura suaveolans*) and wood mouse (*Apodemus sylvaticus*). Red fox (*Vulpes vulpes*), wild boar (Sus scrofa), red squirrel (*Sciurus vulgaris*), common mole (*Talpa europea*) and wheasel (*Mustela nivalis*) are also common for this habitat. Presence of the otter (*Lutra lutra*) is likely in this habitat of the investigated area, even though not confirmed for certain.

Birds: The fauna of resident species is not much different compared to the other forest types in the railway corridor area, except for *Falco tinnunculus* and *Cettia cetti*. The main difference can be observed in the fauna of breeding birds. Specific for this habitat are: *Acrocephalus palustris*, *Remiz pendulinus*, etc.

Reptiles and amphibians: This habitat is preferred both, by amphibians and reptiles. In total 8 amphibians and 10 reptile species are present. The amphibians found here are Fire Salamander (*Salamandra salamandra*), Common Newt (*Lissotriton vulgaris*), Yellow Belied Toad (*Bombina variegata),* Common Toad (*Bufo bufo*), Green Toad (*Pseudepidalea viridis*), European Tree Frog (*Hyla arborea*), Balkan Stream Frog (*Rana graeca*) and Marsh Frog (*Pelophylax ridibundus*). The reptiles found here are: Hermanns Tortoise (*Eurotestudo hermanni*), Erhard’s Wall Lizard (*Lacerta erhardii*), Green lizard (*Lacerta viridis*), Balkan Green Lizard (*Lacerta trilineata*), Slow Worm (*Anguis fragilis),* Aesculapian Snake (*Zamenis longissimus*), Grass Snake (*Natrix natrix*), Dice Snake (*Natrix tessellata*).

Butterflies: Riparian habitats form good biotopes for the survival of the butterflies. Sparse willow woodlands along the rivers are home of dozens of species such as: *Thymelicus lineola, Brintesia circe, Apatura ilia, Polygonia c-album, Maniola jurtina, Celastrina argiolus, Pieris mannii, Pararge aegeria, Leptidea sinapis, Limenitis reducta, Erebia ligea, Vanessa cardui, V. atalanta, Aglais urticae, Aglais io, Apanthopus hyperantus, Anthocharis cardamines, Lycaena tityrus, Colias crocea, C. alfacariensis, Pontia edusa, Gonepteryx rhamni, Argynnis adippe, A. paphia, Melanargia larissa, Pyronia tithonus, Nymphalis antiopa, N. polychloros, Polyommatus icarus, P. belargus, Satyrium spini.*

Ground beetles: The fauna of ground beetles of willow woodlands is considerably rich. There were more than 30 species recorded. All of these species are hygrophiles and only few are eurytope species. Dominant species are *Carabus granulatus*, *Chlaenius nitidulus, Stenolophus mixtus, Agonum sexpunctatum, Bembidion* species, etc.

Dragonflies: Dragonfly fauna of the willow woodlands is one of the most important conservation aspects. There are about 15 dragonfly species. The most characteristics are *Calopteryx virgo, Calopteryx splendens, Libelulla depressa, Sympetrum sanguineum*.

Orthoptera: Orthopteroid fauna is very similar to sandy and gravel river banks, but the abundance of species in willow woodlands is much lower.

6.11.2.3.3.2 Riparian Willow-Poplar Belt

Reference to EUNIS Habitats: G1.11 Riverine [Salix] woodland - **G1.112 Mediterranean tall [*Salix*] galleries** (G1.1121 Mediterranean white willow galleries)

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

Reference to CoE BC Res. No. 4 1996: **44.1 Riparian willow formations**

General characteristics: This habitat is represented as a very narrow belt along the streams and rivers with willow domination and rare occurrence of poplars. The flora, fauna and fungi species in this habitat are identical with the previous one. For more detailed data on the species composition, please refer to Annex 15.

Distribution in the area of the railway corridor: Well-developed riparian willow-poplar belts are present at certain localities along Kriva Reka river (see Appendix IV - Habitat Map).

6.11.2.3.3.3 Riparian Shrub Communities - Shrublands of Tamarisk and *Salix amplexicaulis*

Reference to EUNIS Habitats: F9.12 Lowland and collinar riverine [Salix] scrub - **F9.123 Balkan riverine willow scrub**

Reference to EU HD Annex I: **3230 Alpine rivers and their ligneous vegetation with *Myricaria germanica*** and **3240 Alpine rivers and their ligneous vegetation with *Salix elaeagnos***

Reference to CoE BC Res. No. 4 1996: **44.1 Riparian willow formations**

and

Reference to EUNIS Habitats: F9.31 [Nerium oleander], [Vitex agnus-castus] and [Tamarix] galleries - **F9.3133 East Mediterranean tamarisk thickets**

Reference to EU HD Annex I: **3230 Alpine rivers and their ligneous vegetation with *Myricaria germanica*** and **3240 Alpine rivers and their ligneous vegetation with *Salix elaeagnos***

Reference to CoE BC Res. No. 4 1996: **44.8 Southern riparian galleries and thickets**

General characteristics: This habitat mostly represents the heliophilous shrubland dominated by *Tamarix* spp*.* and *Salix amplexicaulis*. These shrub species form the specific plant community named **Tamarici-Salicetum amplexicaulis** (Kárpáti 1962) Em 1967. It develops on sandy and gravely river drifts in the range of the willow community. The ground comprises sandy or gravely soil or soil in the process of formation. These areas are flooded from time to time and the wetland shrubland or forest vegetation cannot be established. In the herb layer, *Lycopus europaeus*, *Equisetum arvense*, *Juncus articulatus*, *Mentha longifolia*, *Agrostis alba* etc. are common. Numerous annual species from the neighbouring grassland areas can often be seen.

Distribution: Riparian shrub communities in Macedonia are regularly distributed in the lower and middle Vardar river valley together with the valleys of the main tributaries: Crna Reka, Bregalnica, Pcinja etc.

Distribution in the area of the railway corridor: This habitat develops on the river Kriva Reka banks or smaller permanent river islands. In the Kriva Reka river valley, riparian shrub communities develop in the vicinity of the village of Kostur (see Annex 16 - Habitat Map, under “Riparian scrub communities”).

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this biotope is given in Annex 15.

Fauna: Animal composition of the shrublands of *Tamarix* and *Salix amplexicaulis* is mixture of the different types of fauna of the neighboring communities and it is very similar with the fauna of the willow woodlands, but much poorer. It is due to the small surface that the community is distributed on very small areas. This is especially true for the birds, amphibians, reptiles and mammals.

Figure 138 *Salix amplexicaulis* shrubland near Dlabochica village

Butterflies: One of the most suitable habitats for butterfly diversity is the river banks. Representatives from the Lycaenidae family are most common for this habitat. Typical inhabitants found along Kriva Reka are the Large Cooper, *Lycaena dispar*, the Lesser Purple emperor, *Apatura ilia* and the Common Gleider, *Neptis sappho*. An array of other butterfly species are also found here: *Lycaena alciphron, L. virgaureae, Pyrgus malvae, P. sidae, Glaucopsyche alexis, Maniola jurtina, Papilio machaon, Iphiclides podalirius, Aglais io, Coenonympha pamphilus, Zerynthia cerisy, Pyronia tithonus, Erebia medusa, E. ligea, Limenitis reducta, Phengaris aion, Plebeius argus, Polyommatus amanda, Cupido osiris, Ochlodes sylvanus, Erebia euryale, Vanessa atalanta, Boloria euphrosyne* etc. Pierids like *Aporia crategi, Pieris mannii, Colias crocea, C. alfacariensis* and *Pontia edusa* are too common in this habitat.

Ground beetles: The ground beetles fauna of tamarisk communities is similar, but poorer in species than willow woodlands.

Dragonflies: Dragonfly fauna is consisted of 16 species, the same ones that occur in the willow woodlands. The most characteristic are *Sympetrum sanguineum, Libelulla depressa* and *Onychogomphus forcipatus*.

Orthoptera: Orthopteroid fauna is very similar to sandy and gravel river banks (see appropriate chapter).

6.11.2.3.4 Open terrain - natural grasslands

Almost all grasslands in the studied area are represented by the category hill pastures, which is characteristic of the hilly areas in all valleys and plateaus in Macedonia. As a secondary formation, hill pastures are surrounded by sparse woody vegetation of different degradation stages. Hill pastures with sparse shrubs can be considered as different habitat, and in the region of the railway line it is of very similar vegetation composition with typical hill pastures.

6.11.2.3.4.1 Hill Pastures

Reference to EUNIS Habitats: **E1.33 East Mediterranean xeric grassland** (E1.332 Heleno-Balkanic shrot grass and therophyte communities)

Reference to EU HD Annex I: **6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea**

Reference to CoE BC Res. No. 4 1996: **34.5 Mediterranean xeric grasslands**

General characteristics: Hill pastures in Macedonia are secondary formations. They develop in the areas situated in the sub-Mediterranean and warm continental oak forest belt. The climax communities in the observed region are associations of pubescent oak and Oriental hornbeam or other thermophilous oak communities. Nonetheless, the primary forest vegetation is heavily degraded or has totally disappeared because of excessive exploitation or systematic cutting to provide pastures and arable land during the last two millennia. There are no published data concerning the hill pastures in the area along the railway line but, according to our observation, the dominant community in the entire area is **Helianthemo-Euphobietum thessalae** Micev. 1973. This Central Balkan endemic association belongs to Trifolion cherleri Micev. 1970 alliance and Astragalo-Potentilletalia Micev. 1970 order. The community develops in the areas distinguished by an influence of the Mediterranean climate, that is, humid and not very cold winters, and 1-3 months of summer drought. The Mediterranean influence is evident through the presence of Mediterranean plant species (Figure 139). Characteristic plant species that define the physiognomy of the habitat are grass speces. The following species are common: *Andropogon ischaemum, Chrysopogon gryllus, Dianthus gracilis, Helianthemum salicifolium, Teucrium polium, Koeleria splendens, Crocus cancellatus, Festuca callieri, Fumana procumbens, Centaurea deusta, Xeranthemum annuum, Hippocrepis ciliata, Minuartia hammata, Astragalus spruneri, Genista sessilifolia* and many others. For detailed list of species, see Annex 15.

There was no systematic research in this particular area concerning the distribution of plants, fungi and animals. Thus, the only data provided in this report were derived from our observations during the habitat types' mapping.

Distribution: The hill pastures habitat is distributed in the central-east and northeast parts of Macedonia and in the southern part of Serbia.

Distribution in the area of the railway corridor: It is characteristic for the first part of the studied railway section till Kriva Palanka, but it spreads across the rest of the corridor on south exposed slopes. Close to the settlement, the species composition changes slightly because of the invasion of ruderal plants, as well as weed plants from the neighbouring fields. The best-developed communities occur in the areas of villages such as Drenjevo, etc (see Annex 16 - Habitat Map).

Figure 139 Hill pastures in the area of Dlabochica village

Flora, fungia and fauna

The extended list of plant, fungal and animal species characteristic for this habitat is given in Annex 15.

Fungia: As far as fungi are concerned, the grassland species dominate in the area, in particular non-mycorrhizal saprotrophic species such as *Pleurotus eringii, Bolbitius vitellinus, Bovista plumbea, Calvatia utriformis,* etc.

Mammals: Commonly found species in this habitat are: common mole (*Talpa europea*), sibling vole (*Microtus rossiaemeridionalis*), guenther's vole (*Microtus guentheri*), wood mouse (*Apodemus sylvaticus*), striped field mouse (*A. agrarius*), brown hare (*Lepus europeus*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), marbeled polecat (*Vormela peregusna*), badger (*Meles meles*) and roe deer (*Capreolus capreolus*).

Birds: There are about 30 bird species in this habitat. The number of resident species is very low (*Perdix perdix* and *Galerida cristata*). There are 10 breeding species such as *Coturnix coturnix, Melanocorypha calandra, Calandrella brachydactyla, Alauda arvensis, Anthus campestris,* etc. However, this habitat is very important for foraging birds from surrounding habitats.

Reptiles and amphibians: Hill Pastures are more sutable for reptiles than amphibians due to the lack of humidity and water. Only two species of amphibans are present in this habitat, Common Toad (*Bufo bufo*) and Green Toad (*Pseudepidalea viridis*). This habitat is favourable for the reptiles and it is the richest of all habitats along the rail-line. In total 11 species of this class can be found here and the representatives are: Hermanns Tortoise (*Eurotestudo hermanni*), Erhard's Wall Lizard (*Lacerta erhardii*), wall lizard (*Podarcis muralis),* Balkan Wall Lizard *(Podarcis taurica*), Green lizard (*Lacerta viridis*), Balkan Green Lizard (*Lacerta trilineata*), Whip Snake (*Dolichophis caspius*),.

Butterflies: Hill pastures are excellent habitat for butterflis. In the investigated area, following species can be found populating this habitat: *Hesperia comma, Euchloe ausonia, Pontia edusa, Pieris mannii, P. napi, P. rapae, Aglais urticae, Pseudophilotes vicrama, Papilio machaon, Iphiclides podalirius, Zerynthia cerisy, Colias crocea, Gonepteryx rhamni, Lasiommata megera, Arethusana arethusa, Pyrgus malvae, P. serratulae, Polyommatus icarus, Lycaena phleas, L. tityrus, L. vigaureae, L. thersamon, Plebeius sephirus, Aporia crategi, Callophrys rubi, Argynnis niobe, Melitaea athalia, M. phoebe, Boloria euphrosyne, Cyaniris semiargus, Limenitis reducta, Melanargia larissa, Coenonympha pamphilus, Plebeius agestis, Vanessa cardui, Euphydryas aurinia, Hesperia comma* etc.

Ground beetles: The ground beetles fauna of hill pastures is very specific and rich in species. It differs considerably from the one of the forested habitats. The majority of the species are carnivores or omnivores, but some species are dominantly herbivores (e.g. *Dixus obscurus, Acinopus picipes*). All of these species are praticolous and characteristic for open-type of habitats and they only rarely enter the dense forests. All of the species have wide distribution in Europe or Mediterranean area.

Dragonflies: There are several species of dragonflies that occur in the hill pastures. The most common species is *Onychogomphus forcipatus*.

Longhorn beetles: Although larvae of longhorn beetles develop in wood, most of the adults feed on flowers in open terrains with low vegetation. Because of that, species that are characteristic for degraded oak and hornbeam forest can be seen often in this habitat: *Purpuricenus budensis*, *Pachytodes erraticus, all four Stenurella species, Pseudovadonia livida* etc. However, due to the presence of other vegetation (like mullein, thistles, spurge and other herbaceous plants), this habitat is characteristic of many other (mainly monofagous) species such *Agapanthia cynarae,* A. kirbyi, A. *maculicornis,* A. *violacea,* A. *vilosoviridiscens, Phytoecia virgula, Oberea erythrocephala, Vadonia moesiaca* etc. Couple of representatives of genus *Dorcadion* also occur here (*D. aethiops* and Balkan endemic species *D. lineatocolle*).

Orthoptera: This habitat is second richest in Orthoptera diversity, although at first glance it is very similar to the degraded oak and hornbeam forest, and generally includes the same species. Common species can be found here like *Tylopsis lilifolia, Ancistrura nigrovittata, Polysarcus denticauda,* *Tettigonia viridissima, Decticus albifrons, Decticus verrucivorus, Platycleis affinis, Bucephaloptera bucephala, Oecanthus pellucens, Gryllus campestris, Dociostaurus brevicollis, Omocestus rufipes, Chorthippus bornhalmi, Acrida ungarica,* but also Balkan endemic species *Saga hellenica,* East mediteranean species like *Asiotmethis limbatus* and *Gampsocleis abbreviata* and *Paracaloptenus caloptenoides* which is on Bern Convention.

6.11.2.3.4.2 Hill Pastures with Sparse Shrubs

Reference to EUNIS Habitats: **E1.33 East Mediterranean xeric grassland** (E1.332 Heleno-Balkanic shrot grass and therophyte communities)

Reference to EU HD Annex I: **6220 Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea**

Reference to CoE BC Res. No. 4 1996: **34.5 Mediterranean xeric grasslands**

This grassland type is represented by areas covered by herb vegetation surrounded by oak forest of different degradation stages. Shrubs are represented with species from the extremely degraded forest trees (*Quercus frainetto, Quercus pubescens, Quercus cerris*, *Fraxinus ornus*), small trees from the subordinate layers of forests (*Carpinus orientalis, Cornus mas, Crataegus monogyna, Pyrus pyraster, Pyrus amygdaliformis, Ulmus sp.)* or true shrub species (*Prunus spinosa, Paliurus spina shristi, Rosa* spp., *Colutea arborescens, Coronilla emeroides, Evonymus europaeus*) etc. The species composition of herb plants is more or less the same with typical hill pastures. Shrubby grasslands are mostly developed from pastures that have not been grazed recently given that a cattle breeding is not very popular in Macedonia lately or they represent the last remainder of the previous forest vegetation (Figure 140).

Distribution: Hill pastures with shrubs are generally distributed within the same areas as hill pastures since they originate as the stage after grazing was abandoned.

Distribution in the area of the railway corridor: hill pastures with sparse shrubs cover almost the whole area observed but they are discontinuous, often mixed with other cultural or natural grassland habitats. Such habitat occupies large areas near the villages of Tlminci, Krklja, Uzem and others (see Annex 16 - Habitat Map).

Figure 140 Hill pastures with sparse shrubs near Dlabochica village

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this biotope is given in Annex 15.

Fungia: Fungal composition in this habitat is characterized by domination of grassland species such as *Agaricus campestris, Astraeus hygrometricus, Bovista plumbea, Calvatia excipuliformis, Hygrocybe conica, Marasmius oreades* etc. Occasionally certain mycorrhizal species from the genera *Amanita*, *Cortinarius, Lactarius, Russula* are also found.

Fauna: The distribution of grasslands with shrubs along the railway line is irregular and they are mixed with hill pastures. This kind of habitat gives more possibilities for breeding and feeding to animals, and consequently is richer concerning animal biodiversity. Insect fauna is more or less similar compared to the one of hill pastures.

Mammals: Mammal fauna is similar to the one of the previous habitat. The Balkan short-tailed mouse (*Mus macedonicus*) is characteristic for terrains with sparse bushy vegetation.

Birds: Sparse shrubs in the hill pastures offer more nesting and roosting sites for birds. There are several resident species. The number of breeders is low, as well. The greatest number of species is foragers as in the case of hill pastures.

Reptiles and amphibians: The composition of species of amphibians and reptiles is the same as the list noted in the Degraded Forest of Pubescent Oak and Oriental Hornbeam.

Butterflies and longhorn beetles: These faunas are similar to the previous habitat.

Ground beetles: Most of the species are the one of the hill pastures without shrubs. However, some of the forest dwellers can be met in this type of habitat. Thus, the diversity is relatively high.

Orthoptera: Orthopteran fauna is similar to the previous habitat, but richer in species that occur mainly on *Rubus,* like *Odontopodisma decipiens, Eupholidoptera chabrieri* and *Poecilimon thoracicus.*

Distribution: Hill pastures with sparse shrubs cover almost the whole area observed but they are discontinuous, often mixed with other cultural or natural grassland biotopes. Such habitat occupies large areas in the vicinity of the villages of Beljakovce, Dimonce, Rudare, Krilatica, Petralica, Tlminci, Krklja, Uzem and others (see Annex 16 - Habitat Map).

6.11.2.3.4.3 Hill pastures on stony ground

Reference to EUNIS Habitats: **E1.A Open Mediterranean dry acid and neutral grassland** (**E1.A22 Helleno-Balkanic supra-Mediterranean siliceous grasslands**)

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: This habitat type occupies stony or sandy open ground with vernal therophytes, forbs and grasses. The plant community that represents the habitat is open perennial grassland and pasture colonizing siliceous, usually poorly developed skeletal soils of the supra-Mediterranean levels. Species composition of the biocenosis is very similar to that of the neighboring hill pasture community. However, numerous species characteristic for the rocky areas can be found as well (**Figure 141**).

Distribution: The hill pastures on rocky sites habitat is distributed in the central-eastern and southeast parts of Macedonia.

Distribution in the area of the railway corridor: Only very small areas covered with hill pastures on rocky ground can be found along the railway corridor of interest, mainly in the surroundings of the v. Uzem (see Annex 16 - Habitat Map).

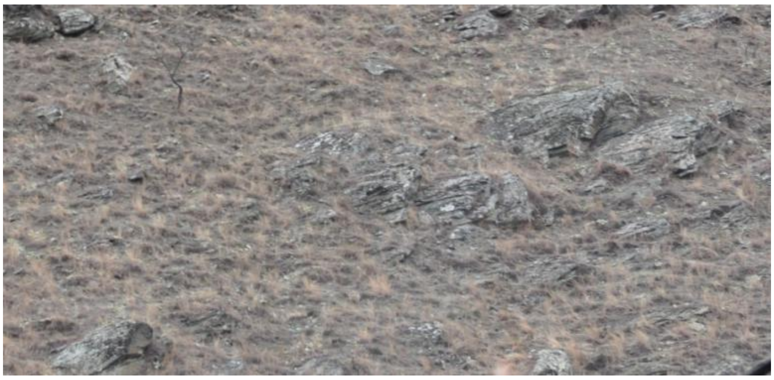


Figure 141 Hill pastures on stony ground near Kriva Palanka

Flora, fungia and fauna

Flora and fungia: This vegetation type is characterized by typical lithophytic **mosses** such as *Tortula muralis* and *Grimmia pulvinata* and a great variety of petricolous species of **lichenoid fungi** such as *Rhizocarpon geographicum, Rinodina lecanorina* and *Xanthoparmelia stenophylla.* For more details concerning flora and fungia, see Annex 15.

Fauna: The extended list of animal species is provided in Annex 15.

Mammals: Typical species for this habitat are: rock mouse (*Apodemus mystacinus*) and beech marten (*Martes foina*). The red fox (*Vulpes vulpes*) is often choosing littering sites in the rocky areas close to rivers.

Birds: This habitat differs from the hill pastures with/without shrubs. The number of breeding species is significantly higher and it is more similar to the habitats of degraded Pubescent oak forests. Characteristic for the hill pastures on the rocky sites is the presence of *Oenanthe oenanthe* and *Oenanthe hispanica*.

Reptiles and amphibians: This habitat is not suitable for the amphibians in general. Only the Common Toad (*Bufo bufo*) and Green Toad (*Pseudepidalea viridis*) live here, usually under the stones. Due to the lack of vegetation which reptiles are using as a shelter from predators and the heat, only three species of reptiles are recorded in this habitat and they are: Hermanns Tortoise (*Eurotestudo hermanni*), Erhard's Wall Lizard (*Lacerta erhardii*).

Butterflies: Cliff and rock vegetation offer unique plant diversity, thus hosting some specific and non-specific butterfly species for this habitat. *Scolitantides orion, Lasiommata maera, L. megera, Hesperia comma and Carcharodus flocciferus* are a typical species found in this habitat. Also, *Argynnis niobe, Zerynthia polyxena, Iphiclides podalirius, Papilio machaon, Parnassius mnemosyne, Colias alfacariensis, C. crocea, Pyrgus sidae, Hyponephele lycaon, Lasiommata petropolitana, Vanessa atalanta, Lycaena thersamon* and many other species can be registered in this habitat.

Ground beetles: Hill pastures on rocky sites are extreme habitats for the majority of ground beetles. The number of species is low and the diversity is low. Dominant species are Cymindis *axillaris, Harpalus triseriatus, Microlestes fissuralis, Carabus graecus morio* etc.

Longhorn beetles and orthopterans: Both faunas are similar to the ones of the previous habitat, but significantly poorer due to the lack of vegetation.

6.11.2.3.4.4 Unmanaged Mesic Grasslands

Reference to EUNIS Habitats: **E2.7 Unmanaged mesic grassland**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: This habitat type comprises grassland that is not currently mown or used for pasture. They occur in patchy areas in mesophilous oak forest and beech forest in the higher elevations of the corridor. It is characterised by 100 % plant cover and larger amount of biomass due to more humid conditions. Plant species characteristic for mesophilic grasslands and mesophile meadows are abundant, but plant species from the neighboring forest vegetation are present as well.

Distribution in the railway corridor: Such grassland from mesophilous oak forests are common on the stretch Uzem village – Bulgarian border, while in beech forests they are common in the surroundings of Kostur village (see Annex 16 - Habitat Map).

Flora and **fauna** elements from neighbouring oak and beech forest are regularly present. **Fungal** composition in the unmanaged mesic grasslands is identical with the hill pastures habitat type, the difference here being the greater presence of mycorrhizal species owing to the vicinity of the well-developed forest associations.

Butterfly fauna of these grasslands is considerably rich in species. Frequently found species in these habitats are: *Boloria euphrosyne*, *Thymelicus sylvestris, Ochlodes sylvanus, Cyaniris semiargus, Pararge aegeria, Argynnis paphia, A. aglaja, A. adippe, Melanargia galathea, M. larissa, Pieris napi, P. mannii, Chazara briseis, Erebia euryale, E. medusa, E. ligea, Parnassius mnemosyne, Phengaris arion, Euphydryas aurinia, Neptis sappho, Nymphalis polychloros, Vanessa atalanta, Pyrgus alveus, Apanthopus hyperantus, P. serratulae, Satyrium accaiae, Pyronia tithonus, Carcharodus flocciferus, Coenonympha leander, C. arcania, Spialia orbifer, Hamearris lucina* etc.

Ground beetles in this habitat differ considerably from the surrounding beech forests. The dominant species are the praticole species as *Calathus distinguendus, Calathus fuscipes, Calathus melanocephalus, Amara convexior* and others.

6.11.2.3.4.5 Wet Meadows

Reference to EUNIS Habitats: **E3.31 Helleno-Moesian riverine and humid [*Trifolium*] meadows**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Wet meadows in the studied corridor have a specific structure of plant and animal species, or species from the neighboring grassland and forest habitats may prevail in the floristic and fauna structure. According to Micevski (1964), these meadows belong to the so-called lowland meadows, and syntaxonomically they belong to the alliance **Trifolion resupinati** Mic**.** (1964). Their distinctive feature is that a range of different species of clover (*Trifolium* spp.) are dominant in the floristic structure, different from continental European meadows, where different grass species prevail (Poaceae). The most common sedges are *Carex hirta* and *Carex distans* (Figure 142). Other characteristic plant species are: *Trifolium resupinatum*, *Myosotis caespitosa* ssp. *laxa*, *Orchis laxiflora*, *Ranunculus repens*, *Carex otrubae*, *Lysimachia vulgaris*, *Convolvulus arvensis*, *Tragopogon pratensis*, *Achillea millefolium* and many others.

Distribution in the railway corridor: Only small parcels distributed along the riparian belt of Kriva Reka at few localities are representing this habitat in the railway corridor (see Annex 16 - Habitat Map).

Figure 142 Typical wet meadow with domination of *Carex* species

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this habitat is given in Annex 15.

Flora: Plant species characteristic of this habitat are a number of clover species (*Trifolium resupinatum*, *T. balanae*, *T. nigrescens*, *T. filiforme*, *T. patens*, *T. repens*, *T. pratense)*, then grasses (*Cynosurus cristatus*, *Anthoxanthum odoratum*, *Agrostis alba*, *Alopecurus utriculatus*, *A. pratensis*, *Bromus racemosus*), sedges (*Carex hirta*, *C. otrubae*, *C. distans*, *C. divisa*), as well as *Lychnis flos-cuculi*, *Ranunculus acris*, *R. velutinus*, *Cirsium canum*, *Inula britanica* and many other meadow species.

Fungia: The grassland species dominate in the area, in particular non-mycorrhizal saprotrophic species such as *Agaricus* spp*., Bovista plumbea, Entoloma sepium, Hygrocybe conica, Marasmius oreades Pleurotus eringii, Bolbitius vitellinus, Entoloma sericeum, Stropharia coronilla, Vascellum pratense,* etc*.* Some edible species such as *Marasmius oreades, Agaricus campestris, A. arvensis, Macrolepiota procera* and *M. mastoidea* are common in this habitat. Occasionally certain mycorrhizal species from the genera *Russula, Lactarius, Tricholoma, Cortinarius* are also found*.*

Mammals: Most common and typical inhabitants of this habitat are the Yellow-necked mouse (*Apodemus flavicollis*), Fat dormouse (*Glis glis*) and the beech marten (*Martes foina*). This habitat is very important for the typical forest mammals since it provides additional food sources.

Birds: The fauna of birds is richer in species compared to the surrounding forest habitat. Many of them forage in meadows, perch or nest on the solitary trees in the meadows (woodpeckers, shrikes, etc.)

Reptiles and amphibians: Meadows are very favourable habitat for both amphibians and reptiles. In total, eight amphibian (*Salamandra salamandra, Bombina variegata, Rana dalmatina, Bufo bufo, Rana dalmatina, R. graeca, Pseudepidalea viridis, Hyla arborea*) and eight reptile species (*Eurotestudo hermanni, Anguis fragilis, Podarcis muralis, P. taurica, Zamenis longissimus, Coronella austriaca, Dolichophis caspius, Vipera ammodytes*) are found in this habitat.

Butterflies: Butterflies rarely inhabit forested areas. Thus, meadows are the spots of high butterfly diversity in the forested matrix of the mountains and foothill areas. The most characteristic butterfly species are *Parnassius mnemosyne, Thymelicus sylvestris, Issoria lathonia, Pieris brassicae, Maniola jurtina*, several *Erebia* species etc.

Ground beetles: Typical ground beetles for meadows are many *Calathus*, *Amara* and *Harpalus* species. Many of these species use only meadows and rarely enter the forest habitats. However, many of the forest dwellers use meadow in search for food, especially during the night. In a result, species of *Molops, Tapinopterus, Myas, Carabus* can be found in meadows, although their primary habitat are forests.

Longhorn beetles: Longhorn beetles can often be found feeding on flowers or flying through the meadows. These are species that develop as larvae in the wood inside the forests. Most common are *Alosterna tabacicolor, Rutpela maculata, Cerambyx scopolii, Xylotrechus rusticus, Morimus funereus.*

Orthoptera: The number of orthopteran species in meadows is interesting. Worth mentioning are mesophile species like Balkan endemites *Isophya speciosa* and *Pholidoptera rhodopensis*.

6.11.2.3.4.6 Meadows

Reference to EUNIS Habitats: **E2.238 Southwestern Moesian submontane hay meadows**

Reference to EU HD Annex I: **6510 Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: This habitat type differs from previous one in sense of being dryer and with a smaller quantity of hay biomass. Most of the meadows in the studied corridor are regularly managed and more or less intensively managed, whereas a minor part of them are extensively managed or have been abandoned a number of years before. Dependent on the intensity of mowing, meadows can have a specific structure of plant and animal species, or species from the neighboring grassland and forest habitats may prevail in the floristic and fauna structure.

The plant community characteristic for this habitat type belongs to the same alliance as in the case with the wet meadow's community – **Trifolion resupinati** Micev. 1964. However in the floristic composition of this mesophilic habitat sedges are not represented with high abundance and cover like in the wet meadows (Figure 143). Cloveer species (*Trifolim resupinatum*, *T. balansae*, *T. filiforme* and others) have higher abundance and coverage. Some grass species (*Alopecurus utriculatus*, *Agrostis alba*, *Poa sylvicola*) are also common.

Figure 143 Meadow near Kostur village.

Distribution: The meadow habitats are widespread in the valleys in Macedonia, but a large proportion of their areas are threatened by extinction due to the abandonment of mowing.

Distribution in the area of the railway corridor: Most of the meadows are along the Kriva Reka river. There are larger areas next to the river in the vicinity of the v. Zhidilovo, and there are smaller areas near the village of Krklja, and also on the stretch between the villages Uzem and Kostur (see Annex 16 - Habitat Map).

Flora, fungia and fauna

In the aspects of animal and fungal species this habitat is similar with the previous one. The extended list of plant, animal and fungal species growing in this biotope is given in Annex 15.

Figure 144 Lithophytic mosses on rock

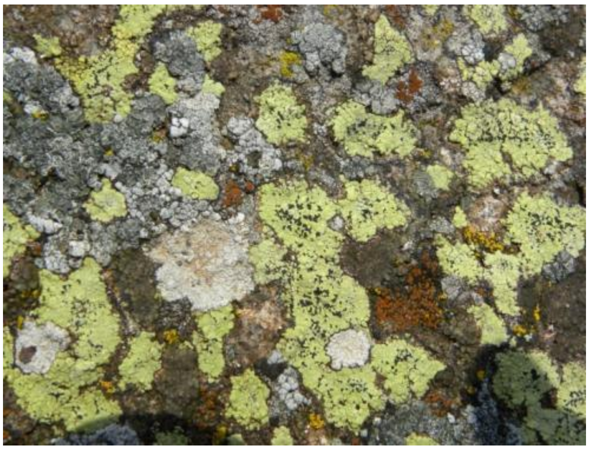


Figure 145 Different species of petricolous lichens

6.11.2.3.5 Wetlands/ water habitats

Rivers and streams

There are several types of water bodies in the area of interest. The proper typology according to Water Framework Directive (WFD) is an on-going process in Macedonia. Preliminary results from these studies will be used for the purposes of the current study.

6.11.2.3.5.1 Epipotamal Streams - Rivers (approximately wider than 5 m)

Reference to EUNIS Habitats: **C2.31 Epipotamal streams**

Reference to EU HD Annex I: **3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation**

Reference to CoE BC Res. No. 4 1996: **none**

Reference to Water Framework Directive (EEC 60/2000): **Lowland medium/small river type**

General characteristics: Water courses that can fulfil the aforementioned criteria for "river" in the area of the railway corridor is only the river Kriva Reka. The lowermost flow of Kiselichka Reka (just befor its inflow into Kriva Reka) can also be consideted as epipotamal stream (see Annex 16 - Habitat Map). This particular habitat is represented only at the lower flow of Kriva Reka (below Kriva Palanka, Figure 146). Vascular vegetation that gives the physiognomy of the river banks and of the water close to the banks is not well-developed.

The river at this place is characterized by relatively fast flow of water and natural riverbed. On the bottom there is a rocky base, made of stones with medium and small dimension, but also presence of sand and weak deposits of organic sediment in the areas with weaker flow. The riparian vegetation is mainly composed of woody species that cause large shadows on the river. The water is visibly turbid, mainly of inorganic origin, but without noticeable odor. Small stone populations of moss *Fontinalis antipyretica* develop on the stone base. *Cladophora glomerata* is also present in the macroscopic algae, whose abundance is likely to increase during the summer months. In addition, on the rocky ground there are large colonies of *Nostoc commune*. Diatomaceous epilytic communities are well developed that indicates an increased content of nutrients in the water.

Figure 146 A view of the Kriva Reka river near Krilatica village

Mammals - Typical mammal species that inhabits rivers is Otter (*Lutra lutra*). For this reason, the area of and around the confluence of Kiselichka Reka and Kriva Reka was proposed for protection as Nature Park "Kiselica River gorge" (MES 2011).

Birds - The only characteristic breeding bird species is the Kingfisher (*Alcedo atthis*). There are no resident birds. A number of species use rivers for foraging (Heron, White and Black Stork) or during migration (some species of ducks, egretts and cormorants).

Amphibians: This habitat is favourable for the amphibians in general and less for the reptiles. Three species of amphibians, such as Yellow Belied Toad (*Bombina variegata),* Balkan Stream Frog (*Rana graeca*) and Marsh Frog (*Pelophylax ridibundus*) and two species of reptiles, Grass Snake (*Natrix natrix*) and Dice Snake (*Natrix tessellata*) are present in this habitat.

Fish - There is an abundant fish population in Kriva Reka. According to the information from the anglers, the following fish species are present in this area: *Leuciscus cephalus* L., *Chondrostoma nasus* L., *Gobio gobio* L., *Barbus barbus macedonicus* Karam, *Barbus meridionalis petenyi* Heck., *Abramis vimba melanops* Heck., Alb*urnus albidus, Cobitis taenia* L., *Salmo truta phario* (only in the upper flow of Kriva Reka).

Dragonflies: Larvae of dragonflies develop in the aquatic ecosystems. There are many species that lay their eggs in the running waters of rivers and streams.

Diatoms and macroinvertebrates

The diatomaceous flora in the Kriva Reka[21] near the village Židilovo (see Table 129) is represented by species that are widespread in river ecosystems. Both hiporhithral and epipotamous communities are dominated by *Hannaea arcus* (24% and 15% respectively), *Fragilaria tenera* (23% and 14% respectively), *Odontidium neomaximum* (15% and 18%) and *Encyonema silesiacum* (18% and 27%). This composition is typical for waters moderately laden with nutrients. The higher representation of *Nitzschia linearis* (3% and 8%), as well as the presence of *Nitzschia palea*, indicates an anthropogenic pressure on the river. Additionally, a relatively small number of species has been

[21] The point at v. Zhidilovo is taken as a representative point

identified on this site, although it would be expected that the diversity of diatoms would be significantly higher. Due to the higher water level (introduction of water with lower content of food substances due to heavy rains and melting of snow), it is possible for communities to appear species with a weaker tolerance towards eutrophication, while during the summer months the community should be represented by more tolerant, but even fewer species.

In the community of macroinvertebrates of Kriva Reka, near the village. Židilovo is mainly dominated by oligosabrobic species, such as *Epeorus assimilis* (Ephemeroptera), *Perla bipunctata* (Plecoptera) and *Hydropsyche pellucidula* (Trichoptera), but also beta-mesosaprobic indicators *Rhithrogena semicolorata* (Ephemeroptera) and *Potamophylax cingulatus* (Trichoptera).

Figure 147 Kriva Reka at the village of Zhidilovo – an example of epipotamal streams

6.11.2.3.5.2 Hiporhithral Streams - Rivers (approximately narrower than 5 m)

Reference to EUNIS Habitats: **C2.22 Hiporhithral streams**

Reference to EU HD Annex I: HD Annex I: **3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: The area of railway corridor is characterised by more or less well-developed hydrographical network. The main effluent of the region is Kriva Reka, which flows into Pchinja.

Figure 148 The Kriva Reka river in its upper course

Along the alignment there are several rivers that enter this category of habitats: Gaberska Reka, Gradecka Reka, Kiselechka Reka and Kriva Reka in the upper course (in front of Uzem village). This habitat also includes Kriva Reka in its upper course (in the area of the village of Kostur) (Figure 148). All streams that belong to this watershed are not mapped and given in Annex 16 due to their insignificant surface area. In addition, some of these streams do not enter the project area.

The rivers Gaberska and Gradechka in the region of the alignment are with similar hydrological and biological characteristics and represent small watercourses with relatively fast flow. Water is transparent without visible clouding and presence of organic matter. Riparian vegetation is mainly represented by leafy and grassy plants, and woody vegetation is less represented. The bottom is stone, with the presence of medium and small stones to which *Nostoc commune* is massively developing. Macrophytic vegetation in the water is poorly developed, and is mainly represented by small populations of *Ranunculus trichophyllus*. In areas with weaker flows there is sand, with little presence of detritus or organic sediment. Macrophytic algae have not been observed. Epilithic communities are relatively poorly developed, indicating lower nutrient content.

Kiselechka Reka is the largest tributary of Kriva Reka in the investigated area. The river is with a rapid flow and the presence of large stones at the bottom. The water is poorly clouded, probably due to excavations carried out near the river. In parts with non-rapid flow there is a mixture of sand and organic sediment. The rocks have the development of macroscopic algae *Vaucheria sessilis* and *Cladophora glomerata*. There is epilythic flora on the rocky substrate, which in turn indicates the presence of relatively high content of nutrients.

Kriva Reka, in the upper course of the village of Uzem, represents a small river with a rapid flow and presence of large and medium stones on the bottom. The water is strongly clouded by the visible presence of inorganic particles, but also by a weakly noticeable odor. On the rocky ground there are rich epilytic communities, as well as a high coverage with *Cladophora*. In the sections of the river with a weaker flow there is a sediment that is a mixture of sand and organic matter. Riparian vegetation is poorly developed because the river is located near the village of Uzem.

Plant species and communities represented in this habitat are with similar composition as in Kriva Reka.

The vertebrate fauna that is present in this habitat is more or less the same as in lKriva Reka.

Birds - The fauna of birds of smaller rivers and streams is similar to the one of Kriva Reka. More specific is the Dipper (*Cinclus cinclus*).

Amphibians: There are few species of amphibians and reptiles in this habitat, mostly semi-aquatic ones. Two species of frogs, Balkan Stream Frog (*Rana graeca*) and Marsh Frog (*Pelophylax ridibundus*) and the Grass Snake (*Natrix natrix*) as a representative from the reptiles.

Diatoms and macroinvertebrates

The species composition of the Gaberska River (Table 129) is represented by diatoms, which are mainly mesotrophic, such as *Cocconeis placentula var. lineata* (24%), *Gomphonema pumilum* (19%), *Navicula veneta* (6%), *Cocconeis pediculus* (5%). This composition is found in many rivers in Macedonia and is typical for rivers with medium eutrophication that may result from erosion or a relatively small intake of wastewater from communal or agricultural origin. The river was expected to have higher presence of oligotrophic species, but the studies made for the purposes of this EIA showed their low presence in the collected samples.

The research of Gaberska River show a moderately high variety of aquatic invertebrates (16), of which only 7 taxa belong to the sensitive EPT groups (Ephemeroptera, Plecoptera and Trichoptera). An important hallmark of the community is also the oligosaprobic aquatic insects *Cordulegaster heros* (Odonata) and *Deronectes moestus* (Coleoptera), as well as beta-mesosaprobic species *Caliaeschna microstigma* (Odonata), *Ancylus fluviatilis* and *Radix labiata* (Gastropoda). In the community there are also more tolerant species, like the alpha-mesosaprobic leech *Erpobdella octoculata* (Table 130), indicating a certain negative impact on water quality.

Figure 149 Gabarska Reka

As in the previous case, the diatom composition of Gradecka Reka is represented by species that are mainly characteristic of mesotrophic waters (Table 129Table 129). The diatom community is dominated by *Nitzschia fonticola* (20%), *Planothidium frequentissimum* (13%), *Nitzschia dissipata* (7%), *Planothidium lanceolatum* (6%), *Amphora pediculus* (6%). These species are one of the most common in the flora of Macedonia and are found in rivers with mesotrophic character.

Detailed analysis of the macroinvertebrates from Gradechka Reka showed a relatively similar composition with the Gaberska Reka community, but also an exceptionally low total number of taxa (Table 130). It is likely that the unstable hydrological characteristics of the watercourse, that is, the small amounts of water in the riverbed (Figure 150), lead to a reduction in the species diversity of macroinvertebrates.

Figure 150 Gradechka Reka

Kiselecka Reka is characterized by greater diatom diversity compared to other aquatic habitats (Table 129). The presence of *Vaucheria sp*. indicates waters with a relatively lower concentration of nutrients. However, through the composition of the diatomaceous flora, the impact on the river is obvious. Namely, in both epiphytic communities, mesotrophic species predominate, such as *Cocconeis pediculus, Diatoma ehrenbergii, Diatoma moniliformis, Diatoma vulgaris* and *Nitzschia dissipata*. Such composition is characteristic for rivers under moderate anthropogenic impact with pronounced eutrophication and pollution.

In the Kiselechka River, bentocenosis is developed with a gradually high diversity (16 taxa) of macroinvertebrates, qualitatively rich in EDT taxa (11) (Table 130). It is these groups, accompanied by amphipodic shrimps, that are dominant members in the community, although with a reduced number compared to previous research. It is probable that excavations carried out near the river (Figure 151-left) contributed to this phenomenon. Among the macroinvertebrates, oligosaprobic species *Epeorus assimilis* (Ephemeroptera), *Perla bipunctata* (Plecoptera) and *Odontocerum hellenicum* and *Hydropsyche instabilis* (Trichoptera) are still predominant, but also the beta-mesosaprobic indicators *Rhithrogena semicolorata* (Ephemeroptera), *Potamophylax cingulatus* (Trichoptera) and *Gammarus balcan*icus (Amphipoda), while tolerant representatives have not been noticed.

Figure 151 Kiselechka Reka

The composition of the diatom community of Kriva Reka at the village Uzem (Table 129) is similar to the communities at v. Zhidilovo. It is characterized by the dominance of the species *Hannaea arcus* (14-25%), *Fragilaria tenera* (14-23%), *Encyonema silesiacum* (20-40%) and *Odontidium neomaximum* (4-19%). Generally, this composition is characteristic for smaller rivers with lower nutrient content. On the other hand, the presence of many teratogenic forms of the species *Fragilaria tenera* is very indicative. There are many data in the literature that indicate that these aberrant forms occur at higher concentrations of heavy metals. It is likely that the introduction of heavy metal-laden waters from the tailings of Toranica mine causes such damage to frustules. The impact of these waters is visible through the color and odor of the water, especially in the upper course of the river. The impact of the mines on the river is also evident in the presence of *Mayamea atomus* and *Nitzschia palea* which are considered most vulnerable to pollution.

In the community of macroinvertebrates from Kriva Reka near the village of Uzem, the dominant oligosaprobic species are include *Epeorus assimilis* (Ephemeroptera), *Perla bipunctata* (Plecoptera) and *Hydropsyche pellucidula* (Trichoptera), but also the beta-mesosaprobic indicators *Rhithrogena semicolorata* (Ephemeroptera) and *Potamophylax cingulatus* (Trichoptera). However, the results shown in Table 130 indicate a significant decline in the diversity of macroinvertebrates (10 taxa) in the upper course of the river and the absence of the sensitive species *Rhyacophila obliterata* (Trichoptera) and *Gammarus balcanicus* (Amphipoda). It is evident that the Toranica mine has a negative impact on the wildlife of Kriva Reka.

Figure 152 Kriva Reka at the village of Uzem

6.11.2.3.5.3 Intermittent streams

Reference to EUNIS Habitats: **C2.5 Temporary running waters**

Reference to EU HD Annex I: HD Annex I: **3290 Intermittently flowing Mediterranean rivers of the Paspalo-Agrostidion**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: These streams characterise numerous ravines in the railway corridor region on the left and right slopes of river Kriva Reka valley. The water flow exists only during the humid period of the year (See Annex 16 - Habitat map, though these streams were not specifically mapped). They have high water level after snow melting in early spring, and a half of the year (more or less) these streams are characterised by a dry bed. That is the reason why these streams do not have great importance as water ecosystems. But, the ravines through which they flow are regularly covered by denser or sparser woody or herbvegetation, thus strongly differing from surrounding grassland or agricultural habitats.

Amphibians: Amphibian species present in this habitat are: Yellow Belied Toad (*Bombina variegata),* Common Toad (*Bufo bufo*) and Green Toad (*Pseudepidalea viridis*).

Butterflies: Common species for this habitat are: *Carcharodus flocciferus, Pygus alveus, P. sidae, Spialia orbifer, Parnassius mnemosyne, Zerynthia cerisy, Apanthopus hyperantus, Arethusana arethusa, Lasiommata petropolitana, Pyronia tithonus,Vanessa atalanta* etc.

6.11.2.3.5.4 Gravelly and Sandy Riverbanks

Reference to EUNIS Habitats: **C3.62 Unvegetated river gravel banks**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **24.2 River gravel banks**

and

Reference to EUNIS Habitats: **C3.61 Unvegetated river sand banks**

Reference to EU HD Annex I: **3270 Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: This habitat represents a very specific type of grassland developing on the riverbanks or smaller permanent river islands. The ground consists of gravely soil or the soil in the process of formation. These areas are occasionally flooded and the wetland shrubland or forest vegetation cannot be ascertained. The vegetation does not cover the whole ground, it is sparse and represented by herb species, mainly *Gramineae*, then many pioneer plant species adapted to sandy ground from *Polygonaceae, Chenopodiaceae* and other families. The presence of small, young willow or tamarisk sprouts also contributes to the physiognomy of this biotope.

Distribution: This biotope is common for almost all lowland rivers in Macedonia.

Distribution in the area of the railway corridor: This kind of biotope is typical of the river Kriva Reka and the lower course of its tributaries. It is more or less a common biotope. Along the course of the Kriva Reka river, this habitat occurs in many places (see Annex 16 - Habitat Map, under “River gravel bank”).

Flora and fauna

The extended list of plant and animal species growing in this biotope is given in Annex 15.

Mammals: This habitat is characterized by the following species: otter (*Lutra lutra*), guenther's vole (*Microtus guentheri*), sibling vole (*M. rossiaemeridionalis*), wood mouse (*Apodemus sylvaticus*), striped field mouse (*A. agrarius*), fox (*Vulpes vulpes*), wolf (*Canis lupus*) etc.

Birds: The fauna of birds is poor in this habitat. There are no resident species and only four breeders: *Charadrius dubius, Actitis hypoleucos, Motacilla cinerea, Motacilla alba.* Sandy and gavel river banks are foraging sites for six species of herons, egrets and storks.

Reptiles and amphibians: This habitat is mostly inhabited by amphibian and reptile species that are semi-aquatic, in total three species of amphibians and two species of reptiles are found. The amphibians found are Marsh Frog (*Pelophylax ridibundus)*, Balkan Stream Frog (*Rana graeca*) and European Tree Frog (*Hyla arborea*). The reptiles found are Grass Snake (*Natrix natrix*) and Dice Snake (*Natrix tessellata*).

Butterflies: One of the most typical members for this habitat, which can be found in the investigated area, is the Northern Wall Brown, *Lasiommata petropolitana.* Presence of *Scolitantides orion, Aporia crategi, Pseudophilotes vicrama, Zerynthia cerisy, Phengaris aion, Erebia medusa, Pyronia tithonus, Polyommatus icarus, Cupido osiris,Plebeius sephirus, Colias alfacariensis, Pyrgus sidae, Argynnis aglaja, Brintesia circe, Hipparchia syriaca, H. statilinus* and *Maniola jurtina* is also evidenced.

Ground beetles: These habitats are very rich in ground beetles species due to the greater diversity within some genera, especially *Bembidion*. However, all of these species are widespread in Europe or the Balkans. The dominant species in the river banks of the lowland rivers are *Bembidions subcostatum vau, Bembidion decorum, Bembidion lampros* and *Nebria brevicollis*. On the river banks of small rivers and streams, some other species increase their dominance: *Platynus scrobiculatus* and *Limodromus assimilis*.

Dragonflies: Dragonfly fauna derives from the fauna of willow woodlands and tamarisk habitats. However, only certain numbers of species use this habitat during the hunting and mating.

Orthoptera: Although they are relatively small areas, these habitats are characteristic of certain species of this order which are highly specialized for life in this conditions like species of genus *Tetrixa*, cricket *Pteronemobius heydenii, Aiolopus strepens* etc. Also, due to sandy soil, here can be found species more specific for rocky sites like *Acrotylus insubricus, Oedipoda germanica* and *Oedipoda caerulescens.*

Stagnant Water Biotopes

The biotopes representing the area along or around the slow-flowing water are not very frequent in the area of the railway corridor. Usually they are represented by swampy areas in the scope of the river arms and reed belts along the rivers.

6.11.2.3.5.5 Artificial Ponds

Reference to EUNIS Habitats: **C1.61 Lime-deficient oligotrophic temporary waters** and **C1.62 Mesotrophic temporary waters**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: This habitat is very important for the amphibians because ponds have a role as reproductive centres during the spring period, which is the mating season for these animals. The last goes especially for the localities were the neighbouring habitats are hill pastures or degraded oak forests. The amphibians that are present in the stagnant waters are Common Newt (*Lissotriton vulgaris*), Yellow Belied Toad (*Bombina variegata*) (Figure 154), Common Toad (*Bufo bufo*), Green Toad (*Pseudepidalea viridis*), European Tree Frog (*Hyla arborea*), Balkan Stream Frog (*Rana graeca*) and Marsh Frog (*Pelophylax ridibundus*).

Figure 153 Small temporary pool along the railway track

Figure 154 Yellow-bellied Toad (*Bombina variegata*)

6.11.2.3.6 Anthropogenic habitats

This chapter deals with the anthropogenic habitats such as urban and rural settlements as well as plantations of conifers and deciduous trees and agricultural land (fields, orchards, vineyards, fallow fields).

Tree Plantations

The forests planted by man in the studied corridor are mostly composed of black locust (*Robinia pseudoacacia*) and black pine (*Pinus nigra*). *Pinus nigra* is usually planted because of its capability to grow in dry and very unfavourable conditions. The same applies to *Robinia pseudoacacia* but it is planted to stabilise the soil, too. Very seldom Canadian poplar (*Populus* X *canadensis*) and high-stemmed *Populus nigra* cultivars represent the broadleaf plantations in the railway corridor. Along the railway, certain small stands of *Ailanthus glandulosa* (invasive alien species) can be found. However, the latter can be included in the ruderal sites. This habitat tipes are interesting for both amphibians and reptiles. They usually inhabit it from the neighboring habitats. Amphibians prefer it because of the constant humidity because of irrigation. The amphibians present here are Common Toad (*Bufo bufo*), Green Toad (*Pseudepidalea viridis*), European Tree Frog (*Hyla arborea*) and Marsh Frog (*Pelophylax ridibundus*). Reptiles also prefer this habitat because is rich with prey (grasshoppers, bugs, worms, rodents) the reptile species found here are: Green lizard (*Lacerta viridis*), Balkan Green Lizard (*Lacerta trilineata*), Whip Snake (*Dolichophis caspius*), Aesculapian Snake (*Zamenis longissimus*).

6.11.2.3.6.1 Black Locust's Plantation

Reference to EUNIS Habitats: **G1.C3 [Robinia] plantations**
Reference to EU HD Annex I: **none**
Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: The forest-like stands of this biotope are comon in the studied corridor but the belts of black locust along the railway line are more common. In some places black locust's stands (Figure 155) are very open and ground vegetation is well-developed, and it is similar to that of the neighbouring grasslands. Many ruderal elements are present here because of their proximity to the roads and settlements.

Distribution: Black locust's forests and woodlands are widespread in the Republic of Macedonia because of the fast growing characteristics of the species and the great resistance to unfavourable conditions. Many areas were afforested in order to prevent eolian and alluvial erosion processes.

Distribution in the area of the railway corridor: Fragments of black locust's forests can be found in many places along the railway corridor. The best-developed areas occur in the vicinity of Kriva Palanka where, in some places, black locust is a dominant tree and forms a virtually clear forest.

Figure 155 Black locust's plantation in the vicinity of Kriva Palanka

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this habitat is given in Annex 15.

Fungia: Black locust's habitat is characterised by the presence of some lignicolous fungi, which are not common in the other habitats that have already been mentioned, such are *Phellinus robiniae*, *Phellinus torulosus*, *Ganoderma resinaceum* etc. Quite common terricolous fungal species in this biotope are the edible mushrooms *Macrolepiota procera* and several *Agaricus* species.

Mammals: Common mammal species registered in this habitat are: red squirrel (*Sciurus vulgaris*), lesser mole rat (*Nanospalax leucodon*), yellow-necked mouse (*Apodemus flavicollis*), striped field mouse (*Apodemus agrarius*), fat dormaous (*Glis glis*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), western polecat (*Mustela putorius*), badger (*Meles meles*), wild cat (*Felis sylvestris*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*).

Birds: The fauna of birds resembles the one of natural oak forest. However, the number of species and population numbers are much lower due to the smaller surface of this habitat.

Amphibians: This is typical habitat of thermophilous species and therefore reptiles prefer it more than amphibians. Two species of amphibians are present here: Common Toad (*Bufo bufo*) and Green Toad (*Pseudepidalea viridis*).

Reptiles: Seven species of reptiles live in this habitat such as Wall Lizard (*Podarcis muralis*), Balkan Wall Lizard (*Podarcis erhardii*), Green lizard (*Lacerta viridis*), Balkan Green Lizard (*Lacerta trilineata*), Aesculapian Snake (*Zamenis longissimus*).

Butterflies: In the railway-corridor, following species can be found occupying this habitat: *Callophrys rubi, Libythea celtis, Aglais urticae, Erebia medusa, Pararge aegeria, Melitaea cinxia, Anthocharis cardamines, Pieris brassicae, Zerynthia polyxena.*

Ground beetles: The fauna of Black Locust's stands is very poor in species. Only few species are known to inhabit these stands.

6.11.2.3.6.2 Conifer Tree Plantations (Black Pine)

Reference to EUNIS Habitats: **G3.F12 Native pine plantations**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Black pine tree is very well acclimatised to the soil and climate conditions in the region under consideration, and it is very often used for plantations. It is planted mainly on the southern slopes of the hills (Figure 156). It was not possible to establish the great difference in the ground layer flora because the forest has elements from the neighbouring vegetation types.

Distribution: The plantations of this type are very common in the Republic of Macedonia. A sizable part of the projected railway corridor passes through such region. In the observed area, they are mainly distributed on the right side of the Kriva Reka river, starting from v. Dlabochica to v. Uzem (see Annex 16 - Habitat Map).

Figure 156 Black pine plantations in the vicinity of Dlabochica village

Flora, fungia and fauna

The extended list of plant, fungal and animal species found in this habitat is given in Annex 15.

Fungia: The black pine plantations are characterised by the presence of some lignicolous fungi that are specific to different pine species, such are *Meruliopsis taxicola*, *Peniophora pini*, *Phellinus pini* etc. This habitat is characterised by the occurence of mycorrhizal terricolous fungal species, connected to the pine root systems. The most characteristic are *Suilus granulatus*, *Suilus luteus*, *Lactarius deliciosus* etc.

Mammals: Pine marten (*Martes martes*) and the rock mouse (*Apodemus mystacinus*) are the most typical species registered in the pine plantations. Presence of red squirrel (*Sciurus vulgais*) is also expected.

Birds: The size and structure of the Black pine forests in the railway corridor area do not allow permanent presence of some specific bird species for coniferous forests. Thus, the fauna of birds originates from the neighbouring forests.

Reptiles and amphibians: There are no typical representatives from amphibians and reptilians in this habitat. The species from these classes are the same as the neighboring habitats.

Butterflies: Often recorded butterflies in pine woodlands are: *Kirinia roxelana, Hipparchia statilinus* and *H. syriaca.* However, species characteristic for woodland clearings can be also spotted in this habitat: *Coenonympha arcania, Pyronia tithonus, Pararge aegeria, Pyrgus alveus, Anthocharis cardamines, Satyrium spini, Vanessa atalanta, Phengaris arion.*

Ground beetles: Black pine plantations are the richest habitat in ground beetles species out of the anthropogenic habitats. Compared to natural forests, they show lower diversity. The species have origin from surrounding habitats (Italian and Turkey oak forests, submontane beech forests). Several endemic species thrive in the Black pine plantations.

6.11.2.3.6.3 Mixed Conifer and Black Locust's Plantation with Oak Trees

Reference to EUNIS Habitats: **G4.F Mixed forestry plantations**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Black locust and pine are combined with natural oak forest and develop in the larg areas. This habitat type appears as mixed conifer-deciduous forest community admixed with a number of plant species from the neighboring oak belt (Figure 157). The extended list of plant, animal and fungal species growing in this habitat is provided in Annex 15.

Distribution: In the corridor area, the best areas with this type of habitat are situated in close proximity to Krklja village. It is a well-formed mixed forest association with a specific structure of species (see Annex 16 - Habitat Map).

Figure 157 Black and Scots pine plantations in the vicinity of Dlabochica village

6.11.2.3.6.4 Small Broadleaf Tree Plantation

Reference to EUNIS Habitats: **G5.2 Small broadleaved deciduous anthropogenic woodlands**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: This habitat is defined as plantations and small intensively-managed woods of deciduous broadleaved trees less than about 0.5 ha in area. Such habitat type is characterized mainly by the plantations of Canadian poplar (*Populus* X *canadensis*). Very often individual Lombardian poplar trees (*Populus* "*italica"*) are planted on the field or acre boundaries (Figure 158). The stands are usually open and ground vegetation is well developed. It is very similar to that from neighbouring grasslands or other communities.

Distribution: Poplar plantations are widespread in the Republic of Macedonia. They are intensively planted due to their high and fast biomass production. Many field and garden edges in Macedonia were planted with Italian poplar in order to prevent wind blowing and to produce shade for farmers. In the investigated railway corridor the small stands of Canadian poplar and Lombardian poplar, as well as tree belts, are evenly distributed throughout the whole corridor.

Figure 158 Poplar plantations near the Kriva Reka river

Flora, fungia and fauna

The extended list of plant, fungal and animal species found in this habitat is given in Annex 15.

Fungia: The poplar forest habitat is characterised by the presence of some lignicolous fungi that are common on planted old poplar trees, such are: *Ganoderma adspersum*, *Pleurotus ostreatus*, *Agrocybe aegerita* etc.

Fauna: The fauna of broadleaf treer plantations somewhat resembles the natural willow woodlands, but the number of species is certainly lower. Poplar trees offer good sites for nesting and roosting of birds. The amphibians and reptiles species in this habitat are the same as the neighboring habitats.

6.11.2.3.6.5 Anthropogenic Tree Belts and Lines

Reference to EUNIS Habitats: **G5.1 Lines of trees**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Tree lines along the roads may not create a specific plant community or separate habitat. The importance of such vegetation, together with the tree lines on the edges of fields, acres and gardens is great because they may serve as corridors for spreading of many species.

Distribution: Tree lines are scattered irregularly throughout the whole area of interest. The most typical ones can be found in the plain area between the villages of Rankovce to Uzem.

Flora, fungia and fauna

Flora: The tree and shrub species constituting this habitat have both natural and anthropogenic origin. Some of the tree species resemble natural vegetation (*Ulmus minor*, *Pyrus amygdalyformis*, *Prunus spinosa*, *Crataegus monogyna*, *Rosa canina*, *Rubus spp*. etc.) and some of the species have been introduced by people (*Prunus cerasifera*, *Robinia pseudoacacia*, *Ailanthus altissima* etc.). The herb species are represented by the elements from the neighbouring ruderal or agricultural communities.

Fungia: Such habitat type is characterised by the presence of some lignicolous fungi, parasitic or saprobes on different tree and shrub species. The most common species are *Phellinus puncatus* (on *Prunus cerasifera), Peniophora incarnate* and *P. lycii (*on *Pyrus amygdalyformis), Vuilleminia cystidiata (*on *Crataegus monogyna),* etc.

Mammals: There is no typical mammal fauna for this habitat. However, one can expect the following species in it: sibling vole (*Microtus rossiaemeridionalis*), guenther's vole (*Microtus guentheri*), lesser mole rat (*Nanospalax leucodon*), yellow-necked mouse (*Apodemus flavicollis*), striped field mouse (*Apodemus agrarius*), fat dormaous (*Glis glis*), black rat (*Rattus rattus*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), beech marten (*Martes foina*), badger (*Meles meles*), wild cat (*Felis sylvestris*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*).

Birds: The fauna of birds represents a combination of the species of oak forests and willow woodlands. However, the general diversity is lower.

Reptiles and amphibians: The amphibians and reptiles species in this habitat are the same as the neighboring habitats.

Butterflies and ground beetles: Butterfly and ground beetle faunas are similar to the one of the of Black Locust stands.

Longhorn beetles: A number of polyphagous species on various deciduous trees usually inhabit the tree lines, such as: *Xylotrechus rusticus, Hylotrupes bajulus, Clytus rhamni* etc.

Grasslands of anthropogenic origin

Most of the grasslands in the area in the railway corridor are of anthropogenic origin. Similar to the grasslands of natural origin, they occupy small areas since most of the agricultural land is usually permanently arable.

6.11.2.3.6.6 Ruderal Vegetation and Trampled Areas

Reference to EUNIS Habitats: **E5.1 Anthropogenic herb stands**, including: E5.11 Lowland habitats colonized by tall nitrophilous herbs; E5.12 Weed communities of recently abandoned urban and suburban constructions; E5.13 Weed communities of recently abandoned rural constructions; E5.14 Weed communities of recently abandoned extractive industrial sites

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Concerning the floral composition, the most significant feature of this biotope is the domination of weedy and ruderal plant species over herb species typical of grassland communities. The vegetation cover is more or less closed, thus indicating that the fields have been abandoned for many years (see the following figure).

Distribution: The remarks pertaining to the previous habitat (anthropogenic tree lines and belts) also apply to the current one. This habitat has pattern of distribution in the area of the railway corridor identical with the previous one (see Annex 16 - Habitat Map).

Figure 159 Ruderal vegetation near Kriva Palanka

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this habitat is given in Annex 15.

Flora: Grass species like *Cynodon dactilon*, *Lolium spp*., *Bromus spp*., *Hordeum vulgare* etc. form the herb cover. *Anthemis arvensis* often penetrate from natural grassland areas. Tall herbs like *Arctium lappa*, *Hyosciamus niger*, *Datura stramonium*, *Cichorium intybus, Xantium spinosum, Onopordon sp., Cirsium spp*. and many others are quite common.

Fungia: The presence of grassland fungi is the main attribute of this habitat from a mycological aspect. The most common species belong to the non-mycorrhizal genera such as *Agaricus, Coprinus, Entoloma, Psathyrella, Stropharia* etc.

Mammals - Most common mammal species in this habitat are: eastern hedgehog (*Erinaceus concolor*), common mole (*Talpa europea*), sibling vole (*Microtus rossiaemeridionalis*), guenther's vole (*Microtus guentheri*), striped field mouse (*Apodemus agrarius*), lesser white-toaded shrew (*Crocidura suaeveolans*), wood mouse (*Apodemus sylvaticus*), western house mouse (*Mus domesticus*), beech marten (*Martes foina*), Balkan short-tailed mouse (*Mus macedonicus*), brown hare (*Lepus europeus*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), badger (*Meles meles*), wild boar (*Sus scrofa*), roe deer (*Capreolus capreolus*).

Birds: Ornithofauna of abandoned fields is very similar to the one of hill pastures. Dominant are species such as *Perdix perdix, Melanocorypha calandra, Coturnix coturnix, Alauda arvensis, Anthus campestris* etc.

Reptiles and amphibians: The amphibians and reptiles species in this habitat are the same as the Hill pastures habitat or the same as the neighboring habitats.

Butterflies: Abandoned fields and meadows are one of the most visited habitats by the butterflies. Common species in this habitat are: *Maniola jurtina, Pieris rapae, P. brassicae, P. mannii, Pontia edusa, Zerynthia polyxena, Iphiclides podalirius, Aglais io, Erebia medusa, Polygonia c-album, Argynnis pandora, A. niobe, Vanessa cardui, V. atalanta, Polyommatus icarus, Colias crocea, Brintesia circe, Plebeius argus, Melanargia galathea, Arethusana arethusa, Coenonympha pamphilus,* *Pyrgus malvae, P. serratulae, Lycaena tityrus, Aporia crategi, Euphydryas aurinia, Parnassius mnemosyne* etc.

Ground beetles: About 15 species are known to occur in the abandoned fields. Dominant species are *Amara aenea, Calathus fuscipes, Calathus melanocephalus, Cicindela campestris, Harpalus affinis, Harpalus attenuatus, Harpalus rufipes, Harpalus serripes serripes, Harpalus tardus, Microlestes fissuralis* and *Poecilus cupreus*.

Longhorn beetles: Due to the presence of herbaceous vegetation like mullein, spurge and thistles, this habitat is also caracteristic for some of species that occurs in pastures: *Agapanthia cynarae*, *A. maculicornis, A. violacea, A. vilosoviridiscens, Phytoecia virgula, Oberea erythrocephala, Vadonia moesiaca* etc.

Orthoptera: Because these habitats are often adjacent or relatively close to open terrains of natural origin, it is expected that species of hill pastures can be found here. Some of them are *Leptophyes albovittata, Ancistrura nigrovittata, Poecilimon thoracicus, Poecilimon brunneri, Melanogryllus desertus* etc.

6.11.2.3.6.7 Abandoned Arable Land

Reference to EUNIS Habitats: **E5.1 Anthropogenic herb stands**, including: E5.11 Lowland habitats colonized by tall nitrophilous herbs

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none** and

Reference to EUNIS Habitats: **I1.53 Fallow un-inundated fields with annual and perennial weed communities**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Abandoning the arable land has been a rather common process in Macedonia in recent decades. This habitat differs from ruderal habitat due to the development of several tree and bush species as a consequence of natural succession. Although very similar to the previous habitat, it has been treated as a different one since the presence of shrubs offers niches for many animal species, especially for food and shelter. In addition to the distinctive herb plants defining this habitat mentioned for the previous habitat type, the shrub species growing here (*Paliurus spina Christi*, *Rosa spp*., *Prunus spinosa* etc.) define its physiognomy.

In the aspects of fungi, this habitat is identical with the previous one. The fauna is almost identical with the fauna of the previous habitat, with more favourable conditions for the presence of orthopterans and more bird species. Thus, *Lanius* and *Sylvia* species are much more abundant. For more detailed data on the species composition refer to Annex 15.

Figure 160 Abandoned arable land cavered with ruderal vegetation

Distribution: Abandoned fields and meadows habitat is common in Macedonia. It is very similar throughout the area of its distribution but differs in many specific characteristics as regards to species composition, rising from the different grassland communities adjacent to this habitat in different areas.

Distribution in the area of the railway corridor: Abandoned fields and meadows in the area of the railway corridor are represented by small areas, distributed in a patchy pattern within the scope of the agricultural land, particularly in the area of the v. Dlabochica and Tlminci (see Annex 16 - Habitat Map).

Agricultural land

The agricultural land, in general, is characterised by smaller or larger areas planted with only a single plant species. Biomass production is huge compared to similar natural ecosystems but it is of low biodiversity value. From nature conservation and preservation point of view, smaller plots of arable land are more appropriate than large fields and plantations.

The agro-ecosystems along the railway corridor are represented by individual parcels of different types of fields, acres, gardens and meadows. The biodiversity value of the agricultural land in this area is higher than normally due to the presence of natural or fruit trees at the boundaries of the fields, which is a very common occurrence (more than a half of the fields are of this type). That is the reason why we have paid particular attention to this phenomenon during the habitat mapping.

6.11.2.3.6.8 Orchards

Reference to EUNIS Habitats: **G1.D4 Fruit orchards and FB.31 Shrub and low-stem tree orchards**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Orchards in the area of the railway corridor are not a characteristic type of agricultural activity, and they are represented with several small individual parcels. The composition is very diverse and they are primarily of the mixed type. Apricots, apples, cherries, pears, plums, walnuts etc. are the most frequent and almost regularly mixed, often by domination of certain species. Fruit trees are usually planted in the villages and in their close proximity. The production is intended only for individual use. Therefore, orchards occur only sporadically in the studied corridor, and they are with inconsiderable dimensions.

Distribution: This type of orchards (habitat) is widespread in the rural flat and hilly regions in Macedonia. Orchards in the observed railway corridor cover a small area in the area of the v. Drenje, in the Kriva Reka valley (see Habitat map-Annex 16).

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this habitat is given in Annex 15.

From biodiversity point of view, the animal species are most important for this habitat, but in the area of the railway corridor orchards do not contribute significantly to biodiversity value of the area. Anyhow, the most characteristic species are given below.

Mammals: Species found in the orchards can also be found in other agricultural terrains. Most common are: eastern hedgehog (*Erinaceus concolor*), lesser white-toaded shrew (*Crocidura suaeveolans*), common mole (*Talpa europea*), red squirrel (Sciurus vulgaris), sibling vole (*Microtus rossiaemeridionalis*), lesser mole rat (*Nanospalax leucodon*), fat dormaous (*Glis glis*), Balkan short-tailed mouse (*Mus macedonicus*), brown hare (*Lepus europeus*), fox (*Vulpes vulpes*), wild boar (*Sus scrofa*), weasel (*Mustela nivalis*), roe deer (*Capreolus capreolus*).

Birds: Very few species are present in orchards. *Merops apiaster, Upupa epops, Galerida cristata* and *Oenanthe oenanthe* nest in the orchards; other species use these habitats for foraging.

Reptiles and amphibians: The species of amphibians and reptiles are the same as in the fields and acres habitat.

Butterflies: Depending on the intensiveness of agriculture in the orchards, several species can be registered in this habitat: *Iphiclides podalirius, Pyrgus malvae, Aglais io, Melanargia galathea, Maniola jurtina, Pontia edusa, Plebeius agestis, Melitaea phoebe, Erynnis tages, Lycaena phleas, Pyrgus alveus, Vanessa cardui, Pieris brassicae, P. mannii, Polyomatus icarus* etc.

Ground beetles: The species that inhabit orchards (and vineyards) are widespread eurytopic species. The number of species is low. Commons species are: *Amara aenea, Calathus melanocephalus, Carabus coriaceus cerisyi, Harpalus affinis, Harpalus rufipes, Harpalus serripes, Harpalus tardus* and *Poecilus cupreus*.

6.11.2.3.6.9 Vineyards

Reference to EUNIS Habitats: **FB.41 Traditional vineyards**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

Vineyards are not characteristic for the studied area and for this part of Macedonia; consequently they are represented by a small percentage. The proportion of small parcels and plantations is the same as for orchards and fields (see Habitat map-Annex 16).

As far as biodiversity is concerned, vineyards are of higher relevance than fields and gardens. The fauna (vertebrates and invertebrates) of vineyards is almost identical with the one of orchards. The extended list of plant, fungal and animal species growing in this habitat is given in Annex 15. However, vineyards do not have any particular value neither for biodiversity, nor for economy of the area due to their insignifican coverage (only one vineyard parcel, large enough to be mapped, is present in the area of interest).

6.11.2.3.6.10 Fields and Acres

Reference to EUNIS Habitats: **I1.3 Arable land with unmixed crops grown by low-intensity agricultural methods**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

General characteristics: Fields and acres in the area of the projected railway line are mostly represented by wheat and corn culture. Industrial plants are cultivated very seldom. This habitat type does not have significant value for the biodiversity in the area. However, it is interesting for the area of the railway corridor that fields are very often planted with 1) fruit trees inside or at the boundaries, or 2) they contain remainders of wild trees from natural forests besides fruit trees, or 3) they are surrounded by poplar and willow trees. Certain mixtures of fields and gardens significantly enhance the biodiversity value of this habitat type. Typical gardens in the studied area are very rare. They are usually mixed with fields and almost regularly surrounded by fruit trees.

Distribution: Fields and acres are widely distributed throughout the corridor area but scattered and with small dimesions.

Flora, fungia and fauna

The extended list of plant, fungal and animal species growing in this habitat is given in Annex 15.

Fungia: There are some fungal species typical of various types of agricultural land such as *Agaricus campestris*, *Coprinus* spp., *Psathyrella* spp. etc. The species composition is identical in all types of agricultural land.

Mammals – Driven by the food supply, fields and acres are home for many mammal species such as: lesser white-toaded shrew (*Crocidura suaeveolans*), common mole (*Talpa europea*), sibling vole (*Microtus rossiaemeridionalis*), guenther's vole (*Microtus guentheri*), lesser mole rat (*Nanospalax leucodon*), wood mouse (*Apodemus sylvaticus*), striped field mouse (*Apodemus agrarius*), fat dormaous (*Glis glis*), black rat (*Rattus rattus*), Balkan short-tailed mouse (*Mus macedonicus*), brown hare (*Lepus europeus*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), badger (*Meles meles*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*).

Birds: About 25 bird species can be listed for the habitats of fields and acres. Three of them are resident (*Perdix perdix, Miliaria calandra* and *Galerida cristata*) and 11 more species are breeders. Other bird species use field and acres for foraging.

Reptiles and amphibians: Only two species of amphibians are found here and they are: Common toad (*Bufo bufo)* and green toad (*Pseudepidalea viridis*). This habitat is also rich in reptile species, among and the species composition is very similar to that of the dry pastures and abandoned fields.

Butterflies: This habitat is not suitable for butterflies. However, sporadic occurrences of species from Pieridae family can be registered.

Ground beetles: The structure of the community is characterized by the presence of few species with great dominance: *Amara aenea, Calathus melanocephalus, Harpalus serripes, Harpalus rufipes* and *Poecilus cupreus*.

Urban or urbanised areas as habitats

The area along the railway line is not very densely populated but the population is relatively regularly dispersed. Only one urban centre – Kriva Palanka is situated partly n the railway corridor. However, its urban characteristics are not typical and it has also rural characteristics on a significant part of the towns surface. The dispersed type of village settlements in north-eastern Macedonia causes distribution of very sparse small groups of houses over large areas, which are then named a village. The presence of isolated houses is also common. These parts are hardly urbanised, they are enclosed by fields, vineyards, orchards, meadows, natural vegetation and individual trees.

The primary feature of urbanised areas as a habitat type is the presence of allochtonous plant species, essentially decorative trees and shrubs, but also fruit trees and vegetable plants. It is also significant that many plant and animal species are strictly adapted to urban conditions such as ruderal and weed plants, specific bird and mammal species etc. Taking into account the impact of settlements' types as habitats on many plants (especially) and animal species, we have grouped them in several biotope types.

6.11.2.3.6.11 Rural Settlements - Villages

Reference to EUNIS Habitats: **J1.2 Residential buildings of villages and urban peripheries; I1.22 Small-scale market gardens and horticulture, including allotments**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

Rural features characterize village settlements along the railway corridor. As a rule, the houses in these villages are surrounded by small gardens and fruit trees even in their central part (next to the main road). In such conditions, many wild animal species are adapted for living close to human presence.

The peripheral parts of the villages in the area of the railway corridor are characterized by sparsely distributed houses with small meadows, grasslands and sparse trees around. The participation of natural vegetation is high. Besides cultural and decorative plant species, vegetation is primarily represented by elements from the neighbouring habitats and ruderal and weed species (see Annex 15). Some parts of the villages, excusivelly next to the main raod to Bulgaria, are more urbanised and are less important from a biodiversity standpoint.

Flora, fungia and fauna

The extended list of plant, fungal and animal species found in this habitat is given in Annex 15. From biodiversity point of view, the animal species are most important for this habitat.

Mammals: Villages are suitable mammal habitats. Viriety of vegetable, livestock and poultry offer food supply for both, herbivore and carnivore mammals. Most common species are: lesser white-toaded shrew (*Crocidura suaeveolans*), red squirrel (*Sciurus vulgaris*), yellow-necked mouse (*Apodemus flavicollis*), wood mouse (*Apodemus sylvaticus*), striped field mouse (*Apodemus agrarius*), fat dormaous (*Glis glis*), black rat (*Rattus rattus*), western house mouse (*Mus domesticus*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), western polecat (*Mustela putorius*), beech marten (*Martes foina*), badger (*Meles meles*), wild cat (*Felis sylvestris*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*).

Birds: There are about 40 bird species that occur in the villages. This number is higher even compared to some of the natural habitats. There are 10 resident and 31 breeding species, most of them tightly connected to antrhopogenic habitats: *Pica pica, Corvus monedula, Corvus cornix, Corvus corax, Passer domesticus, Passer montanus, Ciconia ciconia, Falco tinnunculus, Columba livia, Streptopelia decaocto, Tyto alba, Otus scops, Athene noctua, Asio otus, Hirundo rustica, Hirundo daurica, Delichon urbica, Sylvia atricapilla, Parus caeruleus, Parus major, Oriolus oriolus* and *Passer hispaniolensis*.

Reptiles and amphibians: The rural settlements are rich in amphibians because usually there are small gardens with constant water supply (wells and springs) near the households. Therefore, many amphibian species are present here such as Common Newt (*Lissotriton vulgaris),* Agile Frog *(Rana dalmatina),* Yellow Belly Toad (*Bombina variegata),* Common Toad (*Bufo bufo*), Green Toad (*Pseudepidalea viridis*), European Tree Frog (*Hyla arborea*) and Marsh Frog (*Pelophylax ridibundus*). These habitats are preferred by the reptiles as well. Seven species of reptiles are present such as Hermanns Tortoise (*Eurotestudo hermanni*), Slow Worm (*Anguis fragilis*), Erhard's Wall Lizard (*Lacerta erhardii*), Wall Lizard (*Podarcis muralis*), Balkan Green Lizard (*Lacerta trilineata*), Green Lizard (Lacerta viridis), Whip Snake (*Dolochopis caspius),* Aesculapian snake *(Zamenis longissimus).*

Butterflies: Compared to the towns and cities, rural areas contain much more diverse butterfly fauna due to the natural environment around them and the unique features like the gardens and ruderal sites, which are common gathering places for butterflies. Typical and frequent dwellers in this habitat are: *Lycaena virgaureae, Lycaena tityrus, Polyommatus belargus, P. icarus, Leptidea sinapis, Plebeius argus, Pieris brassicae, P. napi, Coenonympha papmphilus, C. arcania, Maniola jurtina, Argynnis paphia, Satyrium acaciae, Colias crocea, Arethusana arethusa, Nymphalis polychloros, Erebia medusa, Vanessa cardui, V. atalanta, Cupido osiris, Erynnis tages, Polygonia c-album, Pseudophilotes vicrama, Hamearis lucina, Pyrgus alveus, Aglais urticae, Aporia crategi* etc.

Ground beetles: It is interesting that the fauna of the villages is very similar to the one of the agricultural land (orchard, vineyards, fields and acres). All of these species are connected to human activities. The most common are: *Amara aenea, Calathus melanocephalus, Calathus fuscipes, Microlestes fissuralis, Harpalus serripes, Harpalus rufipes* and *Poecilus cupreus*.

Longhorn beetles: Because these areas include gardens, fruit trees, various plants in flower, stored firewood, a significant number of species can be found here, mainly similar to abandoned fields and tree lines.

6.11.2.3.6.12 Urban Settlements

Reference to EUNIS Habitats: **J1.2 Residential buildings of villages and urban peripheries; J1.41 Urban and suburban commercial units**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

From biodiversity standpoint, the animal species are most important for this habitat. Fauna of urbanised settlements along the projected railway corridor mostly consists of common species, both invertebrates and vertebrates. Thus, there are not many species that deserve particular emphasis (for more data see Annex 15).

Mammals: Urbanized areas are non-suitable habitat for the survival of the mammals. However, species like red squirrel (*Sciurus vulgaris*), black rat (*Rattus rattus*), striped field mouse (*Apodemus agrarius*), western house mouse (*Mus domesticus*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), beech marten (*Martes foina*) and badger (*Meles meles*) can be found in this habitat.

Birds: Bird fauna of towns in the railway corridor are is much poorer than the one of the villages. Only 16 species were recorded: resident and breeding birds represented both by eight species.

Reptiles and amphibians: Amphibians are in constantly present because of the river Kriva Reka in Kriva Palanka. Four species are found: Common Toad (*Bufo bufo*), Green Toad (*Pseudepidalea viridis*), European Tree Frog (*Hyla arborea*) and Marsh Frog (*Pelophylax ridibundus*). The reptiles are usually in the periphery of the towns and they are represented with Hermanns Tortoise (*Eurotestudo hermanni*), Erhard's Wall Lizard (*Lacerta erhardii)*, Wall Lizard (*Podarcis muralis*) and Balkan Green Lizard (*Lacerta trilineata*).

Butterflies: Urban areas do not offer good living conditions for the butterflies. Yet, several species can be found in this habitat. Most of these species have wide range of habitat preferences: *Pontia edusa, Libythea celtis, Polygonia c-album, Pieris brassicae, P. mannii, P.rapae, Polyommatus icarus, Nymphalis antiopa, Vanessa atalanta, Aglais io, Iphiclides podalirius, Colias crocea* etc.

Ground beetles: The fauna of urban settlements is not much different of the one in the villages. The population abundance is probably lower, but the number of species is almost the same. Dominant species are: *Amara aenea, Calathus melanocephalus, Calathus fuscipes, Microlestes fissuralis, Harpalus serripes* and *Harpalus rufipes*.

6.11.2.3.6.13 Man-Made Structures

Reference to EUNIS Habitats: **J3.2 Active opencast mineral extraction sites, including quarries; J3.3 Recently abandoned above-ground spaces of extractive industrial sites; J1.4 Urban and suburban industrial and commercial sites still in active use**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

This includes a variety of industrial facilities, glasshouses for early crops, quarries, dumps, sand exploitation localities etc. However, such facilities are not typical for the railway corridor of interest (only one site at the v. Zhidilovo was identified) (see Annex 15 – Habitat Map). Due to its representation in the railway corridor, this habitat type does not have any relevance from biodiversity point of view.

6.11.2.3.6.14 Urbanized areas: roads

Reference to EUNIS Habitats: **J4.2 Road networks; J4.6 Pavements, and recreation areas**

Reference to EU HD Annex I: **none**

Reference to CoE BC Res. No. 4 1996: **none**

The distinctive quality of this habitat is the presence of a special type of vegetation formed under the anthropogenic influence. The presence of certain neophytes coupled by native plants is also common. Some of ruderal plant communities are strictly adapted to development along the roads. Trampled vegetation is also representative for this habitat.

Distribution: The habitats of this type are spread along all roads, but in the area of interest they are the most tyipical along the main road to Kriva Palanka and Bulagarian border. They not relevant for biodiversity value in the area of the railway corridor due to their insignificant coverage and species composition.

In relation to biodiversity, the animal species are most important for this habitat.

Mammals: Mammal fauna in this habitat is similar to the previos one: sibling vole (*Microtus rossiaemeridionalis*), wood mouse (*Apodemus sylvaticus*), black rat (*Rattus rattus*), western house mouse (*Mus domesticus*), Balkan short-tailed mouse (*Mus macedonicus*), wolf (*Canis lupus*), fox (*Vulpes vulpes*), weasel (*Mustela nivalis*), beech marten (*Martes foina*) and badger (*Meles meles*).

6.11.2.4 Important habitats and species (valorisation)

There is no official document or other special publication in Macedonia that identifies or describes important habitats, i.e. habitats of outstanding value because of their species richness, their rarity or because they are endangered. In order to overcome this shortcoming we used European documents: EU Habitat Directive – Annex I and Bern Convention – Resoltion No. 4 (1996).

For assessment of important flora and fauna species we used current international documents and lists (IUCN Global Red Lists, IUCN European Red Lists, EU HD Annex II and Annex IV, EU Bird Directive Annex I and II, Bern Convention – Resolutin No. 6. “Rarity” was also used as a criterion, which was deemed necessary in order to fill the gap that exists because of the absence of national red lists.

6.11.2.4.1 Habitats

The following habitat types are listed in either Habitat Directive (HD) or Bern Convention (BC) or in both:

1. Forest of Pubescent oak and Oriental hornbeam (HD and BC);
2. Forest of Italian and Turkey oak (BC, but in broad sense – thermophilous forests);

3. Forest of Flowering ash and Sessile oak (BC, in broad sense – thermophilous forests);
4. Submontane beech forest (HD and BC);
5. Riparian willow-poplar woodland (HD and BC);
6. Riparian willow-poplar belts (HD and BC);
7. Riparian scrub communities - Tamarisk shrubland (HD and BC);
8. Gravely and sandy river banks (BC);
9. Hill pastures (HD and BC);
10. Hill pastures with sparse shrubs (HD and BC);
11. Hill pastures on stony ground (HD and BC);
12. Rocky and stony areas - hasmophytic vegetation (HD);
13. Rivers and streams - Epipotamal and hiporhitral streams (HD);
14. Intermittent streams - ravines (HD);
15. Meadows – mesophilous (HD and BC).

For detailed description of the habitats and their distribution along the railway alignment, see respective section and sub-sectins above. As described in respected sub-chapters, Forest of pubescent oak and Oriental hornbeam (1), Riparian scrub communities - Tamarisk shrubland (7), Hill pastures on stony ground (11), Rocky and stony areas - hasmophytic vegetation (12) and Intermittent streams – ravines (14) are represented with very small areas in the investigated railway corridor; then they are represented with stands at various degradation stages and are not representative. Due to this, they do not have favourable conservation status as defined in EU Habitat Directive and their revitalization does not seem possible, which means they are of no use for Natura 2000 designation.

Forest of Italian and Turkey oak (2) and Forest of flowering ash and sessile oak (3) are also very degraded habitats in the railway coridor and are not very sensitive to future construction works, despite their value for the overall biodiversity in the region.

Hill pastures with sparse shrubs (10) represent successional stage of transformation of dry grasslands (hill pastures) which means loss of valuable grassland habitat that cannot be stopped in the near future. Thus, clearing of the shrubs in the area of activities for the construction of the railway cannot be considered as negative impact (except for the full destruction of the area of the rail tracks and immediately next to them.

Thus, the following habitats are the most sensitive and may undergo significant negative impact during construction of the railway:

1. Submontane beech forest (HD and BC);
2. Riparian willow-poplar woodland (HD and BC);
3. Riparian willow-poplar belts (HD and BC);
4. Gravely and sandy river banks (BC);
5. Hill pastures (HD and BC);
6. Rivers and streams - Epipotamal and hiporhitral streams (HD);
7. Meadows – mesophilous (HD and BC).

6.11.2.4.2 Biocorridors

Apart from intrinsic value of particular habitats described above in this chapter, many natural and semi-natural habitats (including some parts of habitats not mentioned above) have additional importance due to their function as biocorridors. Their function as biocorridors results from the fact that they enable various daily, periodical or seasonal movements and migrations of different animals or dispersal of plants. The most important role as biocorridors in the area of project interest plays two south-north routs, recognized as important corridors for large mammals in Macedonian Ecological Network[22] (Figure 161 below). These corridors are:

- Osogovo-Bilina Planina linear biocorridor;
- Osogovo-German landscape biocorridor.

Basically this represents connection of Osogovo Mountains with the range of mountains on the border with Serbia (northern Macedonia). These mountains are Kozjak, German and Bilina Planina (from west to east).

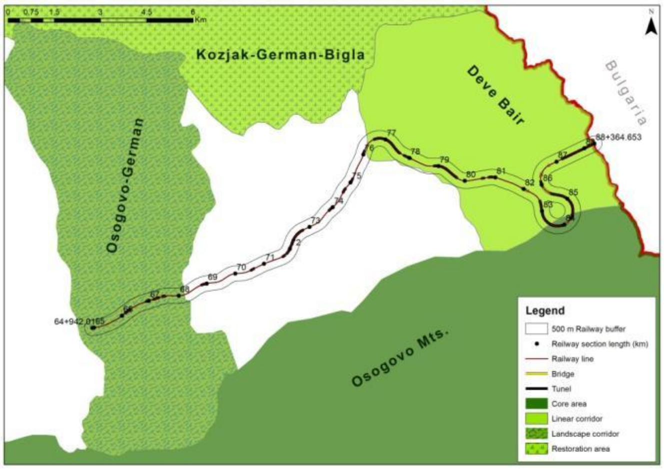


Figure 161 Position of the two biocorridors (Osogovo-German and Deve Bair) that intersect with the railway corridor; Source: Brajanoska at al. 2011)

Biocorridors are especially important for normal life cycle for many animals:

- Amphibians - migrations during reproduction to spawning areas (common toad, green toad);
- Brown bear - movements for searching food and migration; brown bear is extremely rare in this area. Actually its presence is irregular (see Chapter on biodiversity and Annex 15) and these corridors are very important for enabling establishment of bear population in the future;
- Gray wolf - movements for searching pray;
- Ungulates, particularly roe dear - movements and seasonal migration for grazing;
- Small mammals - periodical and seasonal movements.

The railway line cuts both above mentioned biocorridors. The most important features (land cover) of both biocorridors are presented in Table 50 (representative for the whole corridor, not only for the part cut by the reailway corridor).

Table 50 The most important biocorridors along the railway alignment

Biocorridors	Biocorridor type	Position along the alignments	Habitat type coverage (%)	
Osogovo-Bilina Planina (Deve Bair)	Linear corridor	km 64+942 to km 68+300	Forest	42.9
			Scrub	28.2
			Grasslands	6.7

22 MAK-NEN – Macedonian Ecological Network, Elaborated by Macedonian Ecological Society and European Center for Nature Conservation (Netherlands), still on the expert level, expected to be approved by the Ministry of Environment and Physical Planning soon.

			Agricultural area	22.2
Osogovo-German	Landscape corridor	km 80+000 to km 88+200, but the alignment also touches the biocorridor from km 76+700 to 88+000	Forest	27,5
			Scrub	28,8
			Grasslands	18,8
			Agricultural area	25,0

Source: Brajanoska at al. (2011)

6.11.2.4.3 Important species

6.11.2.4.3.1 Flora

Plant speces listed in annexes of international biodiversity conservation documents cannot be found in the railway corridor. National Red List for threatened plants does not exist. Rare or threatened plant speces were not found during the field survey as well.

Figure 162 The Hungarian calamint (*Acinos hungaricus*) - typical plant of hill pastures (left), and the green-winged orchid (*Orchis morio*) – typical of wet meadows (right)

6.11.2.4.3.2 Fauna

6.11.2.4.3.2.1 Mammals

In total, 25 mammal species were assessed according to the Bern Convention, Habitats Directive, Bonn Convention (important for bats), CITES, Emerald and IUCN Red List.

According to the IUCN Red List, all of the species are least concern (LC) and only one is considered as near-threatened species (NT).

There are at least five bat species and all of them are enlisted in Annex of the Bonn Convention. Bat species were not included in the description of the habitats due to the lack of concrete data of their distribuution. It can be assumed that bat species occur in almost all of the habitats in search for food. Their shelters can be found in various habitats: in natural or artificial caves, rock crevices, tree holes, roofs of houses etc.

Figure 163 The Lesser Horseshoe Bat (*Rhinolophus hipposideros*)

If Bern Convention is taken into account then particular attention should be paid to Brown bear, Otter, Wildcat and most of the bat species. Similar conclusion can be derived from the analysis of Habitats Directive (see Annex 15)

6.11.2.4.3.2.2 Birds

The valorization of birds was preformed according to the most relevant conservation documetns, EU Bird Directive and International conventions. (see Annex 15)

Most of the species are categorized as least concern - LC (119 species). There are no bird species in the higher threat categories (EN, VU).

There are 35 species listed as important according to the EU Birds Directive. Annex I contains 15 species. Furthermore, attention should be paid to possible presence of Peregrine falcon(*Falco peregrinus*), especially in the ravines and river gorges during construction phase. (see Annex 15)

6.11.2.4.3.2.3 Amphibians and Reptiles

The valorization of amphibians and reptiles has been done according to the international conventions and legislation for protection of threatened species on European or Global level. The last includes: Convention on the conservation of European wildlife and natural habitats (also known as **Bern convention**), Convention on the conservation of migratory species of the world (also known as **Bonn convention**), EU Habitats Directive and Convention of International Trading of Endangered Species (also known as **CITES** convention). Considering the fact that Macedonia does not have national red list of threatened species, the official IUCN red list was used.

As is it shown in Table 126, there are no endangered species in Macedonia. All of the species are on the Appendix II or III of Bern convention, there are 16 species on the Habitats directive list (5 amphibian and 11 reptile species), 2 species on Emerald list (1 amphibian and 1 reptilian species).

The species *E. hermanni* is on the **CITES** list and the reason is illegal trafficking with these species and unfortunately Macedonia is not excluded from these illegal activities.

According the IUCN red list of threatened species all 9 amphibians and 9 reptiles are marked as LC (least concern), *N. tessellata* is marked as NT (near threatened) due to the small distribution areal on European level. (see Annex 15)

Figure 164 The Erhard's wall lizard (*Podarcis erhardii*) - Balkan endemic species

6.11.2.4.3.2.4 Insects

There are 93 species of ground beetles (Coleoptera, Carabidae) registered in the Kriva Palanka – Deve Bair railway corridor (Table 127). The majority of species are common European ones, with the exception of several species that are considere to be Balkan endemics (*Tapinopterus balcanicus, Molops rufipes, M. robustus*, etc.) (see Annex 15)

Almost 90 species of butterflies (Rhopalocera, Lepidoptera) were recorded in the Kriva Palanka – Deve Bair railway corridor (Table 128). Most of the species are widespread in Macedonia and on the Balkan Peninsula. (see Annex 15)

In total, 20 insect species are treated by Global IUCN Red List (2011.1), EU Habitats Directive and Bern Convention. The majority of species (8) belong to dragonflies. However, all of the dragonflies are listed as least concern - LC (7 species) or near threatened - NT (1 species).

Special attention should be paid to *Morimus funereus* (longhorn beetle) characteristic for old forests. It is enlisted as vulnerable - VU according to the IUCN red list due to the decline of the quality of the forest habitats in Europe. This species is quite common in Macedonia and occurs in various forest types. In the railway corridor area it is present mainly in the submontane beech forests with stable population. (see Annex 15)

Figure 165 The Clouded Apollo (*Parnassius mnemosyne*) – left, and *Morimus funereus* – right

6.11.2.4.3.2.5 Diatoms and macroinvertebrates

In general, in the research area one can encounter species of diatoms and aquatic macroinvertebrates that are widespread in Europe and Macedonia. They inhabit mainly river ecosystems, with medium presence of nutrients (mesotrophic), although in some places there are also oligotrophic species of diatoms (*Meridion circulare, Encyonema silesiacum*) and macroinvertebrates, or eutrophic diatoms (*Nitzschia palea, N. linearis, Mayamea atomus*) and aquatic invertebrates. During the research, there are no species that are rare in the flora and fauna of the Republic of Macedonia or so far unknown, while the number of species of conservation importance is small. Among the macroinvertebrates, only the larvae of the aquatic insects *Cordulegaster heros* and *Caliaeschna microstigma* (Odonata) are species of high conservation significance (Figure 166). In the European Red List of Dragonflies, they are categorized as aquatic insects with a lower risk of extinction, ie they are nearly threatened (NT) species. The species *C. heros* is under the legal protection of the Habitats Directive 92/43 / EEC (Annex II / IV), which further emphasizes the need for a high level of protection, both in the species and in its habitat.

Figure 166 Larva of the dragonfly *Cordulegaster heros*

6.11.3 Protected areas

In this chapter, the protected and other important areas from the aspect of biodiversity and nature are considered. The existing legislation (Nature Protection Law) derives from the formal protection of national protected areas (in the analyzed corridor there are no such areas), but attention is paid to the internationally designated areas and other proposed areas for protection.

The alignment of the railway intersects with:

- National designated areas for protection (proposed):
  - Osogovo Mountains and Kiselicka Reka – proposed for protection;
  - Protected landscape of the Osogovo Mountains – proposed for protection;
  - Nature park „Kiselichka Reka Gorge" – proposed for protection;
- Internationally designated areas for protection:
  - Pchinja-German – Emerald site;
  - Osogovo Mountains – Emerald site;
  - European Green Belt.

Within the project area there are no identified significant plant, bird and butterfly areas. The following subchapters give detailed description of the aforementioned areas, as well as their locations.

6.11.3.1 National system of protected areas

Near the analyzed railway corridor there are no significant spaces that are included in the national system of protected areas. Such areas have not been identified either in the Biodiversity Strategy, the Strategy for Nature Conservation or in the Natural Heritage Study of the Spatial Plan of the Republic of Macedonia.

6.11.3.2 Identified protected areas

In the proposal for improving the system of protected areas (representative network of protected areas), two new areas have been identified and proposed for protection: Osogovo Mountains and Kiselicka Reka (MES 2011).

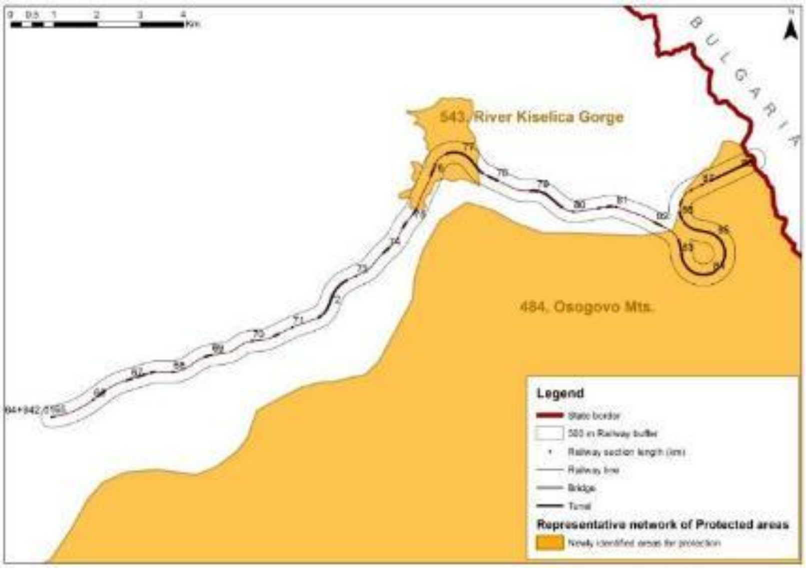


Figure 167 Identified protected areas on a national level (Kiselicka Reka Gorge and Osogovo Mountains)

6.11.3.3 Proposed protected area "Protected landscape of the Osogovo Mountains"

The area was proposed within the Representative Network of Protected Areas (MES 2011), but there is still no legal protection. It covers an area of 77226 ha.

The Osogovo Mountains possess significant values from a biological point of view. A number of internationally and nationally significant species of flora and fauna have been identified, of which a significant proportion are affected, endemic or rare species. The interaction between people and the nature of Osogovo is characteristic and it is of utmost importance to ensure nurturing and preserving it. From here comes the need for protection of the area in the category, which will provide protection of natural values and sustainable economic development in the region. In the area, 18 habitats are registered according to the EUNIS classification system for habitats, five of which are significant for conservation under the Habitats Directive. There are 1007 types and subspecies of plants registered, of which 18 are registered only on Osogovo, among which: *Viola biflora, Anemone narcissiflora, Myriophyllum verticillatum, Pulsatilla montana ssp. slaviankae* and others. Top Tsarev Vrv is the only site for *Genista fukarekiana* (endemic plant, which is found only on the Osogovo Mountains). On Osogovo there are 258 species of macromycetes registered. The presence of 24 species of mammals has been established. 133 species of birds are registered, of which 36 are significant species. There are 10 species of amphibians and 21 species of reptiles identified, including 11 species of fish, eight of which are included on the IUCN Red List. 16 Balkan endemics from the group of snails have been registered, 243 species of spiders (14 endemic), 37 species of locusts (5 Balkan endemics), 15 species of dragonflies, 99 species of daily butterflies (*Erebia aethiops* and *Minois dryas* are found only in Osogovo), 203 species of Carabidae. Osogovo is characterized by interaction between humans and nature, and biological diversity and human heritage, preserved in natural landscapes, has contributed to the formation of characteristic landscapes. Osogovo has six types of landscapes, the most characteristic of which is the Osogovo Mountain rural area.

The railway passes through the northeastern part of the area. Length of 282 m (km 82 + 376 to 82 + 658), the alignment passes through beech forests.

6.11.3.4 Proposed protected area – nature park „Kiselichka Reka Gorge“

The area was proposed within the Representative Network of Protected Areas (MES 2011). The main reason for the proposal is the presence of the *Lutra lutra*. The area is proposed for protection in the category "nature park" (Figure 167).

This area still does not have legal protection. The alignment of the railway passes in the middle of the area (km 75 + 146 to km 77 + 512 ie the total length of 2,366 km, of which 1,911 km pass through tunnels or bridges).

6.11.3.5 Internationally designated areas of protection

From the internationally designated areas of protection, the Emerald sites should be specifically analyzed in the project area, while the plant area "Osogovo Mountains" is less relevant. In the vicinity of the corridor of the Kriva Palanka-Deve Bair railway, significant areas for birds or primary butterfly areas are not found.

6.11.3.5.1 Emerald sites

Emerald Network is a network of Areas of Special Conservation Interest (ASCI) designated for the purpose of preserving the natural habitat network and is developed in the territory of the Member States of the Berne Convention (Convention for the Conservation of Wildlife and Natural Habitats in Europe).

The Republic of Macedonia, as a member state of the Berne Convention (ratified in 1997 with the Law on Ratification, Official Gazette of the Republic of Macedonia No. 49/97) implemented four projects for the development of the National Emerald Network in the period from 2002 to 2008, during which they were identified and processed a total of 35 areas of interest for conservation and they were proposed to the Bern Convention Secretariat for their inclusion in the national Emerald Network.

In the wider area of the railway corridor there are two relevant Emerald areas: Pchinja-German and Osogovo Mountains (Figure 168).

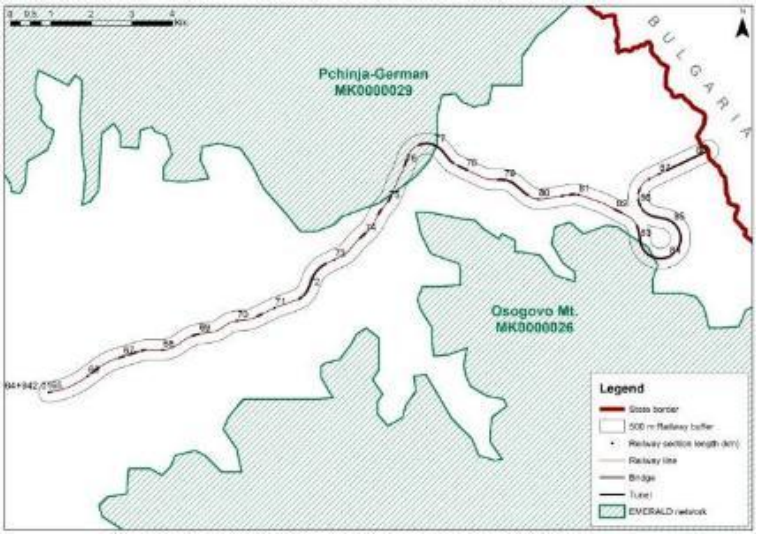


Figure 168 Emerald sites Osogovo Mountains and Pchinja-German

6.11.3.5.1.1 Emerald site Pchinja-German

The area covers an area of 63490 ha. This area has been identified on the basis of multiple criteria. The presence of two habitats from the Resolution no. 4 of the Bern Convention: Beech forests and thermophilous and supra-Mediterranean oak woods. Also, the presence of a large number of species from Resolution No. 6 of the Bern Convention is evident: 25 bird species, 7 mammals, 7 amphibians and reptiles, 4 fish and 3 invertebrates.

The alignment of the railway passes through the Emerald area Pchinja-German from km 75 + 213 to km 77 + 070 ie. in length of 1,857 km. Of these, 1,427 km pass through tunnels or bridges. The alignment passes through pine plantations, black locust plantations, degraded thermophilic oak forests and mesophilic oak forests.

6.11.3.5.1.2 Emerald site Osogovo Mountains

The site covers an area of 56674 ha. This site has been identified on the basis of the presence of four residences under Resolution No. 4 of the Bern Convention: Bruckenthalia heaths, Rich fens, Beech forests, and Thermophilous and Supra-Mediterranean oak woods. Also, the presence of a large number of species from Resolution No. 6 of the Bern Convention is evident: 25 bird species, 7 mammals, 5 amphibians and reptiles and 3 invertebrates.

The alignment of the railway passes through the Emerald area of "Osogovo Mountains" from km 83 + 080 to km 83 + 630 ie. through a space in which significant populations of species with high conservation significance were not identified.

6.11.3.5.2 Significant plant areas

Significant plant area (SPA) Osogovo Mountains. Due to the presence of plant species of international (*Hericium erinaceus, Fritillaria gussichiae* and *Amaurodon viridis*) and national significance (11 species), as well as eight significant habitats, the Osogovo Mountains have been identified as Significant plant area (Melovsky et al. 2010). The site has an area of 50543 ha (Figure 169).

The planned corridor is outside of the significant plant area "Osogovo Mountains" (no direct and indirect impacts can be expected).

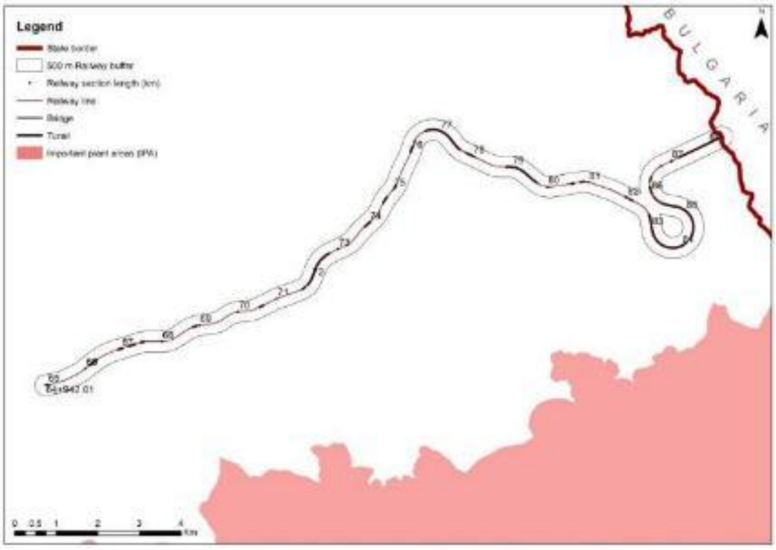


Figure 169 Significant plant area Osogovo Mountains

6.11.3.5.3 European Green Belt

The Republic of Macedonia and the Republic of Bulgaria, are participants in the initiative Green European Belt, especially its regional branch: Balkan Green Belt. This initiative involves preserving biodiversity and resources by creating transboundary protected areas along the border line of the former "iron curtain". Osogovo Mountains are a priority region along the eastern border of this belt in the Republic of Macedonia (Figure 170). The significance of the Green Belt is perceived through the existing protected and proposed areas for protection, the existence of biocoridors, the promotion of traditional values, etc. The construction of the railroad between Macedonia and Bulgaria is a symbol of connecting the two countries ie. overcoming the historical barrier ("iron curtain").

Figure 170 Distribution of the Green Belt in the eastern and northeastern part of the Republic of Macedonia (the minor map shows the Balkan Green Belt)

6.12 Material assets

6.12.1 Water-supply, irrigation and sewerage

The town of Kriva Palanka gets its drinking water from the location Kalin Kamen through the town's water-supply, built in three phases from 1972 to 1988, by water intake structures of 116 springs with variable yield from 25 to 100l/s. Part of the town is supplied with drinking water from the town water-supply "Skrljava" with yield from 4 to 12 l/s, which decreases especially in the winter period. During 1993/1994 another well was built, with yield of 4 l/s, and near the end of 2000, two more wells with capacity of 6 to 7,5 l/s and both were directly connected to the town reservoir of the town water-supply "Kalin Kamen". From the total water of the town's water-supply, 80% is used by the households, 20% by the economy and small businesses in the Municipality. From 25 to 40% is used in irrigation, and in the summer period up to 50%. So far, the average yield of the water-supply springs provides 113 l/citizen daily.

The need for irrigation water is especially prominent in the villages. For this purpose, a large portion of the drinking water is used, creating shortages in the summer period, especially prominent in the major villages such as Konopica and Mozhdivnjak. Irrigation water in the Town is used strictly from the town's water-supply, i.e. the drinking water.

For irrigation of the agriculture land in the Municipality, the water from Kriva and Duračka Reka are used too, which are polluted as a result of uncontrolled run-off of industrial and communal wastewaters.

To overcome the water shortage problems in the future, it is planned to construct dams on Stanečka Reka, Maštenica, Selska Reka, etc. By construing a dam on Stanečka Reka, the irrigation needs for all agricultural areas in municipality Kriva Palanka would be fulfilled.

Municipality Kriva Palanka is not fully covered by a sewerage network, and there is no system for wastewater treatment, i.e. the wastewaters are discharged in water bodies unfiltered. In the rural settlements, the wastewaters are collected in septic tanks, because most rural settlements are of a scattered type and mostly divided by neighborhoods. To improve the conditions, a construction of three major sewerage systems is planned, as well as secondary network in parts of the Town and some suburbs, such as: a) construction of a sewerage network for the part "Duračka Reka"; b) completion of the main sewerage network in the village Moždivnjak and the village Dlabočica, near the main road; c) construction of sewerage in parts of the village Konopica and the village Židilovo. The full construction and reparation of the existing sewerage systems is underway: the main collector and connecting the right to the left collector to the site of the future wastewater treatment plant for the town Kriva Palanka.

Project area: In order to provide information and data about the present or planned irrigation and drainage infrastructure in the project area, TEKTON LLC Skopje, part of the team hired to prepare the Infrastructure project for section 3 of the railway, addressed the Ministry of Agriculture, Forestry and Water Economy. The answer from the Ministry (0302/18/14 from 21.06.2017, Appendix 2), stated that this type of information could be received from the JSC Water Economy of Republic of Macedonia. The management of the water economy is authorized for maintenance and operation of the irrigation and drainage systems.

The answer also stated that during the preparation of the project documentation, it should be noted that special care to not disturb the functionality of the existing water economy objects and the irrigation and drainage infrastructure.

In the project area, especially in Kriva Palanka, there exists a constructed water-supply and sewerage network. The layout of the network lines, and the eventual conflicts with the planned railroad line are not officially confirmed by the official authorities from municipality Kriva Palanka.

6.12.2 Waste management

The permanent disposal of the generated waste from municipality Kriva Palanka is done at the controlled landfill Konopica. The dominant type of waste is solid waste, livestock waste, gardening waste and construction debris.

Table 51 Municipal landfill

No.	Municipality	Settlement	Site	Length	Width	Landfill area, m^2	Landfill volume m^3
1	Kriva Palanka	Konopica	Gorna Luka	22.27284	42.18140	6,123	40,000

As part of the Project “Preparation of Regional Waste Management Plans and Strategic Environmental Assessments (SEAs) for East and Northeast Regions” (EuropeAid/130400/D/SER/MK), 2014, field research was undertaken, where in the Municipality, 36 illegal landfills were registered, especially in the rural areas. The distribution of the municipal landfills and the illegal landfills is presented in the following map:

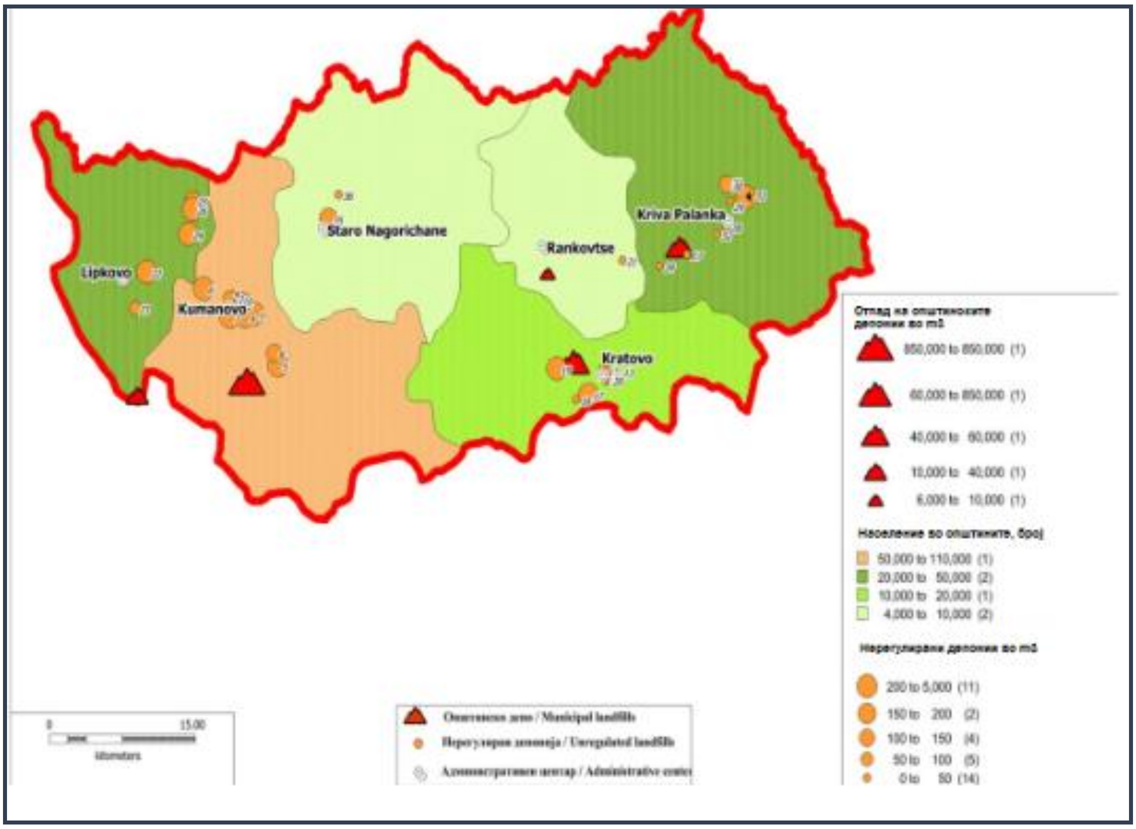


Figure 171 Distribution of the municipal and illegal landfills in the Region

Source: Regional waste management plan for North-East Region, 2014

The following chart shows the characteristics of the main landfill and the illegal landfills in municipality Kriva Palanka (area, volume, etc.)

Table 52 Characteristics of the main landfill and the illegal landfills in municipality Kriva Palanka

Municipality	Settlement	Site	X	y	Surface area, m^2	Height, m	Area volume, m^3
Kriva Palanka 682-4-1	Konopica	Konopica	22.28194	42.17639	50	0.5	25
Kriva Palanka	Kriva Palanka	Lovacki	22.33111	42.19861	8	1.0	8
Kriva Palanka	Lozanovo	Lozanovo 3	22.33583	42.21889	25	1.0	25
Kriva Palanka	Lozanovo	Lozanovo 2	22.3325	42.23194	24	3.0	72
Kriva Palanka	Lozanovo	Lozanovo 1	22.33141	42.23239	60	2.0	120
Kriva Palanka	Kriva Palanka	Konev rid	22.31889	42.1925	10	1.0	10
Kriva Palanka	Kriva Palanka	Pašina Vodenica	22.35528	42.22194	3,000	1.5	4,500
Kriva Palanka	Moždivjnak	Bežanov rid	22.24806	42.16694	40	1.0	40

Source: Regional waste management plan for North-East Region, 2014

Waste collection and transportation

The services for collection, transportation and disposal of waste in the North-East Plan Region are provided by the public communal enterprises (PCE). According to the received questionnaires, the percentage of population receiving regular service in the municipality Kriva Palanka goes to around

80%. Most of the population living in the rural areas does not receive waste collection service. As a result, the number of illegal landfills is increasing, located at the periphery of the settlements.

Table 53 Collection system coverage in the municipality Kriva Palanka

Population (2012)	20,257
Service provider (public/private)	ЈКП
Population receiving waste collection service – coverage (%)	80
Generated waste (t/citizen/annually)	0.250
Share in the regional generated waste	10.3%

Source: Regional waste management plan for North-East Region, 2014

Table 54 Collection system coverage

	KRIVA PALANKA
Collection coverage (%)	78%
Population receiving service	80%
Total population (2012)*	20,257
% Urban population	70%
% Rural population	30%
Urban population	14,180
Rural population	6,077
Total population receiving service	16,206
% Urban population receiving service	70%
% Rural population receiving service	10%
Urban population receiving service	14,180
Rural population receiving service	2,026

Source: Regional waste management plan for North-East Region, 2014

The public communal enterprise “Komunalec” from Kriva Palanka is responsible for waste management and covers 55% of the population in the Municipality. The landfill in Kriva Palanka has been marked high risk to the health of the population.

In the future, the waste management in municipality Kriva Palanka will be in concordance to the Regional waste management plan for North-east region. The present landfill will be closed and recultivated.

The construction debris in municipality Kriva Palanka will be disposed at a location named “Pašina Vodenica”, at 2km distance from the Town. In accordance to the Plan, it is planned greater quantities of construction debris to be generated in the Municipality, a result of the highway construction, the railroad line and other infrastructural projects. To that end, municipality Kriva Palanka plans to undertake activities to determine and establish a new landfill for construction debris.

6.12.3 Electric supply

- **Electric power distribution**

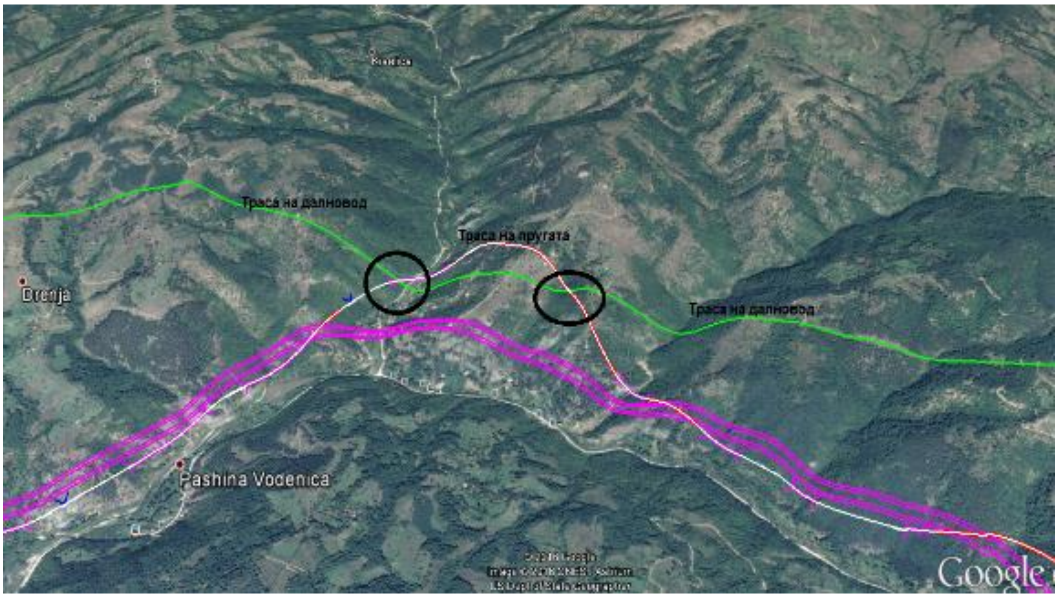
The whole Region is covered by an electric supply distributive network. Municipality Kriva Palanka does not possess its own energy sources.

Through the local electric power distribution system, a high-quality, stable supply of electric energy is provided, in the domain of primary electric energy supply. All inhabited settlements in the Municipality have been electrified, with the exception of a several individual objects in the scattered type settlements, where the low-voltage network is with an inappropriate degree of completion, especially from the electric energy delivered aspect.

The electric energy supply on the territory of municipality Kriva Palanka is done through the branch of 110kV transmission line Kumanovo-Probištip and by international trade through the 110 kV transmission line Kumanovo-Probištip and by international trade through a 110 kV line to the Republic of Bulgaria. This voltage is transformed to 35 and 10 kV at the main power substation (110/35/10) kV, located in the industrial part at the Town entrance, and the power substation in village Ginovce. The transformed voltage is distributed through cable transmission line to the power substations 10/0,4 kV, where the voltage is transformed to 0,4 and as such, through low-voltage conductors is distributed to the end consumers. The total length of the surface 10 kV and 0,4 kV network is 1.000 km, and the underground network has around 40 km length. The main power substation has an installed power of 2x20 MVA. There are a total of 150 power substation in the territory of municipality Kriva Palanka, 130 of which are the property of EVN-Macedonia, which also manages the distribution network. The regional electro-distribution center is located at the KEC (customer-energy center) – Kratovo.

Project area: In the project area, the 110 kV transmission line runs in the railroad line proximity, as well as the local electro-distribution system for electrical energy.

On the basis of the available documentation, it was established that the railroad line intersects the transmission line at the locations shown in the following pictures.



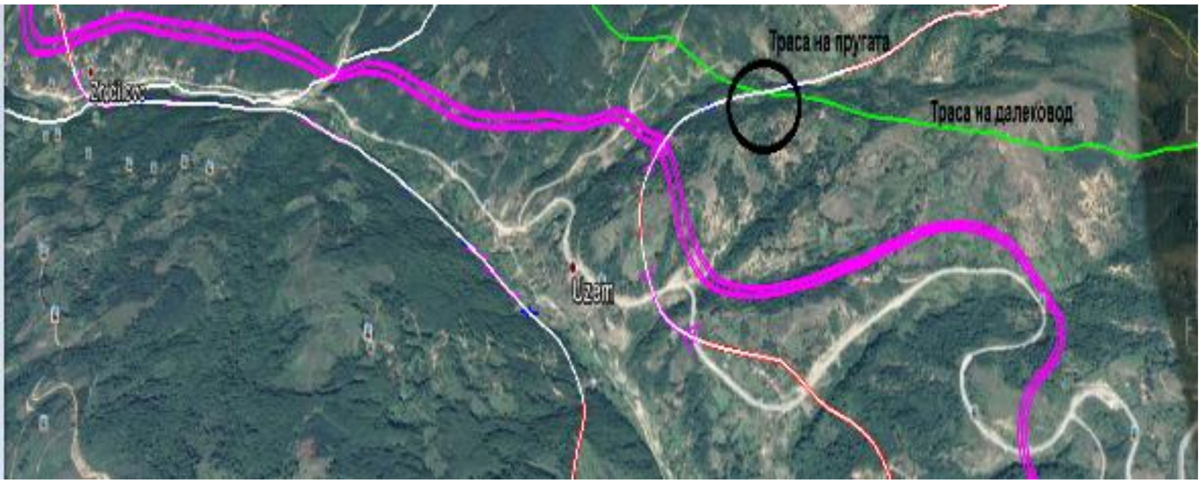


Figure 172 The intersection between the railorad and the present 110 kV transmission line

A more detailed information about the intersection of the line with the transmission line and the local electro-distribution network, as well as about the present and planned objects and infrastructure, should be acquired from MEPSO and EVN, which are authorized for electric energy distribution through a high-voltage network and distribution, and supply of electric energy.

In order to acquire information about the presence of existing or planned installation conductors and objects in the project area owned by ELEM, JSC Macedonian power plants, an opinion was requested by TEKTON LLC Skopje. In the delivered memo by ELEM (08-3753/1 from 22.06.2017, Annex 2), it was noted that in the project extent JSC ELEM has no existing or planned installations and objects, i.e. does not possess any data and information about the project area.

- **Gas supply network**

The current gas network is part of the Russian transit pipeline moving through Ukraine, Romania and Bulgaria and was built to satisfy the needs of Turkey, Greece and Macedonia. The gas pipeline moves through the municipalities Kriva Palanka, Kratovo, Kumanovo and Skopje, but only 15% of the total system capacity is used, which is significantly low considering the potential the gas offers as a heating energy source and for electric energy production.

In the future, expansion of the gas distribution pipeline network throughout the whole territory of the Republic of Macedonia is planned. The following picture shows the planned pipelines for distribution of natural gas in the country.

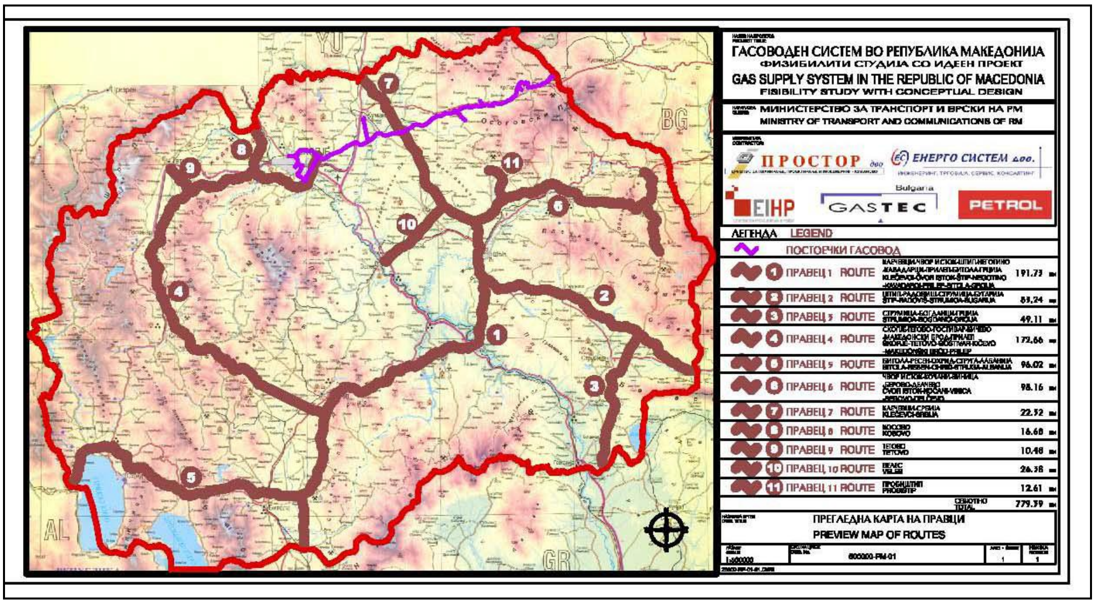


Figure 173 Planned pipelines for natural gas distribution in the country

Project area: From the delivered technical documentation about the construction of the railroad line from Section 3, we could observe that the planned line intersects the gas pipeline network of Kriva Palanka in several places, at the following chainages: km 70+80.28, km 71+ 519.13, km 74+860.00, km 81+613.9. The following picture shows the locations where the railroad line intersects the gas pipeline.

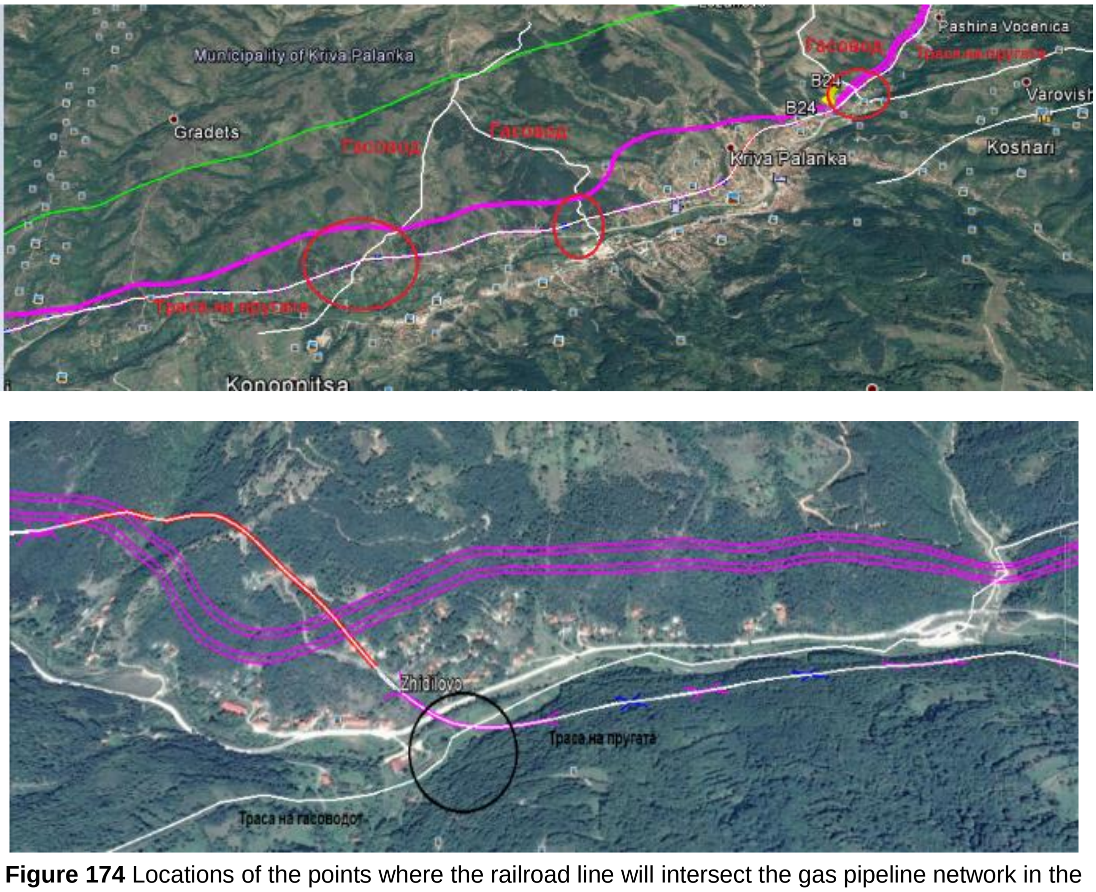


Figure 174 Locations of the points where the railroad line will intersect the gas pipeline network in the municipality Kriva Palanka

In order to acquire information about the existing and planned infrastructural conductors and objects in the project area, TEKTON LLC Skopje, requested an opinion from MER, JSC Skopje (Joint stock Company for performing energy activities MACEDONIAN ENERGY RESOURCES Skopje in state ownership). In the received memo from EMER, JSC Skopje (03-1367/2 from 29.06.2017**,** Annex 2**)** it was stated that in the mentioned project area there is no pipeline constructed and there is no construction plan for a gas pipeline.

In order to acquire information about the underground installations in the project area, an opinion was requested from GA-MA, AD, Skopje. In the received memo from GA-MA (0308-819/2 from 13.07.2017, Annex 2) it is stated that in the project area, there are four intersections of the newly projected line and the constructed gas pipelines whereby 3 are with the main gas pipeline Ø 530 mm and 1 with the town gas supply network for Kriva Palanka Ø 108 mm. In the memo, it is stated that for two intersections with the main gas pipeline network and one with the town's gas pipeline network, protective buildings were constructed in 1996, according to the first variant of the railroad line. With the new railroad line, the constructed protective buildings are avoided. Furthermore, in the memo there are suggestions for further designing, reviewing of the possibility for dislocation of the railroad line, in order to use the constructed protective buildings of the pipeline, according to the first variant of the railroad line, as well as obligations which the design engineers and the future contractor should undertake during the railroad design and construction.

6.12.4 Telecommunications network

A telephone network is established in all inhabited places in municipality Kriva Palanka, and the area is covered by an internet network as well.

Project area: Within the project area, being a part of a settlement, there is a possibility of a telecommunication installations presence.

In order to acquire information about existing and planned installation in the project area, a request was sent to TELEKS, LLC Skopje, and in it (0302-428-17 from 23.06.2017), the aforementioned note that in the project area an underground cable infrastructure exists and the it was delivered in an electronic form to the information requesting party.

Also, in the memo by Macedonian Telekom JSC Skopje (07-208675/2 from 13.07.2017, Annex 2) it is stated that in the project area there is an existing telecommunication infrastructure. In the memo, further suggestions and directions which need to be taken into consideration in future design have been given, i.e. to consider the corridor for the cable communications network.

In the memo from the Ministry of Internal Affairs (41964/2 from 07.07.2017, Annex 2) it is stated that the Ministry has no data about the existence of their installations. If, during construction, some telecommunications installations appear, it is obligatory required to inform the Ministry.

In the memo from AEC (1404-1908/2 from 04.07.2019, Annex 2), on the basis of previously required information about telecommunications network, it is stated that the data available to the Agency for Electronic Communications has been delivered in an electronic form to the data requesting party.

6.12.5 Road network

A significant road way connecting the southern part of the Balkan Peninsula to Asia Minor, today marked as corridor E-8, has for centuries passed through the municipality Kriva Palanka.

Kriva Palanka is connected in southwest through a modern road to Kumanovo (64 km) and to the capital of the Republic of Macedonia, Skopje (99 km). In the south through the direction Čatal, it is connected to Kratovo (45 km), and towards northeast through Deve Bair to Kjustendil (37 km) in the Republic of Bulgaria.

Municipality Kriva Palaka is connected to its neighboring municipalities via the following road ways:

- Kumanovo – Stracin – Kriva Palanka - KKP Deve Bair: motorway A2 (M2) and E871 on the territory of R. of Bulgaria (towards east);
- Kriva Palanka – Ketenovo - Kratovo: A2 (M2) and motorway 206 (towards south);
- Kriva Palanka – Ketenovo – Kratovo – Krupište – Kamenica: A2 (M2), motorway 206 and A5 (M5) (towards south-east).

The road network distances between Kriva Palanka and the most significant administrative centers and settlements in the North-East region are the following:

- Kriva Palanka - Kumanovo 60 km along the A2 (M2);
- Kriva Palanka - Skopje 101 km along the A2 (M2), A1 (M1- E75) and A3 (M3);
- Kriva Palanka - Rankovce 21 km along the A2 (M2);
- Kriva Palanka - Tabanovce 70 km along the A2 (M2) and A1 (M1- E75);
- Kriva Palanka - Kratovo 42.5 km along the A2 (M2) and motorway 206.

These motorways are in a relatively good condition and they enable comfortable and quick connection between the settlements with a speed of 75-80 km/h. On the other hand, the Town's connection to the other municipalities in the region and the surrounding villages via the local road network is of poor quality. The present size of the roads, their horizontal and vertical profiles enable low level of comfort during transport, as well as slow speed at 30-25 km/h, which prolongs travel time.

Table 55 Road types in the municipality Kriva Palanka

	2009	2010	2011	2012	2013	2014	2015
Municipality of Kriva Palanka							
Total	170	170	195	170	170	174	174
Asphalt and cobblestone	80	83	80	90	95	99	100
Macadam	-	-	21	1	1	1	1
Earthen	82	79	86	71	66	69	68
Uncut	8	8	8	8	8	5	5

In order to improve the road network in municipality Kriva Palanka, an express road at the section Kriva Palanka-Rankovce is planned, 25 km long, as well as rehabilitation of the present motorway Kriva Palanka-Deve Bair.

Project area**:** From the available technical documentation, it could be concluded that the railroad line moves parallel to the planned express way Rankovce-Kriva Palanka line, which is part of the planned Corridor VIII highway, and they do not intersect.

The railroad line intersects with the existing road leading from Kriva Palanka-Deve Bair at several points, as well as some local earthen roads. To cross these roads, the project documentation plans to use bridges and tunnels.

The following picture shows the locations where the railroad line will intersect the existing road Kriva Palanka-Deve Bair at Židilovo (bridge will be built) and the place Uzem (bridge and tunnel).

Figure 175 Railroad line intersection at Zhdilovo with the existing road Kriva Palanka-Deve Bair

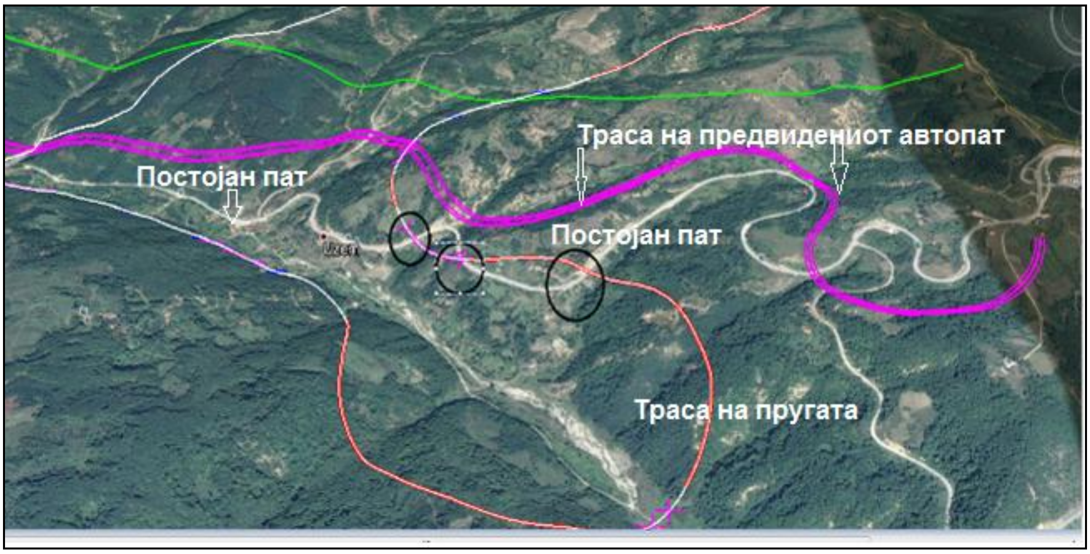


Figure 176 Intersection of the railroad line at Uzem with the existing road Kriva Palanka-Deve Bair

The intersection of the railroad line with the planned highway line (if the highway is constructed in the future) will be done at the following chainages:

- On the left of the highway: km 75+965.13 – on the right of the highway: km 76+009.05
- On the left of the highway: km 77+926.8 - on the right of the highway: km 77+992.70
- On the left of the highway: km 78+987.11 - on the right of the highway: km 78+925.34
- On the left of the highway: km 79+625.66 - on the right of the highway: km 79+652.21
- On the left of the highway: km 86+373.63 - on the right of the highway: km 86+345.87

The following pictures show the locations where the railroad line intersects the Corridor VIII highway line.

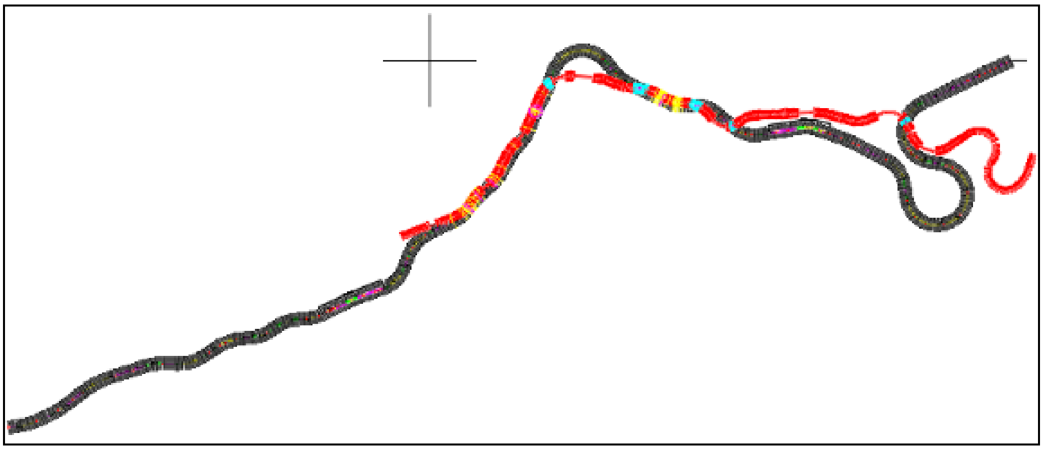


Figure 177 Intersection of the railroad line and the future Corridor VIII highway line

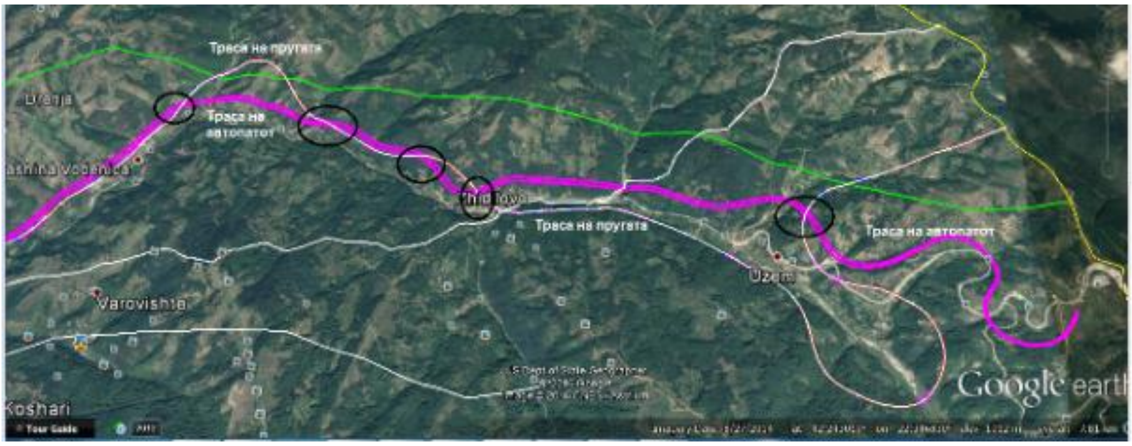


Figure 178 Intersection of the railroad line and the future Corridor VIII highway line

In the memo delivered to the Public Enterprise for State Roads (10-6698/4 from 14.07.2017,Annex 2), sent on the basis of requesting information about existing and planned infrastructural lines and buildings, it is stated that alongside the subject area moves the planned highway A2-corridor 8, section Romanovce-BC Deve Bair and that line should be taken into consideration. Part of the subject area moves along the national road A2 (previous designation M-2) which in the plans of PESR is supposed to be expanded with another lane and that should be taken into consideration when designing the infrastructure project. Also, the railroad line Kriva Palanka-border of R. of Bulgaria in several places intersects the national road A2 (M4) and in one place it intersects with the regional road P2250 (P-207). The memo suggests to take into consideration the standards and legislation for intersection between a national road and a railroad line.

6.13 Social aspects baseline

6.13.1 Short introduction about the project area

The understanding of the project area is on two levels. The first level is determined according to the socio-economic and political organization of the territory and the authorization transferred to certain administrative bodies, responsible for the organization of life and resources at the marked territory. In this particular case, that is the municipality Kriva Palanka. The second level refers to the more direct understanding of the involved territory, such as the involved settlements in their administrative borders and especially the involved real-estate along the railroad line wtih the accompanying objects.

The first approach, a macro approach, regarding the Municipality as a whole, helps understand the life of the population in the Municipality, because the greatest part of the resources used for the project are within the Municipality's frame, not just from some involved settlements.

The second approach, a micro approach, aims to reflect the correct impression of the directly affected citizens of the settlements, and especially their affected real-estate along the railroad line and the accompanying objects. The necessity to work on two different levels when observing the project area stems from the aim not to minimize and marginalize the importance of the social influences which will arise from the project implementation, especially the consequences which directly concern the settlements and citizens/owners/individuals losing properties and homes.

6.13.2 General characteristics about the municipality Kriva Palanka

The municipality Kriva Palanka is located in the eastern part of the North-East Plan Region. The second by size urban and economic center in this part of the region is located there, with 34 inhabited places (B's, Baštevo, Borovo, Varovište, Gabar, Golema Crcorija, Gradec, Dlabočica, Dobrovnica, Drenak, Drenje, Duračka Reka, Židilovo, Kiselica, Konopica, Kostur, Košari, Kriva Palanka, Krklja, Krstov Dol, Lozanovo, Luke, Mala Crcorija, Martinica, Meteževo), of which only the town of Kriva Palanka is an urban settlement.

The municipality borders the Republic of Bulgaria at its eastern border, whereas the western border is shared with the municipality Rankovce. The international road connecting Republic of Macedonia to the Republic of Bulgaria runs through the Municipality.

Municipality Kriva Palanka covers a relatively big area of 481 km^2, which is predominantly hill-mountain terrain.

The project area, narrowly speaking, includes four rural settlements (T'lminici, Židilovo, Krklja and Uzem) and one urban settlement (Kriva Palanka). The railroad, the ancillary objects and the infrastructure are positioned in parallel to Kriva Reka, with a geographical and visual orientation towards east.

The most affected settlement is the town Kriva Palanka because the railroad moves through a highly inhabited part (albeit through a tunnel) and where activities of real-estate acquisition will be undertaken, located over the railroad line. The four other rural areas will be affected less. The rest of the inhabited settlements in the Municipality will feel certain effects, mostly peripheral but still relevant.

The following map shows the position of the directly affected ones and the rest of the settlements which belong within the Municipality borders.

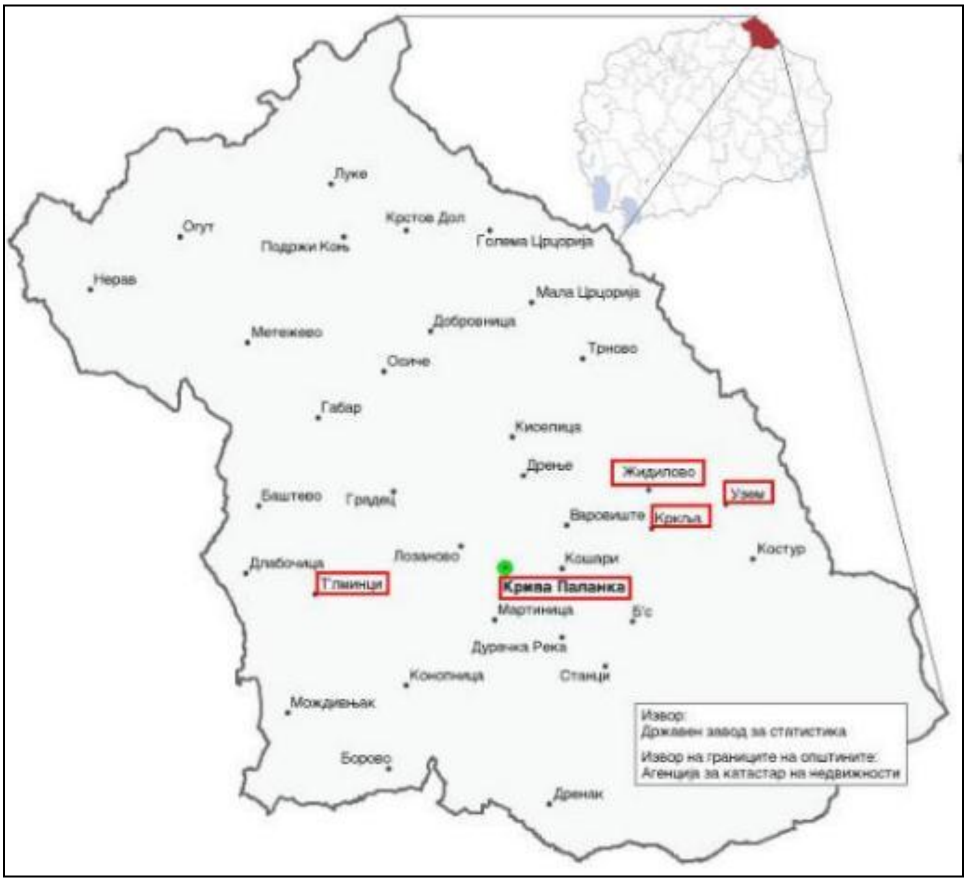


Figure 179 Map of the municipality Kriva Palanka

6.13.3 Demography

The demographic profile of municipality Kriva Palanka has not been drastically changed since the last census in 2002, although a new census is needed for a real representation of the conditions and requirements. Municipality Kriva Palanka faces certain changes in population numbers, which is happening in almost all parts of the Republic of Macedonia. In a 15 year period, municipality Kriva Palanka has lost 3.7% of the population, whereas at a national level the population has increased by 2.3%. The following chart gives an overview of the demographic image of the Municipality for the period since the last census of people and households in 2002.

Table 56 Demographic image of municipality Kriva Palanka

	Assessment (31.12.2015)	Population (2002)	Appartments (2002)	Households (2002)	km^2	Population density (2015)	Population density (2002)	Population growth
Republic of Macedonia	2071278	2022547	698143	564296	25713	81	79	48731
Municipality Kriva Palanka	20043	20820	9448	6600	480,81	42	43	- 777

(Source: the SSO webpage[23])

[23] The data presented for 2002 was taken from the 2002 Census, whereas the 2015 data is official predictions by the State Statistical Office and are available on their webpage.

From the chart data, we can conclude that the total population in municipality Kriva Palanka, has decreased by 777 people in a 13 year period, or 3.7% of the total population. In 2002, the population of Kriva Palanka was 1.03% of the total population of the Republic of Macedonia, whereas from 2015 that percentage is 0,97%. This drastic decline in population is the result of the general socio-economic factors and trends in the country, especially the village-city migration, predominantly to Skopje.

In the course of the past 7 decades, small variations in the project area population numbers have been noticed. The following diagram shows the population movement by census year in three different categories of affected territories: affected rural areas, the town Kriva Palanka and the municipality as a whole.

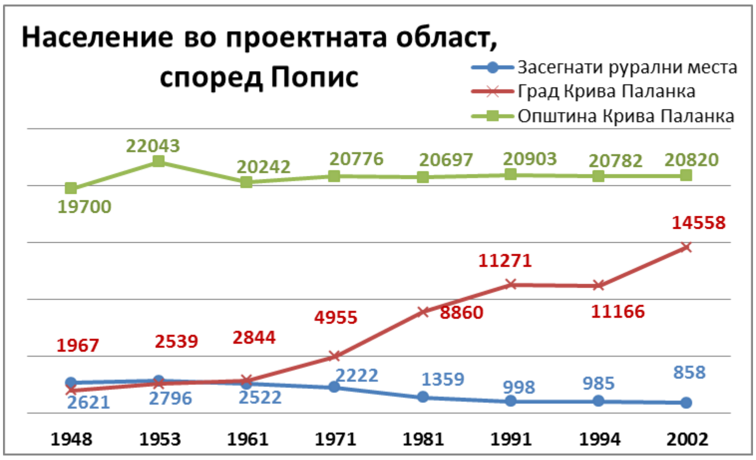


Figure 180 Overview of the population condition in the project area, according to census years

(Source: the SSO webpage)

The last registered population condition, by gender and with a 5 year interval, is represented in the picture below. Women make up 48.3% of the Municipality's population. Men dominate in all series up to 60 years, where the difference is 3.4% of the total population. That means there is a significant number of unmarried and/or divorced/widowed.

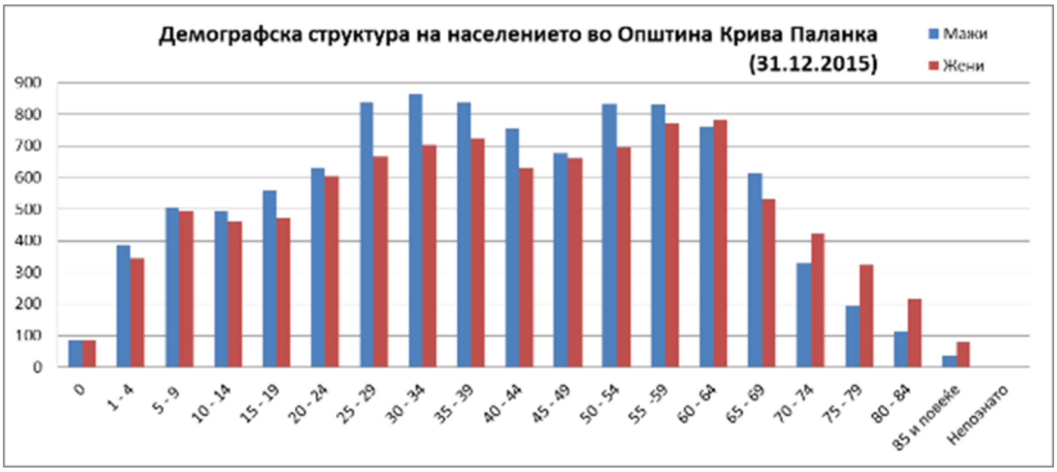


Figure 181 Overview of the population condition in the project area, according to census years

(Source: the SSO webpage, report 2.4.16.10 – Population evaluation, 2016)

The migration rate in municipality Kriva Palanka is higher compared to other municipalities in the Republic of Macedonia. Although at first glance the migration, expressed in relative numbers, seems low, however it is high at a national level. Namely, from 2015 onward, 1.6% of the total number of people in Macedonia who have migrated from one to another municipality have done so in municipality Kriva Palanka, which indicates that there is a high degree of internal migration, local village-city migration. Also, the migration balance is 50 people in Municipality for 2015, whereas the total migration balance for the period 2009=2015 is 163 people, i.e. 163 have completely left municipality Kriva Palanka. That is almost 5% of the net migration in the Republic of Macedonia for that same period. We need to mention that the migration in Kriva Palanka is happening only towards the Skopje region (city of Skopje, municipality Ilinden 5 residents) or towards another town in Macedonia, and a few abroad because for that same period only 20 residents of Kriva Palanka have completely left Republic of Macedonia. The following chart shows the migration in the Municipality in numbers.

Table 57 Migrations in the municipality Kriva Palanka, 2009-2015

	KRIVA PALANKA	2009	2010	2011	2012	2013	2014	2015	Вкупно
A	**Total Immigrated**	102	56	51	99	41	33	71	**349**
B	**Immigrated from another municipality**	23	23	26	77	33	26	36	**182**
C	**Immigrated from another place in the same municipality**	67	32	20	22	0	1	28	**141**
D	**Immigrated citizens in the Republic of Macedonia from other countries**	12	1	5	0	8	6	7	**26**
E	**Total emigrated**	131	93	116	99	73	85	121	**512**
F	**Emigrated to another municipality**	64	60	77	77	73	84	93	**351**
G	**Emigrated to another place in the same municipality**	67	32	20	22	0	1	28	**141**
H	**Emigrated citizens from the Republic of Macedonia to other countries**	0	1	19	0	0	0	0	**20**
-	**Net migration (C-G)**	**-29**	**-37**	**-65**	**0**	**-32**	**-52**	**-50**	**-163**

(Source: the SSO webpage, report 2.4.16.17 – Migrations, 2015)

The largest share of the people migrating from the Municipality in 2015 are people aged 30-64 (41 person), followed by youth aged 15-29 (11 people.) Only one person from the youngest group, up to 14 years of age, has left the Municipality, as well as 4 people aged above 65 years. Marriage (19) is the most common reason for leaving the Municipality, followed by family reasons (12 people).

By gender, 33 people versus 24 have permanently left the Municipality, whereas by education, 27 university educated people, as well as 2 postgraduates have permanently left the Municipality. By ethnicity, 55 of the 57 people who have permanently left the Municipality are of Macedonian ethnicity, and 2 are of Roma ethnicity.

The ethnic content of the affected population is relatively homogenous, where in 2002, 96.1% have declared as Macedonians, and 3.2% as Roma. Serbians share 0.5% (103 people) of the total, whereas 44 people have declared themselves as others (0.25%). Only 2 people have declared as Turks and Bosniaks each, and 3 as Aromanians. All who have declared as Roma and Turks live in the Town, as well as 85% of those declared as Serbians and 39 of those declared as others.

In the directly affected villages, during the 2002 census, all people have declared as Macedonians.

6.13.4 Economy, employment and professions

6.13.4.1 Income providing strategies

Macedonian citizens, generally, provide their income by:

- Engaging their personal effort and skills (salary and other income),
- Income from property and property rights (renting real-estate and other means),

- Income realized as individual farmers and independent service providers,
- Transferable incomes (retirement, social transfers, transfers to unemployed and current private transfers from abroad)
- Capital gains (income from securities sale, capital participation and real-estate)
- Dividend and interest inflow (inflow of investments or capital inflows).

The people from the project area combine different methods of attaining income in the household. Only a small part of the income is not legally obtained (has not been taxed).

The most common income source in the project area is personal effort and skills (salary and other income), although others sources are present as well. The increased cost of living demands a need of extra income which is difficult to register but it is noticeable in the consumption of goods, increase in personal savings and creation of physical goods, mostly real-estate.

Local residents from the project area combine the incomes for performed services (or payment for services rendered) with agricultural activity, mostly farming and fruit-farming, although farming of animals is also present, especially in the rural hill settlements.

Part of the available workforce works seasonally (paid on a weakly and rarely on a monthly basis) as construction workers during construction of individual houses and other projects connected to construction in Macedonia, especially in Skopje, the Eastern and Northeastern Plan Region. Their activity is not considered employment because some of them do not work as registered workers.

The residents of the rural areas combine agricultural with salary income, if they are at all able to be employed with a salary. Renting real-estate or property, for example, fertile farmland, unregistered garage businesses and workshops, illegal logging, selling meat, cross-border trade etc. are some of the means of additional income in the project area. Some people gather plants for the pharmaceutical industry and for culinary needs (rare herbs, plants, and fungi etc., found in less visited places, which are plentiful in the municipality).

6.13.4.2 Employment

Employment (unemployment) is one of the more complex conditions in Macedonian society, because a relatively high level of unemployment is present in the country, however, there is no civil unrest or social dissatisfaction.

The Employment Service Agency of Republic of Macedonia, the regional office at Kriva Palanka, gathers statistical data about the two municipalities, Rankovce and Kriva Palanka. The following chart shows a positive trend in the decrease of unemployment in both municipalities in the last 8 years period. In 2016 from 3067 unemployed people, 1600 are women (52.2%), most of whom are aged 50-54 (229), followed by 55-59 (203), 45-49 (202 unemployed) etc. The number of unemployed women by age decreases parallel to age.

The following chart shows the unemployment data about the project area.

Table 58 Unemployment data for the municipality Kriva Palanka

Unemployment (31 december)	Macedonia			ESARM-Kriva Palanka		
	Total	**Village**	**Share**	**Total**	**Village**	**Share**
2016	104.523	34.335	**32,85%**	3.067	1.097	35,77%
2015	114.979	35.928	**31,25%**	3.424	1.191	34,78%
2014	123.661	37.436	**30,27%**	3.702	1.291	34,87%
2013	96.200	26.089	**27,12%**	3.728	1.032	27,68%
2012	243.403	79.394	**32,62%**	5.361	1.892	35,29%
2011	281.144	92.686	**32,97%**	5.515	1.973	35,78%

2010	321.341	109.179	**33,98%**	6.088	2.201	36,15%
2009	341.295	116.889	**34,25%**	6.375	2.511	39,39%

(Source: the Employment Service Agency of the Republic of Macedonia website)

6.13.4.3 Industrial and business entities

The geographical position of the Municipality determines the dominant manner by which the population will attain income. Because the municipality Kriva Palanka stretches over mountainous terrain and is located in the immediate vicinity of a border crossing through which passes a considerable traffic connection, the dominant activity of the households in providing means of life are the service activities, followed to a lesser degree by agriculture/farming of animals and very little industrial production.

The main income source for the people living in the Town comes from services and production, whereas those living in the rural areas mainly lean on agriculture, farming of animals, fruit-farming, apiculture, gathering herbs and forest fruits, and some from salary, pensions and other social transfers.

The “Toranica” mine operates within the Municipality, also there are small production capacities for production of plastic, textile, ready-made clothing, shoes, carpets and rugs, wood mass and furniture, pastry products, metal constructions, etc. Trade is the most developed economy branch in Kriva Palanka, due to the proximity of the Bulgarian border. This is especially true about used vehicles import. Also, in the immediate vicinity of the Town, several sawmills are operational, logging for fire-wood and furniture wood. There are two fish-ponds for fish farming.

In the last 3 years, there exists a tendency for increase in entrepreneurship, especially in the construction sector, the transportation sector, the storage sector and retail trade for motor vehicles/motorbikes repair.

The real condition of the economy in the municipality Kriva Palanka is shown in the following chart, where we can see the numerical condition of the enterprises according to their main activity.

Table 59 Active business entities by activity sectors in the municipality Kriva Palanka

Municipality of Kriva Palanka, at 31 december	2013	2014	2015
Total	**489**	**509**	**535**
Agriculture, forestry and fish-farming	20	17	17
Mining and rock extraction	1	1	1
Processing industry	59	61	60
Supply of electric energy, gas, steam and acclimatization	0	0	0
Supply of water, waste removal, waste management and environment renovation activities	2	2	2
Construction	13	25	26
Wholesale and retail trade motor vehicles and motorbike repair	208	207	217
Transportation and storage	28	39	44
Accommodation objects and service activities with food	51	48	48
Information and communication	5	2	3
Financial activities and insurance activities	1	1	1
Real-estate activities	1	1	2
Expert, scientific and technical activities	27	28	32
Administrative and ancillary services and activities	1	1	3

Public authorities and defense, mandatory social insurance	3	3	3
Education	11	10	12
Activities of health and social protection	25	24	24
Art, fun and recreation	4	6	5
Other service activities	29	33	35
Activities of households as employers, activities of households producing different goods and performing different services for personal needs	0	0	0
Activities of extraterritorial organizations and bodies	0	0	0

(Source: the State Statistical Office website)

The unsuccessful industrial development in the municipality Kriva Palanka in turn creates a solid number of micro companies which will enable the local population to have some kind of income, mostly from service activities. In the municipality Kriva Palanka the average number of residents per company is 37.5, whereas at a national level the number of individuals from one company is 29.5. These numbers actually express the level of entrepreneurship presence in the affected community, i.e. the readiness to take a risk. A higher average number means a greater dependence of the population from incomes such as salary/pension and that means a greater risk of social vulnerability if they are exposed to temporary or permanent loss of income.

The following chart represents the condition of the type of enterprises in regards to employee numbers.

Table 60 Active business entities by size

31 December	Total	Micro	Small	Medium	Large
Municipality of Kriva Palanka					
2015	535	409	123	3	0
2014	509	400	105	4	0
2013	489	384	102	3	0
2012	489	388	100	1	0
2011	471	312	159	0	0

(Source: the State Statistical Office website)

6.13.4.4 Agriculture

In the project area, agriculture is present as an activity, although at the moment it is far from the proper usage capacity. Large areas of untilled and abandoned land exist, because many of the owners have moved to Skopje, Kumanovo and Kriva Palanka, and those who have not moved, simply do not think that the agricultural activities should be a priority when providing means of life. In municipality Kriva Palanka, mostly potatoes are grown, and to a smaller degree maize, wheat, barley, rye, oat etc.

Around 32% of the population in municipality Kriva Palanka in 2007 conducted agricultural activities. Most of them (52%) worked on growing crops, whereas additional 42% alongside the crops and plantation, keep domesticated animals. Only 4% of the active household members that conduct agricultural activities only farm domesticated animals.

The following chart presents an overview of the human resources used in agricultural activities.

Table 61 Household members who work at individual agricultural holdings

Household members that work on individual agricultural economies	Kriva Palanka
Growing of crops	2.737

Farming of animals	252
Growing of crops combined with farming of animals	3.386
Agricultural service activities	101
Hunting and game propagation	4
Forestry and logging	21
Fishing and fish farming	4
Total number	**6.505**

(Source: State Statistical Office - Census of Agriculture, 2007)

The following graph illustrates the activities and professions of the individual agricultural households, during the 2007 census. From the total 2865 registered agricultural households in 2007 in municipality Kriva Palanka, 2607 (91%) grew vegetables, 1629 (57%) had an orchard too, 790 holdings (27.6%) of the total number grew cereals, whereas the fodder crops were present with 11.8% of the agricultural holdings. Vineyards (0.7%), as well as industrial plants (0.4%) were marginally present due to the terrain configuration.

According to the number of domestic animal units in the agricultural holdings, poultry is present most with 18000 units, i.e. on average 13 units per one agricultural holding. However, although only 117 holdings farm sheep, the total number of sheep was 5009, which is on average 42.8 sheep per one agricultural holding. Only 153 holdings farmed 2405 beehives, which is on average 15.7 beehives per one holding. Just below 35% of the registered agricultural holdings in municipality Kriva Palanka farm 4519 units of goats. Although the household average is a small 4.5 units, the total number of goats in the municipality Kriva Palanka is 3.4% of the total in the Republic of Macedonia.

Figure 182 Number of individual agricultural holdings by utilised agricultural land

(Source: State Statistical Office - Census of Agriculture, 2007)

Irrigation as an agricultural activity in order to improve production is quite prominent. In municipality Kriva Palanka, 82% of the total number of agricultural holdings irrigate 358 ha land, where vegetables dominate with 68.8%, followed by cereals (14.5%) and orchards (10.3%).

Also in municipality Kriva Palanka, during the census 6 households were registered as having fish ponds with 0.08 ha total area (0.07 trout and 0.01 carp).

6.13.5 Housing, communications and utilities

6.13.5.1 Wider project area (municipality Kriva Palanka)

Municipality Kriva Palanka consists of 34 settlements, one of which is an urban settlement (the town Kriva Palanka). Because the population density is quite low, 42 people/km2 (2015), most residents live in individual houses, although there are collective residential buildings in the town. A typical household consists of spouses with their children, although it is not rare the parents of one spouse to live in the same household or under the same roof. All villages are connected to the electrical energy network and have personal water supply.

Public utilities have been formed in the municipality to take care of the utilities.

The public communal enterprise “Komunalec” realizes the following activities: production and distribution of clean drinking water, wastewaters drainage, solid waste collection, transport and disposal, public market maintenance and funeral services. The Municipal public enterprise “Kalin Kamen” handles construction and maintenance of local roads, parking lots, flood management, street light maintenance and preparing technical documentation.

Telephone network is established in all settlements in the Municipality.

Most settlements within the Municipality are connected by asphalt roads, and due to the scattered type of the villages, some only have access roads and are connected internally only by dirt roads. In essence, a satisfactory road network exists between the villages.

Local passenger transportation in the Municipality is organized by several regular bus lines which lead only to settlements near the main road. The bus station in Kriva Palanka is located in the town’s center. No local bus transportation exists in the Town, and taxi companies or private vehicles are used to transport passengers.

In the Municipality, there is a police station and a fire brigade, as well as a main post office and office in the settlement Moždivnjak. The border crossing Deve Bair is located inside the municipality area, which is the most frequent traffic connection to the Republic of Bulgaria.

The political condition of the Municipality is stable. In the last 8 year period, no conflict with the central authority has been noted, because the Mayor of the Municipality belongs to the majority political option of the Assembly. No other type of open conflict exists in the Municipality.

6.13.6 Health and social welfare

6.13.6.1 Health care

The healthcare system consists of three segments: primary, secondary and tertiary healthcare. The primary healthcare in Macedonia is based on a network of private and public health facilities: clinics and health centers. The system of primary protection includes preventative, promotional and curative services through different profiles of health workers and affiliate professionals: doctors, general medicine specialist, dentists, pediatricians, school medicine specialists, gynecologists and labor medicine specialists. The secondary health care is practiced throughout a system of specialist advice services, general and special hospitals and institutes. The tertiary health care is practiced in clinical hospitals and the University clinical center in Skopje. These two levels are responsible for providing preventative, curative and rehabilitative health services through different specialists and subspecialists. Macedonia has a working health care system, geographic and financial approach, disease control and almost full coverage of the population with vaccination.

The health care system is mostly financed through a mandatory healthcare insurance, which gives an option for all citizens to be healthcare insured. The mandatory healthcare insurance is financed by salary allocated amounts, intended for healthcare insurance. Furthermore, Macedonia’s state budget of delivers funds for covering the health insurance expenses for citizens who do not fall under health insurance by any basis, including groups such as: underage children under 18 years of age (26 if they are students), pregnant women, nursing mothers, people above 65 years etc.

The public health is constantly monitored by the Institute of Public Health, and the latest data and healthcare analyses are included in the Health report for the population of Republic of Macedonia 2013.

In Republic of Macedonia in 2012, in accordance to the established ambulant-polyclinic morbidity groups, in first place are the respiratory diseases (24.8%), then diseases of the circulatory system (14.5%), genitourinary system diseases (8.5%) and digestive system diseases (6%). Compared to 2011, in some groups the morbidity rate has increased, especially in the infective and parasitic diseases, genitourinary diseases, conditions of the perinatal period, injuries, poisoning, and certain consequences caused by external reasons (IPH, Health report for the population of Republic of Macedonia 2013)

The healthcare home Kriva Palanka is present in Kriva Palanka, operating over the territory of the municipalities Kriva Palanka and Rankovce. In the municipality, there are thirteen general private clinics, and two private clinics for women.

Table 62 Healthcare sector coverage in the healthcare region Kriva Palanka (2012)

2012	Kriva Palanka	PM
NUMBER OF PHYSICIANS BY HEALTH REGIONS IN MKD		
Number of inhabitants per 1 physician	619,1	358,1
Total number of physicians	**39**	**5755**
General medicine	16	1875
General medicine (% of total number of physicians)	41	32,6%
On specialization	4	326
On specialization (%of total number of physicians)	10,3	5,7%
Specialists	19	3554
Specialists (%of total number of physicians)	48,7	61,8%
Number of dentists	**12**	**1652**
Number of inhabitants per 1 dentist	2011,9	1247,6
Number of pharmacists	**5**	**888**
Number of inhabitants per 1 Pharmacists	4828,6	2321
HEALTH PERSONNEL IN RURAL MEDICAL UNITS BY HEALTH REGIONS IN MKD		
Physician constant	2	225
Physician temporary	0	7
Health personnel with higher and mid-level qualification	2	334
Unit locations	2	262

(Source: Health map of the Republic of Macedonia, 2012)

According to the health map of Republic of Macedonia, the most frequent cause of death of all death cases in the health region Kriva Palanka in 2012 were the respiratory system diseases with 67%.

Recently, organized and realized by municipality Kriva Palanka, health visits are carried out to elder members of the Municipality who live in the rural inhabited areas, and are themselves unable to visit the health facilities, where a team of experts measures their blood pressure, and have health conversations with the people.

6.13.6.2 Social welfare and vulnerable groups

The social welfare system is of crucial value and importance in providing social security and welfare of the citizens of every country taking care of its population.

After its independence, Republic of Macedonia inherited a social system based on high centralization, largely realized through financial transfers and benefits for the citizens exposed to social risk. The social services, as a non-financial measures aimed towards improving the social function of certain individuals and groups exposed to social risk, were insufficiently developed and brought down to an institutional form of protection. In that period, the main role of the state was to act as a protection provider, and the participation of the non-governmental, private and religious sectors in social protection activities was quite insignificant.

Today, an increased accent in the social protection area has been placed upon the development of alternative protection forms to decrease the once dominant dependence on institutional protection, and also continuing with the process of deinstitutionalization.

The intermunicipal center for social works, located in Kriva Palanka, is responsible for the municipalities Kriva Palanka and Rankovce, and also about registration, delivering financial aid in different social areas; assistance and care allowance; child protection; parental allowance, special allowance, permanent financial assistance and social-cash benefits. The following chart shows the number of people who have received social welfare in the municipality Kriva Palanka and the municipality Rankovce in 2015.

Table 63 Social welfare recipients

Kriva Palanka, Municipality of Rankovce included	children	families
Child care allowance	274	144
Recipients of special allowances	88	84
One-off financial assistance for newborn child	88	85

(Source: SSO, Social welfare for children, juveniles and adults in the Republic of Macedonia, 2015)

The chart below gives an overview of the social welfare conditions under jurisdiction of the Intermunicipal center for social work Kriva Palanka, for juvenile and adult recipients.

Table 64 Social welfare data for children, juveniles and adults in the municipalities Kriva Palanka and Rankovce

Juvenile users of Socialwel 31.12.2015	
Municipal centre for social work	**Kriva Palanka**
Total	**56**
Children lacking parental care	10
Marriage and family problems	20
Children with educational and social difficulties	0
Juvenile criminal offenders	25
Persons with visual impairment	0
Persons with hearing impairment	0
Persons with voice and speech disorders	0
Persons with physical disabilities	0
Persons with intellectual disabilities	0
Autism	0
Persons with combined disabilities	0
Others	1
Adult users of social care, 31.12.2015	
Municipal center for social work	**Kriva Palanka**
Total	**1.051**

Socially excluded	6
Persons with visual impairment	34
Persons with hearing impairment	41
Persons with voice and speech disorders	656
Persons with physical disabilities	97
Persons with combined disabilities	148
Financially unprotected	6
Elderly persons	56
Others	7

(Source: SSO, Social welfare for children, juveniles and adults in the Republic of Macedonia, 2015)

One of the measures, introduced by the Government and distributed through the centers, is an increased support such as: parental allowance for a third (159 recipients) and fourth child (1 recipient). Furthermore, employment of people with special needs by private companies is highly supported with 18 employees in three private companies.

Municipality Kriva Palanka, like most of the municipalities in the Republic of Macedonia where the Macedonians are the dominant ethnic group, is increasingly becoming a municipality with older population. Fewer and fewer young people are to be found in the villages, and the population that has not migrated is ageing. Such conditions leads to a situation where the villages are inhabited by older people in the latter stage of life with high risk of social vulnerability, because they live alone or two-people households, i.e. with their spouse, without the younger successor generation nearby. That makes them especially vulnerable to all kinds of changes which could happen, especially in projects of this kind.

6.13.7 Education and child care

In municipality Kriva Palanka the care for the youngest ones is institutionally organized. One kindergarten (Detelinka) exists in the town Kriva Palanka.

Two primary schools (PPS Joakim Krcovski and PPS Ilinden) and one upper secondary school (SPS Gjorce Petrov) support the educational process in the municipality Kriva Palanka. The two major objects of the two primary schools are located in the town Kriva Palanka. Within the project area, distant objects of the primary school Ilinden in the settlements Dlabočica , Mozhdivnjak and Konopica exist.

The following chart presents an overview of the number of children attending school and kindergarten in the Municipality. In the last six years period, the Municipality experienced a significant drop in the number of primary and upper secondary school students, which is caused by the increased migration effect of young people and low fertility rate. In the Municipality, for the last six years, the decrease in children numbers in primary school is 5%, whereas the number of secondary education children has significantly dropped by 25%, with a special accent of almost 40% of the enrolled female children. Furthermore, the gender balance is disturbed in the upper secondary schools. The elaborate data is presented in the following chart.

Table 65 Number of children in preschool, primary and secondary education

Kriva Palanka									
Education	**Preschool**			**Primary**			**Upper Secondary**		
2009/2010	136	62	45,6%	1792	832	46,4%	989	515	52,1%
2010/2011	270	140	51,9%	1763	829	47,0%	924	445	48,2%

2011/2012	259	135	52,1%	1714	814	47,5%	888	406	45,7%
2012/2013	301	160	53,2%	1718	816	47,5%	843	368	43,7%
2013/2014	308	161	52,3%	1646	786	47,8%	789	339	43,0%
2014/2015	376	201	53,5%	1714	826	48,2%	727	315	43,3%

(Source: the State Statistical Office website)

6.13.8 Cultural heritage, religion, values and habits

6.13.8.1 Locations with archeological and historical significance

The project area has been inhabited since prehistory. The geographical location and the climate conditions create great conditions for establishments of human settlements. For centuries people had a nice climate, providing healthy life for all creatures. Undoubtedly, they all left their significant mark upon the local environment and culture. The project area is known for a long time, since it stands on the way connecting Kyustendil (also called Pautalia, Velbazhd) with the communication direction North-South (Morava-Pčinja-Vardar). The following chart shows the famous archeological sites in the project area.

Table 66 Registered Archaeological sites in the affected project area

Settlement	Archaeological site
Municipality Kriva Palanka	
Dlabočica	**Gradište –** late antiquity site **Selište** - late antiquity settlement
Kriva Palanka	**Kale –** small late antiquity castle
Kiselica	**Gradište -** late antiquity site **Selište -** late antiquity settlement **Soborište** - late antiquity settlement **Church** – medieval with a necropolis
Kostur	**Kupišta** - medieval ore smeltery **Ranjeva Niva –** medieval ore smeltery **Cepen kamen -** medieval ore smeltery

(Source: The Archaeological map of the Republic of Macedonia, Tome II, 1996)

6.13.8.2 Registered cultural heritage

In the boundaries of the project area, there is a location which falls under the category of protected cultural heritage, and that is the monastery St. Joakim Osogovski. The monastery is located at the slopes of the Osogovo Mountains, 10km from the border to Republic of Bulgaria, near the town Kriva Palanka. The great monastery complex is dedicated to the ascetic Saint Joakim Osogovski, also known by the name Sarandopor which is a toponym for the region. The church was built in the late 11th or the beginning of the 12 century. The cathedral church has three naves, with 12 cupolas and porches on the western and southern sides. It was built in 1848-1851 by the famous Macedonian builder of the 19th century, Andrea Damjanov. The inside of the church and the cupolas at the porch are painted by the local painter Dimitar Andonov Papradiški ("the last icon painter" and founder of modern Macedonian art), in the period of the last decades of the 19th and the beginning of the 20th century. The images on the wall on the north-western side of the church are painted by another group of artists from Western Macedonia.

The old monastery church in the monastery complex is devoted to The Holy Mother of God, built in the 11th century and rebuilt in the 14th, as well as in the 19th century. Each year the monastery is a host of a summer school of architecture and art.

Project area: In order to acquire information about the eventual presence of cultural heritage sites in the project area, a memo was sent to the Ministry of Culture, the Cultural Heritage Protection Office. In the response from the Management (17-2582/2 from 27.06.2017, Annex 2), it is stated that in the project area there are no protected goods and goods for which there is an assumption of representing cultural heritage. The required aspects for protection of cultural heritage, in accordance to article 65 of the Law on Nature Protection, should be taken into consideration and should be implemented into the project.

6.13.8.3 Religion

The residents in the project area belong to the Orthodox Christian denomination. The full list of orthodox religious temples in the project area has been presented in the following chart.

Table 67 Religious temples in the project area

Orthodox Christian objects
Temple “St. Demetrius “ - Kriva Palanka
Temple “St. Theodore of Amasea “ - v. Konopica
Temple “Holy Trinity “- v. Moždivnjak
Temple “Ascension of Christ“ - v. Dlabočica
Temple “St. Nicholas“ - v. Gradec
Temple “St. Elijah the prophet“ - v.Luke
Temple “St. Nicholas “ - v.Trnovo
Monastery “St. Joachim of Osogovo“ - Kriva Palanka
Temple “St. Paraskeva“ - v. Luke
Temple “St. Demetrius“ - Dubrovnica
Temple “St. Apostle and Evangelist Mark“ - v. Nerav
Temple “St. John the Baptist“ - v. Nerav

(Source: Map of religious objects in the RM – Skopje)

6.13.8.4 Other cultural values of local significance

The cultural life in Kriva Palanka is at a satisfactory level, which could be easily determined from the activities presented in the following chart, but also from the time schedule of the cultural and other events in the Municipality for a period of one year.

Table 68 Known cultural and religious events, and holidays in the municipality

(Source: the webpage of the municipality, but also newspaper internet websites)

Kriva Palanka	**Period**
Kriva Palanka, Pivtijada	January, 19
Kriva Palanka, April Fools' Day	April, 1
Kriva Palanka, International Romani Day	April, 7
Kriva Palanka, Easter egg	(2015) April 20
Kriva Palanka, Firefighters' Day	May, 20
Kriva Palanka, The day of the Macedonian enlighteners “Ss. Cyril and Methodius”	May, 24
Moždivjnk, Kali Kamen Rally	May, 24

Kriva Palanka, Culture day	June, 10
Kriva Palanka, Woodcarving colony	June
Kriva Palanka, Warm cultural wave	June, 20-31
Kriva Palanka, Kraište - Trilateral international meeting	July, 12
Kriva Palanka, Summer school of architecture	July
Dlabočica, “St. Elijah“	August, 2
Kriva Palanka, JOY FEST	August, 23
Kriva Palanka, International folklore festival St. Joakim Osogovski	August, 25, 26, 27
Kriva Palanka, St. Joakim Osogovski - patron saint of the town	August, 29
Kriva Palanka, International theatre festival St. Joakim Osogovski	September, 15-21
Kriva Palanka, Art colony St. Joakim Osogovski	September
Kriva Palanka, International Day of Persons with Disabilities	December, 3

7 ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

7.1 Methodology for environmental impact assessment

The analysis of impacts considers all of the potential environmental changes (positive or negative) that can arise due to Project implementation. The level of change determines the significance of the impact, assessed in terms of spatial scale (scope), duration, probability and intensity. The impact assessment at large gives directions for the changes that are considered significant.

The Environmental and Social Impact Assessment Study (ESIA) summarizes the potential impacts and the effects that may arise during the implementation of the Project. For that purpose, a distinction between impacts and effects has been made, i.e.:

- Impacts are envisaged changes of the baseline environmental scenario that arise due to the implementation of the Project; and
- Effects are consequences of the environmental impacts, resources or receptors that have a certain significance or sensitivity.

- **Defining the significance of impacts**

Quantitative assessment of the **significance of the impacts** is carried out when possible, based on comparative analysis of certain criteria. In case when it is not possible to carry out a quantitative significance assessment, the level of uncertainty is reduced by using assessment based on previously defined qualitative criteria. This includes importance or sensitivity assessment of the receptors in relation to the intensity of the envisaged effect.

In case when no standards are available or sufficient information for the significance assessment of a certain impact is not provided, then the significance is assessed in a manner which considers the magnitude of the impact or the sensitivity of the affected resource or receptor.

The magnitude of the impact is determined based on a combination of many characteristics, such as its nature, scope, duration or frequency and probability of appearance.

Regarding the differences between resources/receptors (and, in many cases, between different types of impacts that affect a certain resource/receptor), the definitions for the characterisations of the magnitude are differently defined in accordance with the resources/receptors or depending on the type of impact. Whenever it is needed, they are defined based on professional judgement and expert experience.

- **Environmental impact assessment process**

The experts with appropriate professional background have assessed all the themes included within the scope of the ESIA Study, that are common for this type of projects. During the assessment of each environmental medium and area of interest, a framework was adopted that includes the following steps:

- Review of the data regarding the baseline environmental scenario (provided via existing data, survey and research),
- Consultation with the appropriate stakeholders in order to identify in order to identify the major problems and to provide additional information where necessary,
- Appropriateness assessment and limitations of the methodology for impact assessment,
- Identification of the resources and the receptors,
- Prediction of impacts,
- Identification of effects,

- Intensity assessment,
- Identification of the mitigation measures and
- Assessment of residual effects[24] or risks.

The Environmental and Social Impact Assessment Study identifies the environmental and social impacts that may arise due to the project implementation during different stages: pre-construction, construction, operation and decommission.

The pre-construction phase includes activities for preparation of project documentation and plans, as well as providing the necessary permits/contracting that will enable a proper project implementation.

The construction phase involves the preparation/clearing of the project area and the performance of construction activities for the railway and other associated objects.

The operation of the railway includes the activities for railway operation, its regular maintenance, repair and reconstruction. The impacts that may arise due to these activities are subject of analysis in the operational phase.

The decommission phase causes environmental and social impacts similar to those in the construction phase due to the similar activities that are expected to be carried out during the decommissioning (dismantling, clearing, transport of materials and waste etc.). Due to the long life cycle of this type of projects, currently it is not possible to predict the mode of decommissioning of the railway; therefore these impacts are not subject of analysis.

The criteria that set the base for the potential impact assessment regarding the implementation of the envisaged project activities are shown in the following table.

Table 69 Criteria for environmental and social impact assessment

Criteria	Assessment	Description
Nature of the impact	Positive	Impact that is considered to contribute the improvement of the baseline scenario or it will trigger a positive change
	Negative	Impact that is considered to cause a negative change or it will introduce unfavorable elemets within the baseline scenario
Type	Direct	Impact arising due to direct interaction of the project activities with the resource/receptor
	Indirect	Impact arising due to activity that is not directly connected with the project, but instead is a consequence of the project
	Cumulative	Impact resulting from multiple environmental/social impacts on a single receptor or effects resulting from combined effects and special developmental projects that are being implemented in the vicinity
Time of appearance	Immediately	The impact is evident immediately and follows the project activity
	Delayed	The impact is evident after some time and often after the project activity has been carried out
Scope	Site	The effects of the impact are evident within or in the vicinity (100 m) of the project area
	Local	The effects of the impact are evident within or in the vicinity (1 km) of the project area
	Area	The effects of the impact are evident within a radius of 1 to 10 km from the

[24] Residual effects are effects that remain even after the implementation of the mitigation measures

		project area
	Regional	The effects of the impact are evident within a radius of 10 to 50 km from the project area
	National	The effects of the impact are evident within a radius of more than 50 km from the project area
	Transboundary	The effects of the impact are evident in the neighboring country
Probability	Certain	The impact will surely arise in normal working conditions
	Very certain	It is very possible that the impact may arise in normal working conditions
	Probable	There is a probability that the impact will arise in normal working conditions
	Small probability	The probability of impact is very small, but sometimes can happen in normal working conditions
Duration	Temporary	It is expected that the duration of the impact will be shorter than the duration of the construction and/or temporary
	Short-termed	An impact expected to last only during the construction
	Medium-termed	An impact expected to last after the construction activities also
	Long-termed	The impact and its effects will continue and will last during the whole operational phase of the project
Intensity/Magnitude	Negligible	No visible change of the analysed media, areas and conditions
	Small	Minor changes of the media, areas and conditions are registered
	Medium	Change of the media, areas and conditions is evident, i.e. temporary or permanent change
	Large	The change of the media, areas and conditions results in long-termed or permanent change and significant interventions are required for restauration; the change is far beyond the national standards and limits
Reversibility	Reversible	The potential impact is temporary and reversible
	Irreversible	The potential impact is continuous and irreversible
Significance	Negligible/Small	The disturbance of the environmental media and areas, species and habitats during a short period of time are localized and reversible. There are consequences, but the impact is very small (the mitigatad, as well as the non-mitigated) and fits within the limits of the approved standards or the receptors are characterized with low sensitivity/value
	Medium	The disturbance of the environmental media and areas, species and habitats is short-termed or medium-termed. The integrity of the ecosystems will not be negatively affected in a long-term period, but there is a probability that the effects on a certain species or receptors will be short-termed or medium-termed. The area/region can recover via the natural regeneration and restoration. The impact can be characterized with a wide scope, ranging from a bit from the limit value for negligible impact, to a level that almost exceeds the legally prescribed limits. If possible, mitigation measures should be applied
	Large	The disturbance of the environmental media and components, species and habitats (e.g. during the project life cycle) can significantly and in a long-term modify the ecosystems and the natural resources at a local and regional level, and may affect the sustainability. The restoration of the previous cannot happen without an intervention. The long-term impacts on environmental media and conditions may trigger irreversible local or

		regional effects
Mitigation measures	Yes	Mitigation measures are necessary

Ranking of the scope of the impact	***Assessment Q_S***
Site impacts	*1*
Local impacts	*2*
Area impacts	3
Regional impacts	4
National impacts	6
Transboundary impacts	All of the mentioned

Ranking of the duration of the impacts	***Assessment Q_T***
Temporary	*1*
Short-termed	*2*
Medium-termed	*3*
Long-termed	*4*

Ranking of the intensity/magnitude of the impact	***Assessment Q_M***
Negligible	*1*
Small	*2*
Medium	*3*
Large	*4*

Assessment of impact significance:

Based on the assessment of the aforementioned criteria, the ***integrated* outcome** can be calculated, using the following formula:

$$Q_{I,\,i} = Q_{S,\,i} \times Q_{T,\,i} \times Q_{M,} \qquad (1),$$

where:

$Q_{I,\,i}$ – Integrated impact assessment outcome;

$Q_{S,\,i}$ – Assessment of *scope of impact*;

$Q_{T,\,i}$– Assessment of *duration of impact*;

$Q_{M,\,i}$ – Assessment of *magnitude of impact*.

Assessment of impact significance

Impact significance (negative)		*Impact significance (positive)*
Assessment	***Significance***	***Significance***
1- 8	***Negligible***	***Negligible***
9-27	***Medium***	***Medium***
28-64	***Large***	***Large***

7.2 Geology and Soils

7.2.1 Impacts on geology and geomorphology

As a result of the construction of the railway along Section 3 of Corridor VIII Kriva Palanka-Bornica with R. Bulgaria, certain negative impacts on geology and relief, as well as on the geospatial aspects can be expected, from the construction and operational phases.

- **Construction and operational phase**

The construction of the railway, where several cuts are envisaged, can lead to an increase in the intensity of the modern geomorphological processes in certain places, if appropriate preventive measures are not taken, although in spite of the fact that a large part of the alignment will be with tunnels and bridges, which will contribute to minimal surface decomposition and degradation of the relief.

As a result of the anticipated activities in the construction phase, increased erosion (sprinkling, fragmentation, deposition) of poorly resistant stones that dominate along the alignment (shale, volcanogenic sediments, etc.) is expected, in places where cuts and excavations with a larger angle are envisaged, especially on the south side.

Given the large slopes of the terrain, the geological composition, the climate and other properties, it is possible to expect increased landslides and rockfall in the construction phase, but also in the operational phase, if stabilization is not carried out on slopes which will be assessed as potentially susceptible to landslide and rockfall. These occurrences may be particularly pronounced in low intensity (over 40 mm / day) or multiple daytime precipitation (over 20 mm / day). Unless appropriate measures are implemented, there will be appearance of landslides and rockfall in the operational phase, which can lead to numerous negative consequences.

In case of increased erosion, the significant transport and accumulation of deposits in the valley bottom of Kriva Reka will additionally be enhanced. This will cause further filling of the valley and raising the riverbed. As a consequence, the possibility of flooding along the river basin, greater meandering (by washaway / transportation of alluvial soils and arable land), the displacement of the river mud and the like will increase the possibility of flooding. This effect can also be created with insufficient care when constructing objects in the valley floor of Kriva Reka (as well as the sections through the valleys of the Kiselicka Reka, Gradecka Reka, etc.) such as bridges, tunnels, stops and the alignment. A more detailed description of the possible effects of erosion is described in the next chapter-impacts on soils.

Regarding the geo-heritage, the alignment will have a certain negative impact on the remarkable part of the gorge of Kiselichka River (76 + 0 to 77 + 0), especially in the construction phase. There are 2 tunnels envisaged here, a bridge and a cut, which will lead to degradation of the sides of the gorge. Similar negative impacts can be expected on the attractive part of the Kriva Reka gorge between the village Zhidilovo and the village of Uzem, regardless of the large number of tunnels planned along the alignment.

In the operational phase of the railway line, certain visual adverse effects on the geodiversity and the entire area are possible, mainly connected with the bridges on Kiselicka and Kriva Reka (near

Zhidilovo and village Uzem). These impacts have been assessed in detail in the section on impacts on the landscape.

The impacts on geology and geomorphology in the construction and operation phase are assessed as negative with moderate importance.

Environmental components: Geology and geomorphology											
Affected media/areas/receptors	**Source of impacts/emissions**	**Nature of impact**	**Time of appearance**	**Type**	**Scope of impact**	**Duration**	**Probability**	**Reversibility**	**Intensity/magnitude**	**Degree of importance**	**Mitigation measures**
Construction and operation											
Geology and geomorphology	Execution of construction works/occurrence of contemporary geomorphological processes (erosion, rockfall, landslide)	Negative	Immediately/Postponed	Direct	Local	Long-term	Probable	Irreversible	Moderate	Moderate	YES
Surface waters	Occurrence of contemporary geomorphological processes/increased erosion, transport and accumulation of sediment in riverbeds	Negative	Immediately/Postponed	Indirect	Local	Short-term/Long-term	Probable	Reversible/Irreversible	Moderate	Moderate	YES
Geo-heritage (the gorge of Kiselichka River 76+0 to 77+0, as well as the gorge of Kriva River between v. Zhidilovo and Uzem)	Construction of tunnels, bridges and cuts along the alignment/degradation of the sides of the gorge	Negative	Immediately	Direct	Location	Long-term	Certain	Irreversible	High	Moderate	YES

7.2.2 Mitigation measures

Environmental component-Geology and geomorphology	
Construction and operation	
Impacts	**Mitigation measures**
Geology and geomorphology During construction, due to the envisaged activities, contemporary geomorphological processes may occur (erosion, landslides). The increased erosion sedimentation can cause riverbed filling and elevation, meanderings, floods etc.	Application of mitigation measures is necessary in order to reduce the erosion impacts listed in the Chapter on soil impacts-soil erosion. In order to reduce the occurrence of landslides, the following measures are recommended: • Careful performance of construction activities in areas with steep slopes or where cuts and fills with high angle are envisaged (avoid blasting on a larger scale), • Avoid sharp incisions in the foothills of slopes, • Careful dig of drainage and channels, • Avoidance of excess grounwater pumping or diversion of surface water, • Stabilization of steep slopes in sediments and shales with biotechnical and civil engineering activities. In order to reduce the risk of riverbed filling, the following is recommended: • Avoid disposal of excavated material by the riverbeds, • Do not use the gravel and sand from the riverbed and the alluvial plain, • Minimising the initial and operational erosion effect from construction activities in the vicinity of valleys etc. • Special attention should be put on the construction activities in the area of the inundation valley of the river of Kiselichka, Gradechka, and Kriva Reka (especially Kriva Reka) and implementation of appropriate measures.
Geo-heritage The construction of the railway will cause certain negative impact on the geo-heritage, especially on the most impressionable part of the gorge of the river of Kiselichka (76+0 to 77+0), mostly during construction, as well as the attractive part of the gorge of Kriva Reka between the village of Zhidilovo and the village of Uzem.	Due to the inevitability of the construction activities at this section, careful scoping of construction work is necessary in order to maximally avoid the disturbance of this landscape. It is also recommended to: • Avoid direct embankment of the slopes with the excavated material from cuts and tunnels, • Avoid disposal of excavated material at the sides of gorges in this area and forming of man-made rock creeps,

	• Continuous replantation of the area in order to maximally “mask” the construction interventions within the landscape, • Appropriate landscape-integrated technical construction and “decoration” of the bridges until mitigation of the negative visual impact (on the other hand, the bridges will provide an excellent view towards the surrounding mountainous terrain during travelling, and can be attractive not only for adrenaline adventurism, but also for the overall tourism in the Municipality).
Residual impacts: In normal operational conditions, even after the application of the recommended measures, residual impacts on geology and geomorphology are possible.	
Mitigation of residual impacts: If the intensity of the residual impacts on geology and geomorphology is evident, additional analyses will be carried out and mitigation measures will be proposed.	

7.2.3 Impacts on Soils

Soil is a natural resource that is a very complex system and extremely sensitive to various external impacts. The soil reacts rapidly to persistent negative impacts, which can lead to its accelerated degradation, but on the other hand, the recovery of the soil from the changes that occurred as a result of such impacts is very difficult and slow. These changes can lead to the loss of basic soil functions[25] that define its fertility.

Soil degradation is a decrease in soil quality as a result of inadequate activities, mostly in agriculture, forestry, industry and urbanism. Soil degradation can be physical, chemical and biological.

Soil degradation during the execution of construction works may arise as a result of:

- change in the land cover (removal of forest and other vegetation),
- excavations and embankments (changing the natural angle of the terrain),
- sealing the soil by building objects,
- changing the appearance due to excavations, borrow pits, dumping grounds, landfills,
- soil compacting as a result of setting up camps, storage of materials, transporting,
- unwanted spills of pollutants in the soil etc.

The above activities can cause a condition of degraded soils, that is: contaminated soil, eroded soil, sealed soil, acidified soil, salinized soil, compacted soil, physically degraded soil, soil with deteriorated topsoil, impoverished soil without organic matter and nutrients, soil with impaired biodiversity.

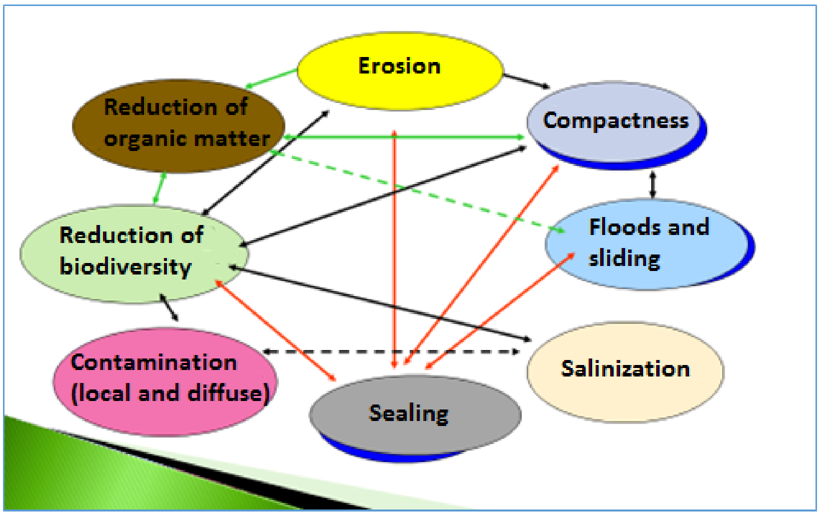


Figure 183 Schematic depiction of soil degradation

As a result of the creation of deforested, artificial steep slopes on the natural terrain, as well as the creation of man-made embankment slopes, dumping grounds, landfills, **erosion** can be intensified, which causes soil loss, loss of humus and nutrients, disturbance of the regime of surface waters, but also indirect damage from the generated deposit.

[25] These are:

- In agriculture and forestry: production of biomass;
- Purification, transition and transformation activity between the atmosphere, water and vegetation;
- Environmental and human protection, primarily via food and drinking water protection;
- Biological habitat (flora and fauna habitat) and a genetic pool much bigger than water and air;
- Spatial base for technical, industrial and socio-economic structures and their development;
- Source of resources for the industry;
- The soil is geological and cultural heritage forming an important part of the landscape we live in and care for, it contains paleontological and archaeological assets with a high value for understanding of the history of the Earth and mankind.

Direct consequences of soil degradation are: disruption of some of the soil functions, and in particular the production function, as well as purification function, and the role of soil as habitat.

The **indirect consequences** of soil degradation are: disruption of the physical and chemical characteristics of the waters, disturbance of the water regime, disturbance of biological diversity, landscape etc.

Implementation of the Project for construction of Section 3 from the railway Corridor VIII Kriva Palanka-border with R. Bulgaria can cause various types of soil degradation in the construction and operational phase, the most significant being: destruction of the topsoil, soil compaction, various types of erosion including rockfall and landslide, contamination of the soil, as well as indirect impacts on the waters, which, depending on the conditions, may have a greater or lesser effect.

- **Construction phase**

In order to evaluate soil vulnerability and identify the most vulnerable locations, the following processes that cause soil degradation are considered and analyzed:

- destruction arising during the removal of the topsoil (top layer),
- the occurrence of accelerated erosion processes and the occurrence of sediment,
- soil contamination,
- soil compaction.

During the construction activities, the soil cover within the contact zone and the wider area will be dug (destroyed), transported, stored and re-applied. As a result of these activities, the soils will be strongly impacted along the entire alignment.

Considering the fragmented parent material, which is easily physically disintegratable and the steep slopes on the terrain, it can be concluded that during the construction activities and the destruction of the soil cover, strong erosion processes and sediment production is possible to occur. In addition, in artificially created slopes, intensive erosion is possible, if they are not adequately stabilized (geo or bio stabilization).

Destruction due to topsoil removal

The envisaged massive construction activities can cause significant disturbance of the topsoil and subsoil. In addition to the construction of the railway line, the construction of the additional infrastructure, more precisely the access roads to the construction site, will cause additional impact on the soil cover.

Regarding the process of destruction of the topsoil, the locations with well-developed vegetation are the most vulnerable, with soils having reached the climax stage of a certain degree of evolution. Such soils are of special natural significance, because they are part of a wider ecosystem, whose destruction would destroy the entire ecosystem and ecosystem functions.

From the analysis of the soil cover along the alignment, the specifics of the terrain and other natural variables, as well as the envisaged construction activities, it can be said with certainty that the soil cover is very sensitive and strong impacts on its properties can be expected, ie loss of the soil cover, reducing its fertility and properties during excavation, transport and re-application.

On the basis of the submitted documentation and site visits to the project area, it can be concluded that from the beginning of the alignment up to the town of Kriva Palanka, the left side of the contact zone extends on a steep terrain with rare vegetation with shallow soils with poorly developed topsoil and low vulnerability. The right side of the contact zone occupies agricultural land on alluvial soils and urban zones, which are strongly influenced by man. These soils have great importance for the population and it is necessary to undertake measures for their protection. However, since the alignment does not go directly to them, no great and direct impact is expected.

The railway alignment at this stretch extends through the steep hills of the Osogovo Mountains that sharply descend to Kriva Reka. The soils, along the alignment, are shallow and not very vulnerable in relation to the destruction of the topsoil, except for one section that starts from km 70 + 220 to 71 + 100 and extends through a forested belt in which one can expect presence of soils with well developed topsoil.

After Kriva Palanka, the left side of the contact zone continues to occupy a steep terrain with degraded vegetation, while the right side covers an area with well-developed forest vegetation until the turn to the village of Samokov, ie to the entrance to tunnel no. 12 (75 + 980) under which there are well developed brown forest soils and rankers.

On this stretch, the alignment runs through a strongly inclined terrain, which is mainly with degraded soil cover and rare vegetation. As the most sensitive, in terms of degradation of the topsoil, are the zones from the beginning of the bridge no. 27 (73 + 760) to bridge no. 28 (74 + 300) and the section between the exit of the tunnel no. 12 (75 + 980) to the entrance to tunnel no. 13 (76 + 620).

From the village of Samokov, ie from the inflow of Kiselichka in the Kriva Reka, to the village. Zidilovo, the contact zone passes through a well forested mountainous and hilly terrain, which sharply descends towards Kriva Reka, and is under well developed beech and oak forests, while in the lowest alluvial terraces of Kriva Reka there is arable land. The surrounding terrains are under well developed rankers and brown forest soils that are quite sensitive to the degradation of the topsoil humus-accumulative layer. The entire alignment extends to well-developed soils, so that the entire stretch can be assessed as highly vulnerable to degradation, and more detailed mitigation measures should be envisaged.

The situation is similar in the section of the alignment from the village of Zhililovo where the alignment crosses the main road and Kriva Reka with bridge no. 37 (79 + 980), up to above the village of Uzem, where the alignment turns in a wide circle to the point 85 + 120. The whole stretch is with a well-developed soil cover from brown forest soils and rankers at the sites with natural pastures.

From the crossing of the railway line at point 85 + 220, until the exit from tunnel no. 21 (86 + 140) the contact zone of the alignment passes through a predominantly steep terrain dominated by soils with shallow solum and chorus. (A) which is in the initial phase of forming. The railway line itself passes through a terrain that is under pasture, urban environment or abandoned agricultural land. In any case, these are degraded soils with a weaker vulnerability.

From the tunnel exit no. 21 (86 + 140) to the entrance to tunnel no. 22 (87-220) the contact zone as well as the alignment itself, passes through a forested terrain with well-developed soils, which should be carefully handled for protection.

Soil erosion

The foreseen activities in the construction phase can cause soil erosion, which will pose a threat to soil resources. Soil erosion can be caused by:

a) execution of earthworks along the entire alignment of the railway (excavations and embankments);
b) construction of objects at certain points along the alignment of the railway (station, halt, bridges, etc.);
c) construction of access roads to the construction site;
d) storing the excavated topsoil;
e) land use (borrow pits).

Soil erosion is a complex process and is a result of the cumulative impact of all factors.

Parameters that determine the erosion process of artificially created slopes are: angle of inclination (slope), slope length along the incline, the type of the surface of the slope and the amount of water flowing to the surface of the slope.

The differences in the erosion processes along the alignment will primarily depend on the depth of the excavation, the incline of the artificial slope, and the characteristics of the substrate on the site. They are very variable on different parts of the alignment.

The cross-section of the formation width on such terrain can be: pure excavation (excavation on both sides), pure embankment (embankment on both sides) and cut (on one side excavation, the other embankment). In accordance with the construction standards, and on the basis of the geological base and the embankment material, the slopes of the excavation inclines are defined and typified. In the project documentation, the slopes of the excavation, according to the construction standards, are typed with a slope of 3: 2 and 3: 1. The slopes of the embankments are far milder and are typed with a slope of 1: 1.5.

Most of the construction work will take place on hilly or steep terrain, and depending on the scope of the works (above all the depths of excavation), there is a significant risk of erosion, especially during periods of heavy rainfall and stronger winds.

Disposal of vegetation in the project area will cause erosion. Erosion can be extended around if no appropriate measures are taken to stabilize the slopes (the excavation slopes are stabilized, if possible, while the biotechnical stabilization of the inclines is obligatory for the embankment slopes).

Soil erosion may also occur on sites that will be used as borrow pits and temporary dumping grounds for soil, materials, etc.

Given the high intensity of the planned earthworks and the soil composition in the project area, and due to the similarity of the coefficient of the reciprocal value of the resistance to erosion (range 0,25-γ –2,0) in the detected soil types, (in the Brown forest soils, cinnamon soils and leptosols γ=0,85, in the rankers γ = 0,9-1,0, in the regosols γ=1,0-1,1, and in the lithosols γ =1,1-1,2), it can be concluded that soils are medium to moderately highly erodable. The soil erosion along the alignment is very similar from the beginning to the end of the alignment. For most of the alignment, from the beginning almost to the end, there is a complex of shales whose coefficient of reciprocal value of erosion resistance is γ = 1.1. At the end of the alignment there are loose sedimentary rocks where the value of the coefficient of the reciprocal value of the erosion resistance is γ=1,6 and they are very erodable.

This means that on the alignment from the aspect of the erosibility of the substrate, there are generally only two different sections: from the beginning of the alignment to above the village of Uzem (shales γ =1,1) and from above the village of Uzem (84 + 200) to the end of the alignment (loose sedimentary rocks, decayed shale and volcanics γ =1,1).

The possibility of erosion, as well as the type and the intensity of erosion, will depend on other factors.

In the case of postings (if they are close to the project area), the erodibility will be similar to the alignment of the railway as a result of the similar pedological and geological composition of the soil.

The erosion of temporary landfills and permanent landfills where the soil layer is fractured can be very high (in such cases, γ=1,6-2 which means very high erosibility is adopted), unless appropriate measures are taken.

Soil erosion can cause indirect impact on the water, ie affect the water infiltration (as a result of soil sealing), cause chemical pollution of the water (if it is contaminated eroded sediment), mechanical pollution of the waters with the eroded deposit and so on.

Soil contamination

Contamination of soil with dangerous substances and contaminated inert material during construction activities may occur in case of unwanted leakages or inadequate storage at locations where the construction activities are carried out, at the locations where raw materials, auxiliary materials and energy sources are stored (fuel, oil and fats, chemical substances, etc.), as well as on the locations where temporary waste of different waste fractions will be stored. Also, soil contamination may occur as a result of sedimentation from the air.

Contamination of the soil can also occur when mixing fertile and quality soils with contaminated soil during activities such as: excavation of the topsoil, its transport and storage. Also, contamination may occur by spreading contaminated soil material during its manipulation. High risk of this type of contamination is on the section of the alignment in the surroundings of the village Uzem as a result of the historical pollution of soils and water caused by the mine "Toranica".

Soil contamination is a serious form of degradation, which leads to a complete or partial loss of its functions. In a number of cases contamination of the soils is reversible and remediation is possible, but if a more serious form of contamination occurs, this process is irreversible and such soils should be evacuated, stored and treated as contaminated material by special procedures. In addition, contaminated soils pose a serious threat to other natural resources, primarily waters. During the construction activities there is a serious possibility of erosion of the soil, where contaminated sediment can come to the surface water bodies and pollute them.

Compaction and loss of the surface soil layer (topsoil)

Compaction of the surface layer is another form of degradation of soils that leads to the loss of physical and mechanical properties of the soil that makes it unfit for reuse.

In the construction phase, there is a possibility of compaction of the soil as a result of the following activities:

- cleaning and preparation of the location for the construction of the alignment and associated facilities and infrastructure,
- excavation of the topsoil and part of the subsoil layer, its transport and storage, and re-application,
- Movement and presence of workers, use of heavy machinery,
- transport activities,
- Temporary storage of construction material and waste.

In partial compaction of soils, their geomechanical convenience for reuse and application is temporarily lost. But if the soil is heavily loaded, there is a permanent loss of its functions and the process is irreversible.

Based on the above, the impacts on soils in the construction phase are assessed as negative, with negligible small to high significance. The construction work will not cause negative transboundary impacts on soils.

- **Operational phase**

The operation of the railway can cause erosion and contamination of the soil.

Erosion

In the operational phase, soil erosion may occur if:

a) no anti-erosion measures are taken on the slopes and above them (geotechnical and biotechnical),
b) the erosion protection measures implemented are not adequate or insufficient and
c) there is no maintenance of the anti-erosion structures and greenery.

In addition, in the operational phase of the railway there is a risk of erosion in the event of improper maintenance of the culverts. In the case of a flow of stormwater in intermittent streams that cross the alignment, the culverts can be filled with deposit, which can cause floating and eroding of the formation width. The following table shows the anticipated culverts, along the alignment of the railway, where there is a risk for such occurrence.

Table 70 Culverts along the alignment

Culvert	Chainage	Type	Dimensions
C01	65+421,50	Box	B=2,00 m H=2,00 m
C02	66+366,47	Box	B=2,00 m H=2,00 m
C03	67+835,75	Box	B=2,00 m H=2,00 m
C04	68+970,75	Box	B=2,00 m H=2,00 m
C05	70+732,00	Box	B=2,00 m H=2,00 m
C06	71+781,63	Box	B=2,00 m H=2,00 m
C07	73+129,22	Box	B=2,00 m H=2,00 m
C08	73+248,77	Box	B=2,00 m H=2,00 m
C09	74+150,87	Box	B=2,00 m H=2,00 m
C10	78+772,78	Box	B=2,00 m H=2,00 m
C11	80+198,00	Box	B=2,00 m H=2,00 m

In addition to the location of the culverts, during extremely intense precipitation, intense soil erosion can occur on any part of the alignment of the railway.

Regular maintenance of vegetation along the alignment can cause erosion of the soil.

Soil contamination

During the operation of the railway, the soil can be contaminated as a result of sedimentation of sediments from the air (precipitated sediments appear at a distance of 10 meters from the railway, due to the rapid sedimentation of substances heavier than air), undesirable leakage of oils and grease and other materials from wagons and locomotives, discharge of dangerous substances in accidents and hazards, emissions of metals from abrasive processes in brakes, rails, wheels and contact lines, lubricants and other hazardous substances used for maintenance of the railway, herbicides to be used for managing the vegetation along the railway line, generation of waste and its inadequate management, etc.

Long-term adverse leakages can cause permanent (irreversible) contamination of soils along the railway line.

Contaminated soils can affect watercourses (surface and groundwater) and fertile land in the project environment.

Based on the above, the impacts on soils in the operational phase are assessed as negative, with negligible small to high significance.

Environmental Components: Soil											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Soil	Removal of vegetation (along the alignment, borrow pits, access roads, storage sites) / ***Soil erosion***	Negative	Immediately	Indirectly	Location	Long-term	Surely	Irreversible	Moderate	Moderate	YES
Soil	Removal of surface soil layer (on alignment, at storage sites, borrow pits, landfills) -***Destruction of surface soil layer***	Negative	Immediately	Directly	Local	Long-term	Surely	Reversible	Large	Large	YES
Soil	Excavation at the alignment - ***Soil erosion***	Negative	Immediately	Directly	Location	Long-term	Surely	Irreversible	Large	Moderate	YES
Soil	Excavation of borrow pits - ***Soil erosion***	Negative	Immediately	Directly	Location	Long-term	Probably	Irreversible	Small	Negligible	YES
Soil	Movement of heavy machinery-***Soil compacting***	Negative	Immediately	Directly	Location	Long-term	Surely	Reversible / Irreversible	Large	Moderate	YES
Soil	Transporting the excavated soil layer to a storage site, or from a storage site to a	Negative	Immediately	Directly	Local	Short-term	Low probability	Reversible / Irreversi	Moderate	Moderate	YES

	place of re-application - ***Soil compacting***							ble			
Soil	Storage of excavated surface soil layer- ***Soil compacting***	Negative	Immediately	Directly	Location	Short-term	Surely	Reversible / Irreversible	Moderate	Negligible	YES
	Storage of excavated surface soil layer- ***Soil erosion***	Negative	Immediately	Directly	Location	Short-term	Surely	Irreversible	Moderate	Negligible	YES
Soil	Construction of embankments - ***Soil erosion***	Negative	Immediately	Directly	Location	Mid-term	Surely	Irreversible	Large	Moderate	YES
Soil	Temporary storage at sites (storage of material, waste, equipment, camps for workers, etc.) - ***Soil compacting***	Negative	Immediately / Delayed	Directly/ Cumulative	Location	Short-term	Surely	Reversible / Irreversible	Moderate	Negligible	YES
	Temporary storage at sites (storage of material, waste, equipment, camps for workers, etc.) - ***Soil contamination***	Negative	Immediately / Delayed	Directly/ Cumulative	Location	Short-term / mid-term	Surely	Reversible / Irreversible	Moderate	Moderate	YES
Soil	Temporary Storage of Hazardous Substances - ***Soil contamination***	Negative	Delayed	Directly	Location	Short-term / mid-term	Surely	Reversible / Irreversible	Moderate	Moderate	YES
Soil	Construction of access roads (earthworks) - ***Soil compacting***	Negative	Immediately	Directly	Local	Long-term	Surely	Reversible / Irreversible	Large	Large	YES

	Construction of access roads (earth works) **– *Soil erosion***	Negative	Immediately	Directly	Local	Long-term	Surely	Irreversible	Moderate	Moderate	YES
Soil	Diversion of watercourses (at storage sites, dumping grounds, landfills) - ***Soil erosion***	Negative	Immediately	Directly	Area	Short-term	Probably	Irreversible	Moderate	Moderate	YES
Soil	Establishing crossing points across streams - ***Soil erosion***	Negative	Immediately	Directly	Location	Mid-term	Probably	Irreversible	Small	Negligible	YES
Soil	Re-application of surface soil layer- ***Soil compacting***	Negative	Delayed	Directly	Location	Short-term / mid-term	Surely	Reversible / Irreversible	Large	Moderate	YES
	Re-application of surface soil layer- ***Soil erosion***	Negative	Delayed	Directly	Location	Short-term / mid-term	Surely	Irreversible	Large	Moderate	YES
Operational phase											
Soil	Inadequate maintenance of the culverts-***flooding and erosion of the soil***	Negative	Immediately	Directly/Indirectly	Local	Long-term	Low probability	Reversible / Irreversible	Large	Large	YES
Soil	Maintenance of the railway line, removal of vegetation- ***Soil erosion***	Negative	Delayed	Directly	Location	Long-term	Low probability	Reversible	Small	Negligible	YES
Soil	Rail traffic - sediment from the air - ***Soil contamination***	Negative	Delayed	Directly	Location	Long-term	Low probability	Reversible	Small	Negligible	YES
Soil	Use of herbicides-***Soil***	Negative	Immediat	Directly	Location	Long-term	Very	Reversib	Small	Negligible	YES

	contamination		ely				likely	le / Irreversible			
Soil	Oil leakage and other liquids from the trains - ***Soil contamination***	Negative	Immediately / Delayed	Directly	Location	Long-term	Very likely	Reversible / Irreversible	Large	Moderate	YES

7.2.4 Mitigation measures

Environmental component-Soil	
Pre-construction	
Impacts	**Mitigation measures**
Soil impactsConsidering the big number of tunnels to be build The railway construction will cause negative impacts on soils due to construction, transport, waste storage etc.	-The Contractor should prepare Soil Management Plan as well as Erosion and Sedimentation Management Plan for the construction and operation of the railway in order to provide: • Protection of the topsoil and the subsoil during excavation, • Protection of the soil from contamination, erosion and sedimentation during construction and operation, The Soil Management Plan should be compliant with the Water and Waste Management Plans. -Good planning of the material balance per sections, i.e. reuse of the excess earth resulting from cut and fill and tunnels. This measure will reduce the need of borrow pits and dumping grounds, and simultaneously will reduce the costs for manipulation with materials and transport; -Preparation of Slope Geostabilization Report in accordance with the Law on civil engineering and bylaws; -Preparation of technical documentation at the level of Detailed Design regarding: ✓ Biotechnical stabilization of the slopes near the alignment, ✓ Anti-erosion structures design and anti-downpour structures design, ✓ Recultivation of the borrow pits and landfills. -Taking samples from the topsoil and subsoil of the identified critical area near the v. Uzem in order to propose appropriate measures for avoidance of the possible impacts of historically polluted soils to the environmental media during earth work in construction phase.. -Determining procedures for appropriate sorage of contaminated soil and possible disposal as excess material, in accordance with the relevant standards[26].
Construction	
Impacts	**Mitigation measures**

[26] In close communication with the Ministry of Environment and Physical Planning

Soil impacts (destruction of the topsoil, compaction, erosion, contamination etc.) The removal of vegetation, the tracing of new access roads, excavation, material and waste storage, movement of mechanization, accidental spills etc. can cause soil degradation.	***General soil protection measures:*** • Application of measures that will result from the Soil Management Plan and the Erosion and Sedimentation Management Plan; • Reuse of part of land masses from the excavations in constructing embankments in water flows with low banks and in locations where overflows occur, based on previously prepared project documentation; • Strict protection of all the zones outside the narrowest construction zone in order to avoid occupation of additional area for temporary or permanent use (construction material storage, parking lot or vehicle repair workshops); • If not designed in the technical documentation, the tracing of new access roads is not allowed
Destruction of the topsoil The removal of the topsoil (at the alignment, in storage sites, borrow pits, landfills) can eliminate the topsoil	***Mitigation measures for the destruction of the topsoil*** • The topsoil (humus) should be properly removed before the construction begins, to be stored and used after the completion of the construction activities, for the purpose of recultivation and stabilization of the slopes • The removed soil heaps to be stabilized or covered (with textile) and to be temporary stored in places located away from the river banks or erosion-prone sites; • During the manipulation of the soil (excavation, transport, storage), special attention should be given to the soil moisture level, i.e. the soil should not be either very dry or very moist.
Soil compaction Movement of heavy machines and mechanization, storage of topsoil, temporary site storage (of materials, waste, equipment, worker camp etc.), haulage road tracing (earthworks), reapplying of topsoil can cause soil compaction.	***Soil compaction mitigation measures*** • Mechanization and technology that causes minimal tremors and harmful impacts that can lead to soil compaction (and indirectly can interfere with the spring water regime in the scope of the corridor and downstream) should be used during railway construction.
Soil contamination The temporary storage of material, hazardous substances, waste, equipment, worker camps etc. can cause soil contamination.	***Soil contamination mitigation measures*** • Washing of equipment and vehicles to be done only at special sites designed to avoid soil and groundwater contamination. The resulting quantities of washed concrete can be further disposed as inert solid waste or to be further reused as filler in certain construction activities • The storage and handling of fuels should be a rigorously controlled process that includes taking measures for prevention of soil contamination. The fueling of the machines and

	generators should be done at least 50 m of watercourses, channels or drinking water wells • The machines should be parked at appropriately envisaged and arranged sites (camps) that fulfill the necessary requirements for soil protection (accidental leaks of fuel and oil) • During the appliance of dyes or other type of chemical protection, appropriate protective measures should be undertaken, e.g. covering of the surrounding soil • Appropriate waste management, in accordance with the legal prescriptions and requirements • In case of soil contamination with accidentally spilled fuels or a derivative, the contaminated soil sample should be removed and disposed at an appropriate location • Appropriate management with the potential contaminated soils during construction • Compliance with the measures from the Hazardous Materials Management Plan and Leak Control Management Plan
Soil erosion Removal of vegetation (along the alignment, borrow pits, haulage roads, storage sites), earthworks, construction of borrow pits, storage of topsoil, construction of embankments, haulage roads, regulation and diversion of watercourses etc. can lead to soil erosion	***Soil erosion mitigation and protection measures*** Implementation of the erosion protection measures from the documentation prepared in the pre-construction phase, i.e.: • Geostabilization of slopes (construction of berms in case of deep cut, construction of retaining walls at steep slopes, covering the slope with montage elements, geosynthetics, stone slabs, shotcreting etc.) • Biostabilization of slopes (different types of degradable biomaterials can be used, but grassing and wood and shrub plantation is mandatory). At the embankment slopes, if the toe of the slope is jeopardized due to the proximity of a watercourse, the toe should be strengthened by use of different geotechnical and biotechnical mesures • Drainage of the formation width to be done with ditches and gutters set along the alignment which at certain points will drain into the watercourses • Dewatering of sites located above the cut slopes to be done with gutters located above the slopes, as well as slope downward gutters that will drain into the ditches. In case of longer slopes, contour gutters in order to break the flow of waters at the slope and redirecting to the existing drains • Temporary and permanent measures must be taken at the dumping grounds and landfills. The temporary measures are represented with different types of covers as well as grassing, while the permanent measures are applied after the finishing of construction activities:

<table>
<tr><td></td><td>biotechnical stabilization of slopes (based on Detailed Design for restoration)
• Avoiding sites located near watercourses (gullies, seasonal watercourses etc.) for establishment of dumping grounds and landfills.</td></tr>
<tr><td colspan="2">Residual impacts: In normal operational conditions, even after the application of the recommended measures, residual impacts on soils (compaction, erosion) are possible.</td></tr>
<tr><td colspan="2">Mitigation of residual impacts: If the intensity of the residual impacts on soils is evident (soil erosion), additional analyses will be carried out and mitigation measures will be proposed.</td></tr>
<tr><td colspan="2" align="center">Operation</td></tr>
<tr><td>Impacts</td><td>Mitigation measures</td></tr>
<tr><td>Soil erosion
Inadequate maintenance of the culverts and vegetation along the alignment can lead to soil erosion</td><td>• Regular monitoring of possible erosion
• Regular maintenance of the vegetation and (if applicable) increase of the vegetation-covered area
• Regular maintenance of the objects/structures
• Implementation of additional measures (if applicable)</td></tr>
<tr><td>Soil contamination
Deposition of air sediment, application of herbicides, leakage of oil and other liquids from the trains can lead to soil contamination</td><td>• Compliance with the European standards for transport of goods
• Compliance with the measures of the Accident and Natural Disaster Protection and Rescue Plan
• In case of risk of serious soil contamination, a detailed analysis and assessment of scope and intensity of contamination is recommended, and if the outcomes of the assessment require, a Plan for Remediation of Contaminated Soil should be prepared or the contaminated soil should be stored in special landfills and replaced with an uncontaminated one
• Preparation of Weed and Ruderal Vegetation Management Plan. This plan should contain the necessary protective measures, i.e.: active substances, concentrations, time and mode of application of the herbicides in order to avoid soil contamination due to their long-term appliance</td></tr>
<tr><td colspan="2">Residual impacts: In normal operational conditions, if the recommended measures are applied, no residual impacts are expected.</td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: /</td></tr>
</table>

7.3 Hydrology and surface waters

7.3.1 Impacts on hydrology and surface waters

One of the main risks for the occurrence of negative impacts on surface waters in the project area (in the construction and operation phase), as well as the risk to the stability of the railway is the inadequate dimensioning of bridges, viaducts and drainage systems, in accordance with the hydrological characteristics of the project area, as well as the probability of occurrence of large waters.

Inadequate dimensioning of these facilities, in addition to destabilization, can cause flooding and adverse impacts on the qualitative and quantitative characteristics of the waters, and also in a direct or indirect way to affect other environmental media and areas as well as the population in Project area.

Below is an overview of the other possible impacts that may be caused by the Project, in the construction and operational phase.

- **Construction phase**

The foreseen activities for the construction of the railway, with all necessary facilities, infrastructure and access roads, can cause disruption of the quantity and quality of surface waters (rivers and streams) in the project area.

The preparation of the construction site for the construction work, which includes the removal of vegetation, can cause an increase in the sediment in the rivers. Subsequently, deep excavation, storage and handling of excavated land and materials may impair the quality of surface water. The risk of erosion, the wash away of the deposited material during heavy rains, the wash away of the precipitated sediment from the air, the leakage of the water used to reduce dust emissions (uncontrolled water use), dust dispersion during strong wind may increase turbidity and also impair the quality of the rivers' waters, as well as the atmospheric waters.

Construction activities near the rivers, as well as in the riverbed (which include, among other things, diversion of the riverbed at the chainages: 70 + 521.72, 74 + 012.35, 74 + 585.44, 79 + 088.78 and regulation of the rivers - Table 9) can cause adverse effects on the water body, such as changes in river flow, erosion and increased sedimentation, turbidity and changes in the morphology of river beds and banks. Also, these activities can cause disruption or loss of important riparian or aquatic plant species, animals and habitats, as well as flooding of surrounding land.

At certain chainages (see Table 7) protective works for improving the stability of the bridges, ie reinforcement of the piers with linings and/or gabions are envisaged. These structural reinforcements of the piers can cause adverse impacts on the flow of the watercourse and contribute to the accumulation of sediments.

Water accumulation may occur at bridges, if the bridge's wings are built in the riverbed. The indirect effect of the construction of the bridges will be the accumulation of sediments and larger parts upstream of the wings of the bridges, which will cause a change in the flow and the way of deposition. The intensity of the impact depends on the number and size of the wings of the bridge, which are located inside the waterbed (the more wider the wings, the greater the water retention). Bearing in mind that the wings of modern bridges are narrow and are usually not built in the river bed, and that the impacts will be limited to a small area behind the bridge's wing, the impact of bridges on the change in the water regime is expected to be low.

During excavation, in some wet areas or areas with high groundwater level, there is a possibility for dewatering (especially during heavy precipitation) in order to proceed with the construction work and to secure the placement of the necessary infrastructure. Discharge of the pumped water in the rivers can cause deterioration of the water quality in them, and also, if the flow is not controlled, cause erosion at the discharge point.

Storage and handling of materials, fuels, lubricating oils will be carried out at the construction sites, and various fractions of waste, wastewater, etc. will be generated. Inadequate management of these can cause deterioration of the quality of water bodies that are in the immediate vicinity.

Pollution of water bodies can be direct (for example, if construction activities take place very close to the water body or indirect, by means of transfer of pollutants through washed soil or contaminated groundwater).

During the excavation and storage of the topsoil, the polluted soils near the village of Kostur and Uzem (from the historical pollution from the mine Toranica) may adversely affect the surface waters.

The impacts on surface waters in the construction phase can be assessed as negative, with moderate significance.

- **Operational phase**

In the operational phase of the railway, besides the impacts of the trains that will travel on the railway line, the sources of impacts in surface waters are the railway station in Kriva Palanka and the halt in Zhidilovo. Also, track maintenance activities may lead to different emissions and impacts that could alter or deteriorate the quality of surface water.

In the operational phase, water pollution from emissions of hazardous substances generated from transport activities can be expected.

Regular operation of the railway is also related to diffuse emissions of inorganic and organic substances into the environment that may originate from unwanted leakage from the trains. Some of them are categorized as hazardous substances-priority substances in the Water Framework Directive 2000/60 / EC, as amended by Directive 2008/105 / EC, which refers to quality standards in the field of water policy (Annexes II and III) and the national legal framework. These substances can contaminate surface and groundwater, infiltrating through the ballast of the line and from there, draining into the lower layers of the soil or in the drainage system along the rails. Some of these pollutants are: copper, zinc, chromium and polycyclic aromatic hydrocarbons (PAH), lubricating oils and greases, as well as herbicides.

The main collector of all emitted substances is the embankment of the railway and the soil along the railway line. Abrasive processes are the main reason for the emission of metals in the soil, and the main sources are: brakes, rails, wheels and contact lines. Substances commonly found in the ballast as a result of the abrasive processes are: iron, manganese, chromium, copper, antimony, tin, lead, molybdenum, nickel, and vanadium in the form of particles. Emissions from lubricants (grease, coating resins and oils) originate from the maintenance of the turnouts. Periodic cleaning of the turnouts with vapor (sometimes combined with a surface active substance) can stimulate the emission of pollutants.

During the operation of the railway, the plants and weeds, which grow along the railway line, are removed for safety reasons and maintaining the stability of the railway line. The aim is to avoid possible errors in communication and signal lines, to maintain visibility over signaling devices and signs, turnouts and crossings and to protect trains and cargo carriages from impacts of overgrowing vegetation and fires. This is usually done using mechanical and chemical methods (using different herbicides). The most popular is the chemical treatment, which is also the most efficient (more space can be treated in a shorter time), but it is also a potential source of water pollution, both surface and groundwater.

Different types of loads that will be transported can also be a source of contamination of soil and water due to potential leaks or accidental spills of hazardous substances (eg liquid fuels, solvents, acids, bases, etc.).

Waste and wastewater generated by passengers and visitors to the railway station and halt, railway office and administrative buildings, as well as from the maintenance of the railway line may cause a negative impact on surface waters.

Due to the existence of the railway, the effects of retention / accumulation of water can occur, especially where the railway passes through waterways due to an inadequate drainage network (sometimes the drainage pipes are small and are unable to accept the stormwater during the periods of precipitation). In case of inadequate design and construction of bridges and viaducts, it is possible to disturb their stability especially in torrential rains and floods, and in the worst scenario - complete collapse of the structure of the bridge, as well as occurrences of accumulation of materials and sediment, flow disturbance and accumulation of water (which can cause flooding of the riparian area).

The impacts on surface waters in the operational phase can be assessed as negative, with negligible small to moderate significance.

Environmental Components: Hydrology-Surface Waters											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Type**	**Time of Appearance**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction											
Surface waters	Clearing the site, removing vegetation, storing soil, erosion, flattening of sedimented sediment, etc. / water quality disruption	Negative	Immediately	Directly	Area / Region	Short term	Very likely	Reversible / Irreversible	Moderate	Moderate	Yes
Surface waters	River diversion, water flow control, construction work in the river bed and near it / changes in flow, increased sediment, disturbance of morphology	Negative	Immediately	Directly	Area / Region	Temporary / Short Term / Midterm	Very likely	Reversible / Irreversible	Moderate	Moderate	Yes
Surface waters	Drainage at the site / flow changes, sediment input	Negative	Immediately	Directly	Area / Region	Temporary / Short Term	Probably	Reversible	Moderate	Moderate	Yes

Surface waters	Inappropriate management: wastewater (sanitary and technical), waste; Chemicals and auxiliary materials, energy, maintenance and servicing of equipment and mechanization etc. / surface quality disruption	Negative	Immediately	Directly	Area / Region	Short term	Probably	Reversible / Irreversible	Moderate	Moderate	Yes
Operational phase											
Surface waters	Inadequate maintenance of drainage structures (waste collection) can cause disruption of water quality and increase the risk of flooding	Negative	Immediately	Directly	Area / Region	Long-term	Not likely	Reversible / Irreversible	Moderate	Moderate	Yes
Surface waters	Rail traffic / Rinsing of settled sediment and leakages	Negative	Immediately	Directly	Location	Long-term	Not likely	Reversible	Negligible	Negligible small	YES
Surface waters	Railway operation / Maintenance of vegetation with	Negative	Immediately / Delayed	Direct / Indirectly	Location	Long-term	Not likely	Reversible	Negligible	Negligible small	YES

	herbicides										
Surface waters	Rail traffic and railway maintenance / waste generation and wastewater	Negative	Immediately / Delayed	Direct / Indirectly	Local	Long-term	Not likely	Reversible	Negligible	Negligible small	YES

7.3.2 Mitigation measures

Environmental components-Hydrology and surface waters	
Pre-construction	
Impacts	**Mitigation measures**
Impacts on bridge and viaduct stability, culverts and railway -The inadequate design of the bridges, viaducts and culverts in relation to the hydrological characteristics of the project area may jeopardize their stability as well as the stability of the railway, which will lead to negative impacts on the hydrology and the quality of surface waters and indirect impact on the other environmental media	• Preparation of hydrological and meteorological layouts for the project area that include detailed information on the hydrological and meteorological parameters for each profile of Section 3, which will provide a starting point for dimensioning of the hydrotechnical structures, regulation of rivers and protection from natural disasters[27] • Establishment of adequate correlation links between the flows of the measuring profiles and the flows measured at the existing hydrological stations (which are part of the country's network). This will save a lot of funding during the execution of the control series of measurements of the quantitative characteristics. For this purpose, previous simultaneous hydrological measurements of the flow quantities are necessary at all points (hydrotechnical structures-bridges, viaducts, culverts), together with the previously surveyed measuring points in the period of 1980-1996 that were executed for the purpose of preparation of the hydrological layout of the region of Osogovo • Preparation of Water and River Crossings Management Plan • Preparation of Flood and Flash Flood Management Plan for the construction phase • Compliance with the best available practices and experiences during the designing in order to avoid flooded areas upstream of bridges
Impacts on the ecological status of rivers -Water pumping and drainage of the construction site -River diversion	• Prior commencing the construction activities the Contractor (in cooperation with the PUC "Macedonian Railways-Infrastructure") should establish communication with the Ministry of Environment and Physical Planning (MOEPP) in order to inform the

[27] An in-depth analysis of floods during a longer period of time is required (some parts of Macedonia have a recurrence period of 80-100 years). This analysis will align the historical floods with the calculated 100-year floods, which in accordance with the legal requirements are competent for the dimensioning of the hydrotechnical structures. Also, the hydrological and meteorological layouts should consider the snow drifts, the direction and magnitude of winds recorded as per local inhabitant testimonies, and should be compared with the recorded data from the main meteorological station in Kriva Palanka.

-Execution of construction activities within riverbeds or in the vicinity of riverbeds -Use of water and management of wastewater	Ministry about the envisaged activities for the drainage of sites with high level of groundwater, modes of drainage, points of discharge into recipients, for the purpose of obtaining directions and/or consent/permits for the execution of these activities and discharge of the pumped groundwater into surface water, in accordance with Article 19 of the Law on waters • Obtaining a Water Management Consent prior of the commencement of construction.The construction activities carried out within a water body/river as well as in the vicinity of rivers should be performed in compliance with the Water Management Consent, issued by the MOEPP (in accordance with Article 174 of the Law on waters), where the water management requirements that should be fulfilled during construction are elaborated • If river water is used for technical purposes (spraying of the construction site in order to reduce the dust emissions, or for the purpose of material preparation), it should be done based on granted Water Use Permit (right of water), issued by the Department of waters within the MOEPP, in accordance with the Article 23, Chapter II.3 Right of water from the Law on waters, or the Contractor should engage/contract an authorized company for industrial water supply • The possible wastewater discharge into rivers should be performed in accordance with the Right of Water Permit, i.e. Discharge Permit issued by the MOEPP in accordance with the aforementioned law
Construction	
Impacts	**Mitigation measures**
Surface water regime and quality Watercourse diversion and regulation, construction site dewatering, clearing of riparian vegetation, execution of construction activities within riverbeds and their vicinity, establishment of borrow pits, landfills etc. may lead to change in the flow of rivers, higher sedimentation level, erosion, disturbance of the morphology of watercourses and deterioration of water quality in rivers	• Compliance with the good construction practice during construction • The execution of the construction activities within riverbeds or near a watercourse should be performed in accordance with the requirements of the issued Water Management Consent • Construction zones in the vicinity of surface waters should be formed at an adequate distance (10-15 m from the top of the side slope of the embankment in case of regulated riverbeds or 150 m from the level of 50-year flood in non-regulated riverbeds), or in case of absence of area for construction zone establishment, the surface waters should be adequately channeled

	• Mounting of portable bridges in order to avoid direct contact of the surface water with the vehicles • The perimeter of the area where vehicle, worker or machine movement will be prohibited should be marked with signal belts • Application of control measures for erosion and sedimentation, through establishment of temporary drainage systems for the removal of potentially dangerous surface waters that will arise in the construction zone • Minimize the possibility of sediment discharge (muddy water) into watercourses during construction activities that take place within the riverbed, i.e. protection techniques like construction of embankments or stream diversion • If there is a risk of discharge of high quantity of sediment into watercourses, to install clarifiers (sediment traps) • During construction to maintain the biological minimum of water continuously • Construction activities to be carried out in dry season, i.e. periods when the waterflow is reduced • It is not allowed to carry out construction within the riverbed or river banks, except when there is no reasonable alternative for construction activities • Bridges to be designed and constructed in a way that will provide minimal intervention and impact on the riverbed • The possible dewatering of the excavated ditches, holes etc. (where there is occurrence of groundwater or accumulated surface runoff) to be discharged in a controlled manner , i.e. in a way that will minimize the physical impacts on the morphology of the recipient • In points where culverts are envisaged, whose dimensions are based on calculations for a certain amount of 100-year flood, to check whether the sediment (earth and mud) carried by the flood waves is included within the calculations, which is very dangerous and a reason for culvert clogging • Taking measures for protection of the forest vegetation which is sparse in the area of the right tributaries of Kriva Reka and encouraging of a new forestation with native vegetation that will contribute to the protection from floods and sediment deposition (water erosion)

	• At points where the natural flow in the watershed will be disturbed due to construction, to be built additional culverts or channels for integrated railway protection and its protection from flooding • If water is pumped out from rivers for the purpose of construction, this activity should be performed in accordance with the requirements from the Water Use Permit • The borrow pits and landfills to be as far as possible from rivers in the project area • Complete implementation of the measures that will arise from the permits and the management plans for: water and river crossings, floods, soil, waste, vegetation etc. All of the aforementioned measures should be implemented along the whole alignment, in particular at: • Bridge no. 1, at km 65+095,735 to km 65+155,280, where protection works are also envisaged; • Bridge no. 3 on Gabarska Reka, at km 65+841,065 to km 66+106,750 where protection works are also envisaged; • Bridge no. 5 on Gradechka Reka, at km 66+742,660 to km 66+884,280 where protection works are also envisaged; • Bridge no. 7 on Rangel, at km 67+360,246 to km 67+455,813 where protection works are also envisaged; • Bridge no. 18, at km 70+889,500 to km 70+923,000, where protection works are envisaged; • Bridge no. 23, at km 72+804,013 to km 72+935,520, where protection works are envisaged; • Bridge no. 27, at km 73+766,218 to km 73+815,775, where protection works are envisaged; • Bridge no. 28, at km 74+195,656 to km 74+409,944, where protection works are envisaged; • At km 70+521.72, where permanent diversion of a seasonal watercourse is envisaged, near Kriva Reka; • At km 74+012.35, where temporary diversion of a seasonal watercourse is envisaged, near Kriva Reka; • At km 74+585.44, where temporary diversion of a seasonal watercourse is

	envisaged, near Kriva Reka; • Bridge no. 32 on Kiselichka Reka, at km 76+402.00 to km 76+612.00, where protection works are envisaged; • Bridge no. 37, at km 79+785.906 to km 80+068.737, where protection works are envisaged; • At km 79+088.78, where permanent diversion of a seasonal watercourse is envisaged, near Kriva Reka; • Bridge no. 37 on Kriva Reka, at km 79+785.91 to km 80+068.73; • Bridge no. 40 on a stream, at km 80+959.86 to km 81+164.75, in whose vicinity a regulation of the riverbed of Kriva Reka is envisaged, and protection works are foreseen; • Bridge no. 41, at km 81+947.750 to km 81+971.250, where protection works are envisaged; • Bridge no. 43 on Kriva Reka (here known as „Kozja Reka“), at km 84+094.529 to km 84+107.459, where protection works are envisaged; • Bridge no. 51, at km 87+023.890 to km 87+032.970, where protection works are envisaged.
Quality of surface water Inadequate management with: wastewater (fecal and industrial), waste, chemicals and auxiliary materials, fuels, maintenance and servicing of the equipment and vehicles etc. can lead to deterioration of the quality of surface water	Water bodies have a capacity of self-purification which enables their restauration, but only when the contamination is accidental/short-termed and doesn’t disrupt the water regime at large. Due to the fact that the alignment is located within the watershed of Kriva Reka, which has a good hydrological potential, the following measures are proposed: • The uncontrolled discharge of wastewater generated from the worker camps is not allowed. It is recommended to set mobile systems for wastewater treatment at these points • Mobile toilets should be placed at the construction sites that will be managed appropriately by a certified company. The mobile toilets should be placed on a distance larger than 100 m from the drainage infrastructure or the watercourse • Wastewater from the construction activities to be collected and treated prior their final discharge in the recipient, i.e. to be managed in accordance with the requirements from the Wastewater Discharge Permit, issued by the MOEPP • Storing, servicing or maintenance of the equipment or any kind of fueling is not

<table>
<tr><td></td><td>allowed at a distance less than 100 m from drainage systems and watercourses
Washing of mixers for prefabricated concrete that contain concrete with alkali cement or cement residues is not allowed as well as washing of the equipment and vehicles in the rivers or in their vicinity
Regular preventive maintenance of the vehicles and the macninery in order to reduce oil, motor oil and fuel leakage
Securing adequate sites for material, fuel, excavated earth and waste storage and their appropriate treatment
Complete implementation of the measures from the management plans for: water and river crossings, floods, waste, hazardous materials and control of leakage and emergency procedures</td></tr>
<tr><td colspan="2">Residual impacts: In normal operational conditions, even if all the proposed measures are implemented, residual impacts are possible. The significance of the residual impacts on surface waters will depend on the level of implementation of the mitigation measures. Small erosion will remain even after the mitigation of impacts and will lead to temporary elevated turbidity of the rivers.</td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: If residual impacts are evident, additional analysis will be carried out and mitigation measures will be proposed.</td></tr>
<tr><td colspan="2" align="center">Operation</td></tr>
<tr><td>Impacts</td><td>Mitigation measures</td></tr>
<tr><td>Surface water regime and quality
Inasequate maintenance of the drainage systems, train leaks, use of herbicides for vegetation management, generation of municipal wastewater can lead to negative impacts on the regime and quality of surface waters</td><td>Regular control and maintenance of the drainage systems in order to avoid clogging with waste and sediment
Regular monitoring of the surface runoff control structures (channels, ditches etc.)
Adequate management of the wastewater generated within the train stations (connection with the town’s sewerage grid or if that’s not possible, the wastewater should be collected within a impervious septic tank that will be managed by a certified company)
Complete implementation of the measures from the management plans for: soil, waste, vegetation, accidental leakage etc.
In case of accidental leaks, notice all the stakeholders downstream of the leak point and the authorized institutions for coming of hazardous substances along with the water (if their quantities are sufficiently large), or construct special ditches for diversion of the water during dry periods, when the water quantity is minimal</td></tr>
</table>

Residual impacts: In normal operational conditions, if all the measures are implemented, no residual impacts are expected.
Residual impacts mitigation measures: /

7.4 Groundwater

7.4.1 Impacts on groundwater

Construction phase

Construction of the railway may lead to impacts on the groundwater regime, as well as to deterioration of the quality of the groundwater.

Groundwater regime means a set of parameters that define the quantitative and qualitative state of the water at a certain place and at a certain time, such as: water level, flow, flow direction, water velocity, transfer of sediment, physical, chemical and radioactive properties, biological composition of waters and other parameters.

The foreseen activities for the construction of the railway line may have an impact on the groundwater regime as a result of:

- Blasting, during the construction of tunnels;
- Earth excavation;
- Compaction of land, during the construction of retaining walls, storage of building materials and waste;
- Pumping of groundwater for dewatering of the land (during construction activities), etc.

During the construction of the tunnels, different methods of construction will be used: drill and blast, as well as cut&cover. For the construction of tunnels 17 (from km 80+571,00 to km 80+639,00), 18 (from km 80+792,00 to km 80+842,00) and 18a (from km 80+842,00 to km 80+916,00), the cut&cover method will be used. The rest of the tunnels will be constructed by using drill and blast method. Tunnel 22 (transboundary tunnel) will be partly constructed by using the cut&cover and partly by using the drill and blast method. The conducted investigations of the groundwater show high groundwater table (up to 3 m depth), which is found at the following chainages: km 65 + 952, km 70 + 032, km 71 + 767, km 76 + 517, km 77 + 737, km 79 + 877, km 82 + 092, km 82 + 500 to 82 + 628, km 82 + 500 to 82 + 628, etc. Blasting and earth excavation, as well as dewatering of these locations, can impact groundwater table, but since the groundwater table depends on the season (during rainy days it can be more or less greater than in dry periods), as well as the fact that the hydrogeology of the terrain is represented with low permeable rocks (which means that the expected water flows are limited), the impacts cannot be assessed as significant.

Like tunnels, the activities for construction of the other railway structures cannot cause significant impacts on the groundwater. Indirect impacts on the quality of groundwater (chemical, physical and bacteriological) may be expected in the case of:

- incidental leakage or spillage of fuel, oils, grease, etc .;
- Improper management of sewage waste water, ie discharge directly into soil;
- Improper storage and handling of chemicals within the construction site;
- refill of fuels, oils and fats to inappropriate locations for that purpose;
- Improper management of liquid waste and waste that has hazardous characteristics;
- Washing and servicing the machinery and equipment at locations unsuitable for that purpose and spraying the construction sites for dust reduction;
- Usage of technical water of inadequate quality, etc.

Based on the aforementioned, the impacts on groundwater in the construction phase can be assessed as negative, with moderate significance.

Operational phase

In normal operation of the railway, no negative impacts on the quality of groundwater along the alignment are expected.

Negative impacts are only possible in case of incident situations (described in the chapter Risk of accidents).

Operational activities on the line are not expected to cause negative transboundary impacts on groundwater.

Environmental Components: Groundwater											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Type**	**Time of Appearance**	**Scope**	**Probability**	**Duration**	**Intensity / Magnitude**	**Reversibility**	**Degree of significance**	**Mitigation measures**
Construction phase											
Groundwater	Construction activities: mining; Land excavation; Use of mechanization and storage of building materials and waste, construction of retaining walls / disruption of the groundwater regime	Negative	Direct / Indirectly	Immediately / Delayed	Location / Local	Surely	Short-term / Mid-term	Moderate	Reversible / Irreversible	Moderate	Yes
	Pumping of underground waters for drainage of the land etc./disruption of the groundwater regime	Negative	Directly	Immediately	Location / Local	Surely	Short-term / Mid-term	Small	Reversible	Moderate	Yes
Groundwater	Inappropriate management: wastewater (sanitary and technical), waste; Chemicals and auxiliary materials, fuel, maintenance and servicing of equipment and mechanization, etc .; / Disruption of groundwater quality	Negative	Indirectly	Immediately	Location / Local	Low probability	Short-term	Moderate	Reversible / Irreversible	Moderate	Yes
Operational phase											
No impact is expected under normal operating conditions											

7.4.2 Mitigation measures

Environmental components-Groundwater	
Pre-construction and construction	
Impacts	**Impact mitigation measures**
On groundwater regime due to: – Blasting, when building tunnels; – Earth excavation; – Soil compaction, when building retaining walls, storage of building materials and waste; – Pumping of groundwater for site dewatering (during construction activities) etc.	• Before starting the activities for temporary pumping of emerging groundwater (construction site dewatering), to inform MOEPP and act according the provided measures and obligations (according to Art 18 from Law on waters); • Not to perform construction activities in conditions of high groundwater level.
On groundwater quality (chemical, physical and bacteriological) due to: – Accidental leakage or spill of fuels, oils, fats etc.; – Improper management with sanitary waste waters, their direct discharge into the soil; – Improper storage and handling with chemicals on the construction site; – Spills of crude oil, oils and fats on inadequate locations for that purpose; – Improper management with liquid waste and waste with hazardous characteristics; – Washing and maintenance of mechanization and equipment on locations inadequate for that purpose and spraying of construction sites due to reduction of clouds (dispersal) of dust; – Use of industrial water with inadequate quality etc.	• Placing mobile toilets for collection of waste sanitary waters and contracting with authorized company; • The storage of oils, fats and chemicals to be done in appropriate containers, placed in indoor facilities, secured with waterproof base and system for leachate collection; • Spills of crude oil and fats to be done on locations secured with waterproof base; • To comply with the envisaged measures for proper management of generated waste; • The waste, with hazardous characteristics (waste oils, oils packaging waste, fats, paints and other chemicals), to be selected and collected in appropriate containers, that are kept on waterproof base, secured with a system for leachate collection in case of incidental leakage; • To regularly submit the waste to an authorized company, that has permit for further treatment based on a Contract; • Washing of vehicles to be done on locations with waterproof base, secured with a system for collection of waste waters and/or their treatment with grease trap; • Contracting with an authorized company for supply of industrial water, and if ground- or surface water's pumping is performed to secure a Permit for pumping of waters from MOEPP etc.
Residual impacts: Despite the implementation of measures for mitigating the impact on groundwater regime, there is still a possibility of residual impacts occurrence.	
Measures for mitigation of residual impacts: If an occurrence of residual impacts is evident, further analysis on the source of emissions and the measures implemented will be performed, and appropriate measures will be taken in accordance with the analysis.	

Operation	
Impacts	**Impact mitigation measures**
Impacts are not expected	Measures for mitigation are not foreseen
Residual impacts: Residual impacts are not expected	
Measures for mitigation of residual impacts: /	

7.5 Ambient air

7.5.1 Effects on ambient air

- **Construction phase**

The envisaged construction of Section 3 of the railway Kriva Palanka-Border with the Republic of Bulgaria includes a series of activities that are sources of air pollution, ie:

- Clearing of vegetation along the construction area;
- Demolition of existing facilities;
- Earthworks involving blasting, excavation, loading, unloading, transport;
- Activities for the construction of a new railway line, facilities (tunnels, viaducts, bridges, access roads[28], etc.) and other infrastructure;
- Welding;
- Storage, handling of materials and waste[29];
- Transportation of materials, waste and workers;
- Installation and operation of worker camps etc.

The above activities may cause:

- Increased emissions of dust;
- Increased emission levels of exhaust gases;
- Increased emissions of volatile organic compounds (when applying asphalt on access roads);
- Generating emissions of aerosols and manganese monoxide, as a result of welding activities, etc.

In this phase of preparation of the EIA & SA Study, due to lack of technical data[30], for calculating the emissions of dust and exhaust gases in the air that will be generated during the construction of the railway line, preliminary data from the EIA & SA Study from 2012 are used. Annex 17 shows a description and calculation of the quantities of dust and exhaust from different sources.

All the above mentioned emissions will affect air quality, which is related to the effects on: a) human health, manifested by respiratory nuisances and irritation, b) visual disturbance (dust clouds), c) deposition of dust in the vicinity of the construction site in the form of a sediment, d) covering the vegetation with dust and reducing the process of photosynthesis, etc.

Under normal meteorological conditions, the impact of dust should be limited within several tens of meters of the area where the construction activities will be carried out. Potential impacts will arise from the accumulation of dust that can cause nuisance within the project area and its immediate surroundings, as well as in the vicinity and along the roadways. The occurrence of this type of impact, within the project scope-locally, is more likely than the disruption of ambient air quality on a wider scale.

In order to reduce emissions from dust at the construction site and the local roads, during the construction works, water spraying will be carried out in order to prevent the dust from dispersing into

[28] Asphalting will be carried out at some locations

[29] Within the project area there is a possibility of setting facilities for preparation and supply of construction materials, like construction of concrete batching plants, borrow pits for clay, filter materials

[30] The existing project documentation for construction of the railway Kriva Palanka-border with Bulgaria lacks precise data on the type and quantity of materials that will be used during the construction, source of supply and location (e.g. borrow pits, concrete batching plants, asphalt base etc.), quantities of waste and exact locations for its disposal (temporary and permanent) etc. Besides, there are no data on working conditions, number of heavy machinery and dump trucks, workdays, frequency and trajectory of movement etc.

the air. Inefficient use of water, using large quantities, can cause leakage in surface water bodies and impair their quality.

The construction phase includes activities for demolition of buildings, which implies the risk of waste generation from building materials containing asbestos. Inadequate disposal and handling of this type of construction waste can cause air pollution with dust containing asbestos.

Much of the construction activities will be carried out outside the populated areas, with continuous airflow, which will contribute to the mitigation of pollutants in the air.

Since construction activities in the immediate vicinity of the border include the construction of a cross-border tunnel only (the activities will be performed exclusively on the territory of the Republic of Macedonia), therefore these impacts are considered insignificant.

During the construction phase there may be incidental occurrences, especially the occurrence of a fire, explosions, etc., which can cause serious deterioration of the air quality. Possible impacts from incident situations are analyzed in a separate chapter (Risk of accidents).

Because construction activities in the immediate vicinity of the border include the construction of a cross-border tunnel only (the activities will be carried out exclusively on the territory of the Republic of Macedonia), therefore these impacts are considered insignificant.

Sensitive receptors, which may be affected by the deteriorated air quality, are: local residents from the settlements in the municipality of Kriva Palanka, and especially local residents living near the alignment of the railway and roads, especially the population from the village T`lminci, Gradec , Kriva Palanka, Zhidilovo, Uzem and Kostur, users of local roads, construction workers, farmers, agricultural land, biodiversity (plant and animal species, as well as their habitats listed in the chapter on biological diversity), soil and surface waters as a result of precipitation of sediments from the air, as well as inefficient use of water to reduce dust emissions.

Based on the aforementioned, it can be concluded that dust and exhaust emissions from vehicles and mechanization can cause negative impacts on air quality of moderate importance, while emissions from welding and asphalting will cause negative impacts with small, ie negligible significance. Impacts on receptors (population, biological diversity, waters, soil) from impaired air quality are assessed with moderate significance. Applying appropriate emission mitigation measures is expected to reduce both the intensity and significance of the impacts.

- **Operational phase**

In the operational phase of the railway, traffic is planned to be carried out with electric traction, which will contribute to the reduction of air emissions. Certain air quality impacts can occur when diesel locomotives and other auxiliary rail vehicles[31] to maintain the railway are used, especially near the railway station, as a result of maneuvering the diesel locomotives, unloading, storage, repair and movement of passenger vehicles.

Emissions generated by diesel locomotives and other machinery and auxiliary track maintenance vehicles arise from combustion of fuel in internal combustion engines. As a result, the main pollutants are derived from diesel engines (ie similar to those used in road transport). These are mainly CO_2, PM and NO_x, small amounts of CO and hydrocarbons, together with SO_x and heavy metals, which originate from the sulfur content and metals in the fuels. Given that these emissions will be generated from a limited (small) number of locomotives and other rail vehicles and machines that will be used under a certain time regime and occasionally, it is considered that the emissions will be minimal compared to those generated In road traffic.

[31]HMD-heavy motor draisine for train pull, machine for construction of the permanent way, small maintenance machines, excavator for maintenance of slopes.

When moving the trains at high speed, dust can emerge. These impacts will depend on the railway infrastructure as well as on the characteristics of the soil, but no significant impacts are expected.

Transport of dry granular materials (for example, minerals and grain) along the section may result in dust emissions, while the transport of fuels or chemicals, hazardous materials, etc. may result in fugitive emissions of volatile organic compounds.

Impacts on air quality in the operational phase can be assessed as small, ie insignificant, and therefore the indirect impacts on the population, biological diversity, soil, etc. are assessed as insignificant.

During the operational phase there may be incidental occurrences (especially the appearance of a fire, explosions, etc.), which can cause serious air quality deterioration. The possible impacts from the incidental events are analyzed in a separate chapter (Risk of accidents).

Based on the foregoing, it can be concluded that dust emissions, exhaust gases emissions of fugitive volatile organic compounds, etc., can cause negative impacts on air quality with little or negligible significance. Impacts on receptors (population, biodiversity, water, soil) from impaired air quality are assessed as impacts with little significance. By applying appropriate emission mitigation measures, reduction or avoidance of these impacts is expected.

Environmental Components: Ambient air											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Ambient air	All construction and transport activities / **Emissions of dust**	Negative	Immediately	Direct / Cumulative	Area	Short term	Surely	Reversible	Moderate / Large	Moderate	Yes
	All construction and transport activities / **Emissions of exhaust gases**	Negative	Immediately	Direct / Cumulative	Area	Short term	Surely	Reversible	Moderate / Large	Moderate	Yes
	Asphalting-welding / **Emissions of volatile organic compounds, aerosols, manganese dioxide, etc.**	Negative	Immediately	Direct / Cumulative	Location	Temporarily	Surely	Reversible	Small	Negligible small	Yes
Operational phase											
Ambient air	Railway traffic and track maintenance / Emissions of exhaust gases from internal combustion engines	Negative	Immediately	Direct / Cumulative	Location	Long-term	Probably	Reversible	Small	Negligible small	Yes
	Railway traffic and track maintenance / Emissions of dust	Negative	Immediately	Direct / Cumulative	Location	Long-term	Probably	Reversible	Small	Negligible small	Yes
	Transport of goods / Emissions of fugitive	Negative	Immediately	Direct / Cumulative	Location	Long-term	Probably	Reversible	Small	Negligible small	Yes

	volatile organic compounds and dust										

7.5.2 Mitigation measures

<table>
<tr><th colspan="2">Environmental components-Ambient air</th></tr>
<tr><th colspan="2">Pre-construction</th></tr>
<tr><th>Impacts</th><th>Impact mitigation measures</th></tr>
<tr><td>Deterioration of ambient air quality
The construction works and transportation activities can cause deterioration of ambient air quality.</td><td>Measures for mitigation of emissions in ambient air from transportation activities:
An optimal layout of the landfills for depositing of materials and stationary construction sites (bases) should be provided in the final design of the railway, in order the length of the access/haulage roads to be reduced on minimum.
Once the access roads, landfills, stationary bases and scope of work for each of them are defined, a detailed analysis of the dispersion of pollutant substances (model) should be prepared and additional mitigation measures according to the results should be envisaged.
Also, the contractor of construction works should prepare:
• Plan for organization of the construction site;
• Dust Management Plan;
• Blast Management Plan;
• Traffic Management Plan.</td></tr>
<tr><th colspan="2">Construction</th></tr>
<tr><th>Impacts</th><th>Impact mitigation measures</th></tr>
<tr><td>Deterioration of ambient air quality
The construction activities (which include blasting, asphalting, welding etc.) and the traffic activities will generate dust emissions, exhaust gases, VOCs, aerosols etc. These emissions can cause direct impacts on the air quality and indirect impact on the human population, biodiversity, soil etc.</td><td>• Implementation of the measures from the Plan for organization of the construction site that should include, inter alia:
- Information about the population/sensitive receptors for construction activities and working hours, before starting with construction phase, as well as placing of a protection fence or temporarily protective walls on the construction sites.
• Implementation of the measures from the Dust Management Plan, that includes good construction practice and techniques for dust reduction, such as:
- Setting anemometers/mobile weather stations at locations where construction works are ongoing. If the wind is with high intensity and there is a chance to mobilize a bigger dust quantity that can’t be reduced with other measures, to stop the construction activities;
- Placement of protective fence around the construction sites on sensitive locations (in</td></tr>
</table>

	populated areas); - Spraying with water (manually or with sprinklers) should be used during the time of excavation, in order to control the visible dust; - Stabilizing or covering the heaps of inert material (earth and waste from construction activities) and daily taking out the excavated earth and other waste material from the construction sites and their transportation and disposal on locations specified by the local self-government in covered transportation vehicles; - The storage sites will be regularly sprayed with water; - Raw materials and waste will be transported in covered trucks; - It's not allowed to incinerate the vegetation removed during clearing of the project area; - Stationary dust emission sources (including concrete batching plants, crushers) will be located as far as possible from the sensitive receptors; - Introduction of procedure for control of asbestos during the demolition works, according the national legislation for hazardous waste, Directive no. 91/689/EEC for hazardous waste, Directive no. 87/217/EEC from the Council on prevention and mitigation of asbestos environmental pollution and EU Directive no. 2009/148/EC for protection of the workers from risks involving impacts of asbestos exposure on the work place. - The materials from the demolition process will be managed according to the national legislation and the EU legislation on management of hazardous waste and asbestos. The risk assessment will be carried out prior commencement of the activities, that will include exposure to asbestos-contaminated dust or materials that contain asbestos. • Implementation of the measures from the Blast Management Plan: - Use of air abatement techniques for dust collection from the drilling equipment (bag filters, water sprays etc.) in order to control dust emissions; - The drilled dry and fine material in the blasting area will be kept wet in order to prevent blowing of dust; - The blasting should be limited to days without winds and days with strong winds should be avoided (especially when the weather is dry) and when the winds blow towards the sensitive areas; - The Blast Management Plan should take into consideration the limitation of the size of the blast, in order to stabilize the dust emissions;

<table>
<tr><td></td><td>- Minimizing the activities for blasting and increased implementation of practices that involve drilling with a tunnelling machine;
• Implementation of measures from the Traffic Management Plan, that includes:
- Control of the driving speed in areas with unsurfaced roads (<20-40 km/h) to minimize the dust generation;
- When driving out of the construction site, the trucks loaded with sand, aggregate, earth and excess material will be covered;
- Optimal use of loaded vehicles, i.e. minimal number of freight vehicles will be engaged that will carry maximal volume of materials;
- Installation of equipment/station for trucks/machinery chassis and wheels washing at all exit points of the construction site, in order to prevent dispersion of material on public local roads;
- Vehicles and construction machinery should be maintained properly and should fulfil the standards for discharge of emissions;
• The Plan will contain a grievance mechanism and processing, in terms of prompt intervention;
• Implementation of measures from the management plans for: waste, raw materials, soil and erosion, vegetation, fire protection report, explosions and hazardous materials etc.
• If there are grievances from the local sensitive receptors-residents, the Contractor will need to implement additional measures/review of existing measures on the location and implement new additional measures.</td></tr>
<tr><td colspan="2">Residual impacts: Despite the implementation of measures for mitigating the anticipated impacts, there is a possibility of residual impacts on the air quality, caused by dust emissions in the ambient air, generated by construction activities, especially in dry periods, as well as exhaust gases emissions.</td></tr>
<tr><td colspan="2">Measures for mitigation of residual impacts: If an occurrence of residual impacts is evident, further analysis on the source of emissions and the measures implemented will be performed, and appropriate measures will be taken based on this analysis.</td></tr>
<tr><th>Impacts</th><th>Impact mitigation measures</th></tr>
<tr><td>Deterioration of ambient air quality
Emissions from railway traffic and railway maintenance can deteriorate the ambient air quality.</td><td>• Implementation of best practice for maintenance of railway, trains and locomotives;
• Implementation of European goods transportation standards;
• Preparation of threat from natural disasters and other accidents assessment with a Plan for protection and rescue from natural disasters and other accidents.</td></tr>
</table>

Residual impacts: Residual impacts are not expected	
Measures for mitigation of residual impacts: /	

7.6 Noise

7.6.1 Impacts caused by noise

Noise is defined as an unwanted sound and is experienced as a trigger of stress in the environment. Sound is what we hear when our ears are exposed to small fluctuations in air pressure. The noise can be described from the aspect of three variable components: a) amplitude (high and low), b) frequency (tone height), c) time model (variability).

The impact of noise is usually considered a disturbance that the World Health Organization (WHO) has defined as "a sense of noise-induced nuisance".

The ear distinguishes sounds between 0 dB (A), which is a threshold of the sense of hearing, and 120 dB (A), which is a pain threshold. The noise level that causes discomfort is 65 dB (A), while the noise level of 85 dB (A) or more is considered a harmful sound, and sounds that may have a direct impact on hearing are 105 dB (A).

Noise affects the nervous and hormonal system that can increase the risk of cardiovascular disease and disrupt the cognitive functions. Health problems that arise from an increased level of noise are:

- Sleep disturbance, including loss of sleep quality and awakening. Restless sleep and fatigue can lead to loss of concentration and to a greater number of accidents and injuries.
- Hindered learning, understanding and remembering (especially in children).
- Anxiety, which leads to stress and to poorer quality of life.
- Tinnitus (perception of sound in the ear at a moment when there is no appropriate external sound).
- Cardiac disorders, including heart attacks and other problems as a result of increased blood pressure.

The noise thresholds that impact the quality of sleep are as follows:

- Less than 30 dB (A): no problem;
- From 30-40 dB (A): slight anxiety, sleep disorder, without real disturbance of vulnerable groups (children, elderly, ill);
- From 40-55 dB (A): disturbing the vulnerable group;
- Over 55 dB (A): health hazards, effects on the cardiovascular system.

The World Health Organization also recommends levels below 50 dB (A) outside residential areas in order to avoid any noise disturbances during the day or evening. This level is lower for the night period and its value is 45 dB (A).

7.6.1.1 Approach to noise impact assessment

In accordance with the Decision on determining in which cases and under what conditions the peace of citizens is considered to be disturbed from harmful noise ("Official Gazette of the Republic of Macedonia" No.1 / 09) and the Rulebook on noise levels in the environment ("Official Gazette of the Republic of Macedonia" No. 147/08), the peace of the citizens is disturbed by harmful noise when the noise limit values in the environment, caused by different sources, are higher than those shown in the following table.

Table 71 Levels of noise above whose values the peace of citizens is considered to have been violated

Area determined by the noise protection degree	Noise threshold dB(A)		
	L_d	L_e	L_n
First degree area I	50	50	40
Second degree area II	55	55	45

Third degree area III	60	60	55
Fourth degree area IV	70	70	60

- **Construction phase**

In cases where the anticipated levels of noise from construction work exceed the target values, all practical protection measures should be applied to minimize the impact of noise. In the case where the predicted noise levels are below the target values, the mitigation measures are reduced to a minimum or they are not recommended.

In areas where the current noise level is higher than the target values, the target values are regarded as a natural background noise.

Most of the project area belongs to the **area of III degree of noise protection**[32], where the level of noise in the environment should not be higher than L_d - 60 dB (A) L_e - 60 dB (A) and L_n - 55 dB (A).

However, part of the project area also belongs to the **area with level II[33] for noise protection**, where the noise level should not be higher than L_d - 55 dB (A) L_e - 55 dB (A) and L_n - 45 dB (A).

Assessment methodology

Noise levels during the construction of the railway line are estimated for different distances from the identified construction activities. The assessment took into account the typical noise levels of equipment and relevant factors, such as: attenuation with distance, land effects and topographic barriers. In the calculation of the noise levels of construction, the forests and trees are not considered / taken into account, which makes the assessment more stringent.

Propagation of the noise is a logarithmic function and is expressed as:

$$L = L(ref) - 20 \cdot \log_{10}\left(\frac{D}{D_{ref}}\right) - 10 \cdot \log_{10}\left[G \cdot \left(\frac{D}{D_{ref}}\right)\right]$$

Where:

L (ref) - Noise level at a reference distance from the source

D_{ref} - Reference distance from the source of noise

D - Distance from the source

G – Ground factor

Taking into account the highest values in the Table 76 and neglecting the field factor, the most unfavorable scenario of noise propagation around the construction sites is set, according to which the diagram in Figure 184 is constructed.

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[32] Area with III degree of noise protection is an area where activities are permitted and where noise would be less of a nuisance, ie the trade-business area-residential area, which is also intended for dwelling, ie where there are facilities in which craft and similar activities of production (mixed area) take place, area intended for agricultural activity and public centers, where administrative, trade, service or catering activities are performed.

[33] Area with II degree of noise protection is an area that is primarily intended for residence or residential area, areas in the vicinity of facilities intended for educational activities, social protection facilities intended for accommodation of children and elderly people, and primary health care facilities, area of playgrounds and public parks, public greenery and recreational areas and areas of local parks.

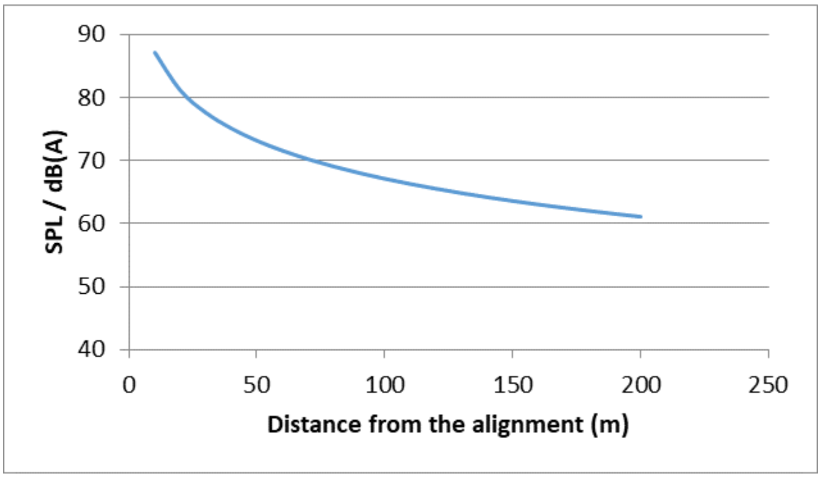

Figure 184 Reducing the noise intensity according to the distance from the source

- **Operational phase**

The environmental noise limit values for different types of regions are defined in Article 6 of the Rulebook on environmental noise levels ("Official Gazette of the Republic of Macedonia" No. 147/08 of 26.11.2008) and they are Shown in the following table:

Table 72 Maximum permitted levels of noise in certain districts

Types of areas	Noise threshold dB(A)		
	L_d	L_e	L_n
Areas exposed to intense road traffic	60	55	50
Areas exposed to intense railway traffic	65	60	55
Areas exposed to aeroplane traffic	65	65	55
Areas with intense industrial activity	70	70	70
Quiet areas out of aglomerations	40	35	35

The method for calculating the expected level of noise from railway traffic in the Republic of Macedonia is prescribed by the Rulebook on the use of noise indicators, additional noise indicators, the method of noise measurement and assessment methods with the environmental noise indicators ("Fig. Journal of the Republic of Macedonia "No. 107/08)[34].

Because the method description in the Rulebook is shown in details, therefore the SCHALL 03 method is applied for calculating. In fact, the SoundPlan Essentials software package with the SCHALL 03 standard for calculations is used. Below are the basic characteristics, equations, and general correction factors used in calculations.

Criteria for noise from rail traffic

The operability of the railway may affect sensitive receptors, that is, the area will be exposed to noise from rail traffic, which can cause adverse impacts on sensitive receptors that have not been affected

[34] However, the Rulebook is not consistent as to which of the methods should be used in calculating or modeling noise from rail traffic. The introductory sentence in Annex 2 to the Rulebook refers to the compulsory application of the Dutch national method of calculation, published in the "Reeken-en Meetvoorschrift Railverkeerslawaai" 96, "Ministerie Folkshistvesting, Ruimteilke Ordening en Milieubeheer, 20 November 1996", however, the description of the method shown in the same Chapter, fully corresponds to the German SCHALL 03 method. Additionally, the aforementioned Rulebook is not in accordance with the Law on Noise, because it calculates the noise levels in two periods (day, night) instead of three (day, evening, night) as defined in Art 20 of the Law.

by this type of noise so far. The impact of noise in the operational phase of the railway on receptors is assessed according to the applicable criteria.

With the commencement of the work on the railway line, the area around it will be treated as an area exposed to intensive rail traffic, which is subject to the limit values shown in **Table 73**.

Table 73 Maximum permitted levels of noise in areas exposed to intense traffic

Period	Noise threshold dB(A)
Day - $L_{eq12\ hours}$	65
Evening $L_{eq8\ hours}$	60
Night $L_{eq\ 4\ hours}$	55

The time periods for noise from rail traffic are:

- Day: a twelve hour period between 07:00 and 19:00,
- Evening: four hours period between 19:00 and 23:00 and
- Night: an eight-hour period between 23:00 and 07:00 h.

Methodology of assessment

With the help of the noise modeling software, SoundPlan Essentials v.2, three-dimensional models of parts of the railway were made, around which groups of sensitive receptors are found.

The modeling of noise propagation was made by applying general acoustic principles such as attenuation with distance, topographic protection, soil effect and absorption in the air. Considered are the neutral weather conditions, since the closest susceptible receptors are located less than 50 meters from the railway. All calculations include a factor of reflection from the facades of +1 dB.

All topographic and geodetic data for the terrain and the railway, with the exception of the height of the houses, are obtained from the designer.

In the following, a preliminary assessment of the noise impacts in the construction and operational phase of the railway is given. Detailed mitigation measures will be applied in the Main Project or the Execution Project, as well as the Noise Management Plan during the construction and operational phases of the Project.

7.6.2 Noise impacts in the construction phase

The construction of a railway is related to a range of noise-generating activities. Noise is generated by the equipment and mechanization, which is used to perform the envisaged activities and its acoustic characteristics. The level of noise at the location of the receptor depends on its distance from the site where the construction works are carried out. The noise level will be relatively high when the construction works will proceed in the immediate vicinity of the receptor, but will be significantly reduced by shifting the activities further along the alignment of the railway. The following tables outline the typical activities for the construction of a railway line and the most commonly used machines.

Table 74 Construction activities that generate noise

Construction activities	Description
Clearing of the project area	The clearing of the project area will take place at the earliest stage, that is, during the preparation of the construction site. Activities can be carried out successively or by simultaneous use of bulldozer, saws, loaders and dump trucks.
Earthworks	Earth works (including excavation, loading, transport, etc.) are likely to last the longest and generate high levels of noise as a result of the use

	of heavy machinery. For the construction of earthworks, bulldozers, backhoe loaders and other heavy machinery will be used. Earthworks for tunneling include blasting, which generates impulse noise, especially when entering and exiting the tunnels.
Construction of bridges and retaining walls	Bridges and retaining walls will be built for crossing of rivers, roads and valleys, as well as for protecting the track from rockfall and demolishing. Activities can take place individually, without simultaneous use of multiple machines, or by simultaneous operation of a pneumatic hammer, compression machine, compressor, generator, etc.
Construction of the railway	The construction of the railroad can take a long time, but it is not expected to have a significant impact on the receptors. The most commonly used equipment and mechanization for this activity is: loader, crusher, compactor, sleeper-placing machine, electric power generators, etc.
Stationary construction site (base)	Stationary construction sites will work throughout the whole construction period, so they should be located as far away from the residential areas as possible in order to reduce the impact of noise. During the preparation of the base, only one machine can be used at one point or simultaneous operation of several machines such as a backhoe loader, a loader and a dump truck. Small performances such as concrete and earthworks in the preparation of parking lots, platforms, tanks, etc. are also contributing in noise generation.

Table 75 lists the machines most commonly used for the construction of railways and the generated noise levels at different distances. The calculations refer to continuous work and take into account only the geometric noise propagation. In this way a stricter assessment is provided.

Table 75 Levels of noise from construction equipment at different stages of the construction

Noise-generating activity	**Equipment/Vehicles**	**Envisaged L_{eq} at different distances from the source (dB(A))**				
		7 m	25 m	50 m	100 m	200 m
Preparation of the project area	Wood grinding and crushing machine	96	85	79	73	67
	Loader	88	77	71	65	59
	Dump truck	83	72	66	60	54
	Water tank truck	82	71	65	59	53
Earthworks	Bulldozer	95	84	78	72	66
	Scraper	85	74	68	62	56
	Backhoe loader	78	67	61	55	49
	Leveling scraper	85	74	68	62	56
	Vibro-roller	89	78	72	66	60
	Ballast placing machine	70	59	53	47	41
	Dump truck	83	72	66	60	54

Noise-generating activity	Equipment/Vehicles	Envisaged L_{eq} at different distances from the source (dB(A))				
		7 m	25 m	50 m	100 m	200 m
	Water tank truck	82	71	65	59	53
Construction of bridges and retaining walls	Machine for impact placement of bars	105	94	88	82	76
	Machine for impact placement of bars by means of drilling	96	85	79	73	67
	Generator	78	67	61	55	49
	Crane	88	77	71	65	59
	Concrete pump	80	69	63	57	51
	Vibrator for concrete	78	67	61	55	49
	Welding equipment	80	69	63	57	51
	Digger	83	72	66	60	54
	Pneumatic hammer	93	82	76	70	64
	Dump truck	83	72	66	60	54
	Concrete mixer truck	84	73	67	61	55
	Water tank truck	82	71	65	59	53
Access roads	Finisher	89	78	72	66	60
	Dump truck	83	72	66	60	54
	Vibrator for concrete	78	67	61	55	49
	Asphalt truck/laying units	81	70	64	58	52
	Vibro-roller	89	78	72	66	60
	Generator	78	67	61	55	49
	Pneumatic hammer	93	82	76	70	64
	Excavator	79	68	62	56	50
	Water tank truck	82	71	65	59	53
Construction of the railway	Dump truck	83	72	66	60	54
	Loader	88	77	71	65	59
	Backhoe loader	78	67	61	55	49
	Vibro-roller	89	78	72	66	60
	Ballast compactor	91	80	74	68	62
	Sleeper-laying unit	83	72	66	60	54
	Angle/incline scraper	88	77	71	65	59
	Water tank truck	82	71	65	59	53
Stationary construction site	Excavator	79	68	62	56	50
	Dump truck	83	72	66	60	54
	Backhoe loader	78	67	61	55	49
	Crane	88	77	71	65	59

Noise-generating activity	Equipment/Vehicles	Envisaged L_{eq} at different distances from the source (dB(A))				
		7 m	25 m	50 m	100 m	200 m
	Generator	78	67	61	55	49
	Lighting tower	66	55	49	43	37

Since different equipment is used at different stages of the construction period, USEPA suggests the following values per phase, as shown in **Table 76**:

Table 76 Levels of noise from the construction site of the railway (15 m from the source)

Phase of construction	Noise from simultaneous use of mechanziation	Noise from minimal use of mechanization
Clearance of the project area	84	84
Excavations	89	79
Foundations	78	78
Construction	87	75
Finishing work	89	75

For the execution of some of the earth works, blasting will also be included. Although it is short-termed and impulsive, blasting can cause an unacceptably high impact if it is not carried out correctly. Well-prepared blasting should not cause a peak higher than 115 dB in 90% of the blasting activities, and no blasting should have a higher peak than 120 dB at sensitive receptors.

The impacts of generated noise on sensitive receptors depend on the type of activities, the distance from residential buildings or other sensitive sites, the existence of natural or embedded barriers, the duration of construction, and so on.

Noise in the construction phase can affect sensitive receptors, that is, the increased level of noise can affect the local population, and also cause negative impacts on the animal world.

Most of the construction activities will be performed outside the populated areas, with no sensitive receptors. Additionally, the noise during construction is a nuisance of a temporary (short-term) nature, so the impacts are not significant, except in the immediate vicinity of the construction sites.

The results of the assessment show that without any mitigation measures, typical values at Leq noise level of 50 to 70 dB (A) can be expected at a distance of about 200 m from the activity. This means that at a certain time, receptors at a distance less than 150 meters from the construction site will be exposed to noise greater than the maximum threshold for second and third degree protection areas. This applies in particular to the intervals between the stations:

- 69 + 950 (before bridge number 16) to 71 + 850 (after entering Tunnel No. 8) (before entering Kriva Palanka and after the station in Kriva Palanka),
- 72 + 760 (before the exit from tunnel No. 8) to 73 + 850 (after entering Tunnel No. 9) -Kriva Palanka,
- 79 + 720 (exit from tunnel No. 16) to 80 + 070 (exit from bridge No. 37) -v. Zhidilovo,
- 81 + 500 to 82 + 680 (at the entrance to Tunnel No. 19) -v. Uzem,
- 85 + 570 (before exit from tunnel No. 20) to 85 + 630 (exit from bridge No. 45) -v. Uzem.

The impacts on sensitive receptors caused by the increased level of noise in the construction phase are assessed as impacts with negligible small to moderate significance.

Since construction activities in the immediate vicinity of the border include the construction of a cross-border tunnel only, no transboundary impacts from noise are expected or if they occur they will be insignificant.

7.6.3 Impacts from noise in the operational phase

The noise in railway traffic originates from locomotives (engine, auxiliary installations, contact between wheels and rails, brakes, sirens) and wagons (contact between wheels and rails, brakes). The number of compositions and speed of the trains are an important factor for generating noise. In fact, the speed of the train determines the dominant source of noise.

Noise from rail traffic can affect sensitive receptors, that is, the area will be exposed to noise from rail traffic. Increased levels of noise can affect the local population, and also cause negative impacts on wildlife.

In order to determine the impact of the noise from the railway traffic, modeling was carried out in order to determine the locations that will be most affected by the increased noise level and to propose measures for their timely mitigation. The modeling procedure and the modeling results are shown in Annex 18 .

Modeling results show that:

- With rare exceptions, only populated objects beneath or near bridges will be exposed to noise, greater than the maximum allowed values for areas of third degree of protection against noise. On sections without bridges most commonly occur bermes, created by digging the alignment of the railway, which contributes to mitigation of the impacts.
- Part of the residential buildings will be affected by increased noise levels, at different times (day, evening and night) as a result of overcoming the permissible noise levels for each time period.

The following are the locations and number of objects that will be affected by exceeding the permitted limit values, for a time period day (L_d), evening (L_e), night (L_n):

Chainage km 65 + 760 to 66 + 100 (village T'liminci)

- Exceeded values for L_e-4 objects
- Exceeded values for L_n-6 objects

Between the chainages km 70 + 600 and 71 + 807 (station Kriva Palanka)

- Exceeded limit values for night-14 objects

Area of chainages km 72 + 774 to 73 + 840 (Kriva Palanka)

- Exceeded values for L_d-12 objects
- Exceeded values for L_e-25 objects
- Exceeded limit values for L_n-43 objects

Between the chainages km 75 + 180 and 75 + 500 (Pashina Vodenica)

- Exceeded values for L_e-8 objects
- Exceeded values for L_n-8 objects

Between the chainages km 79 + 731 and 80 + 080 (Zhidilovo)

- Exceeded values for L_e-12 objects
- Exceeded values for L_n-17 objects

Between the chainages km 82 + 020 and 82 + 520 (Uzem)

- Exceeded values for L_d-3 objects
- Exceeded values for L_e-4 objects
- Exceeded values for L_n-6 objects

The impacts on sensitive receptors caused by the increased level of noise in the operational phase are assessed with moderate significance.

Thematic area: Noise											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Population and Animals	Clearing of the alignment-noise from machines, workers and transport vehicles	Negative	Immediately	Direct	Location	Temporarily	Surely	Reversible	Small	Negligible small	No
Population and Animals	Earth works - noise from machines, workers and transport vehicles	Negative	Immediately	Direct	Local	Short term	Very likely	Reversible	Moderate	Moderate	Yes
Population and Animals	Construction of bridges and retaining walls - noise from machines, the presence of workers and transport vehicles	Negative	Immediately	Direct	Local	Short term	Very likely	Reversible	Moderate	Moderate	Yes
Population and Animals	Construction of tunnels-noise from mining, presence of machines, presence of workers and	Negative	Immediately	Direct	Local	Short term	Probably	Reversible	Small	Negligible small	No

	transport vehicles										
Operational phase											
Population and Animals	Rail traffic-transport of passengers and goods, Presence of railway vehicles for railway maintenance, Transportation of passengers to the station and the halt	Negative	Immediately	Direct	Local	Long-term	Surely	Irreversible	Moderate	Moderate	Yes

7.6.4 Mitigation measures

Thematic area- NOISE	
Pre-construction phase	
Impacts	**Impact mitigation measures**
Increased noise level The construction works and the transportation activities in the contstruction phase will generate increased noise level, which may cause negative impacts on the population and wildlife along the alignment.	The contractor of the construction works needs to prepare a detailed Plan for noise management in the contruction phase, where appropriate measures for decrease of noise in the contruction phase will be foreseen and will allow to meet the criteria for the noise levels, defined in the Decision for establishing in which cases and under which conditions it is considered that the citizen's peace has been disturbed from harmfull noise (Official Gazzette of the Republic of Macedonia No. 1/09 from 01.01.2009). The Plan will identify in details the impacts, duration of impacts on which base specific measures for decrease will be proposed. The plan should be based on the following strategic goals: • Maximum shortening of the duration of construction; • Maximum use of the possibilities for simultaneous activities; • Minimal generation of noise from the equipment (use of most silent equipment or equipment with noise attenuators); • Minimal use of specicial noisy equipment on sensitive locations or in the certain time of the day.
Construction phase	
Impacts	**Impact mitigation measures**
Increased noise level The construction works and the transportation activities in the contstruction phase will generate increased noise level, which may cause negative impacts on the population and wildlife along the alignment.	Despite the implementation of the measures, which will be covered in the Plan for noise management in details, the following measures for decrease of noise level are recommended: **Construction site:** • Locating the noisy equipment as far as possible from the noise sensitive areas; • Selection and location of access roads as far as possible from the noise sensitive areas; • Avoinding work during the night on noise sensitive locations; • Avoinding unloading materials that cause impulse noise. This includes loading materials in dump trucks; • Limitation of blasting operations, exclusively at night and in the shortest possible time internal; • Shutting down the engines of the equipment and machinery when they are not in use; • Concentration of noise activities on one location and transfer to another in shortest possible term;

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Avoiding movement the trucks on the streets of residential areas, whenever possible;
Minimizing driving backwards with the machinery in order to decrease the noise from the noise signals;
Avoiding to create a line of vehicles that run iddle in sensitive areas;
Not to use the sirens of the vehicles for any kind of signalization except when neccesarry;
Implementation of introductory trainings, staff trainings in relation to noise sensitivity, the need to make less noise, not to yell or whistle;
Installation of temporary barriers where it is practical;
Locating the equipment so that the characteristics of the terrain can be used as a natural barrier;
Decrease of noise after the completion of works, i.e. when dismantling the equipment and leaving the construction site.

Equipment

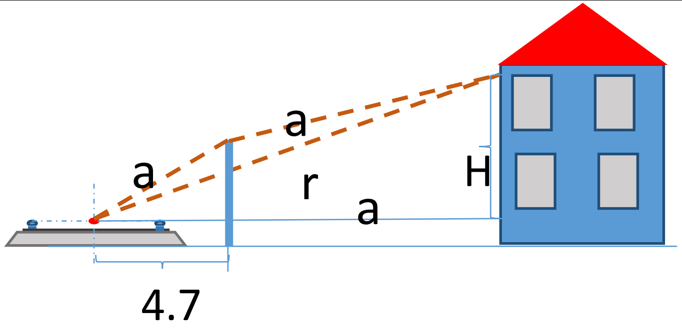
Installation of wide-rande reverse alarms for the equipment which is expected to be driven backwards frequently or during the night;
Check if every vehicle or equipment with an engine with internal combustion has quality muffler (exhaust) installed;
Ensure that the equipment and the machines are well maintained, armor and mufflers are not damaged, rotating parts are balanced, noise from friction is reduced with lubrication, and the noise from cutting is reduced with regular sharpening of the cutting equipment.

Reduction of noise at sensitive receptors

Most of residential objects that are identified as affected by the noise from future railway traffic, will also be exposed on noise from the contruction phase (see chapter on noise impacts). That’s why the measures for reducing the noise from the railway traffic should be implemented as early as possible during the construction, which will ensure noise reduction in both phases at the same time, i.e. installation of permanent sound barriers or sound insulation on the objects as early as possible in the construction phase;
Consultations with affected residents for establishing an acceptable strategy for noise management;
Establishing an easily acceptable and well promoted call service, as well as well developed procedure for complaints and handling with complaints and proposals.

</td>
</tr>
<tr>
<td colspan="2">Residual impacts: There is a possibility for residual impact occurrence that will last only the construction phase, and are directly dependent from the level of working activities, use of equipment and machines, their maintenance, as well as use of access roads. With the implementation of the noise protection measures the residual impacts will be within the limits of the legally allowed noise levels. The importance of residual impacts will be dependant on the nearby receptors and their sensitivity.</td>
</tr>
<tr>
<td colspan="2">Measures for mitigation of residual impacts: If an occurrence of residual impacts is discovered, further analysis on the source of noise emissions and the proposed</td>
</tr>
</table>

<table>
<tr><td colspan="2">measures implemented will be performed, and according to this appropriate measures for decrease of residual impacts will be taken.</td></tr>
<tr><td colspan="2">Operational phase</td></tr>
<tr><td>Impacts</td><td>Impact mitigation measures</td></tr>
<tr><td>Increased noise level
Railway traffic along the rail, use of rail vehicles for maintenance of the rail, transportation of passengers to the station and halt, will generate increase noise level, which may cause negative impacts on the population and wildlife along the alignment.</td><td>The noise from the railway traffic can be controlled with primary and secondary measures. Primary are the ones taken on the source of the noise (surface, sleepers, connectors, rails, wheels, brakes, speed). Secundaty measures are with the purpose to reduce the impact of the noise on the receptors.
Primary measures for reduction of noise level in the environment are:
• Fully welded rails instead of joined together;
• Specially designed sleepers;
• Use of flexible rail connectors for the sleepers;
• Decrease of speed when crossing through sensitive locations;
• Avoiding accelaration or breaking when crossing through sensitive locations;
• Use of disk brakes instead of block;
• Regular shaping of wheels in order to always have ideal circular form;
• Use of brake systems and warnings that generate lowel noise level.
Secundary measures or measures on the receptors include obstacles of dispersment of the noise. They include:
• Sound barriers directly to the rail or on smallest possible distance;
• Sound barriers on smallest practical distance from the receptors;
• Sound insulation on affected receptors.
<u>Sound barriers</u>
Among the most spread measures for noise protection is setting sound barriers between the source of the noise and the receptor. The rule is the hight of the barrier to be 30% higher from the hight where the barrier touches the line between the source and the receptor. According to this the distance of the barrier from the source of the noise affects on its height. The calculations of the sound barriers will be done once their optimal distance from the axis of the rail is established. The basis of the calculations of the sound barriers are given below.</td></tr>
</table>

	 Geometric sizes of the sound barriers calculation The noise mitigation as result of a sound barrier is calculated according to this equation: $D_{e,k} = -(10 \cdot \log(3 + 60 \cdot z_k \cdot K_{w,k}) + D_{BM,k})$ In which $D_{BM,k}$ – noise reduction due to terrain abatement and meteorological conditions $z_k = a_{Q,k} + a_{A,k} - r$ difference in road through and over the obstacle $a_{Q,k}$ - distance from the source to the top of the barrier $a_{A,k}$ - distance from the top of the barrier to the receptor *r* - shortest distance from the source to the receptor If the barrier doesn't cover the optical line between the source and the receptor, then z_k gets negative value. Time correction $K_{w,k} = e^{-\frac{1}{2000}\cdot\sqrt{\frac{a_{Q,k}\cdot a_{A,k}\cdot r}{2\cdot z_k}}}$ for $z_k<0$ $K_{w,k}=1$ Due to the cost price of the sound barriers, they are applicable only on the places that cover larger number of habitats. Additional problem is the field configaration. Conflicts (increased noise levels in relation to allowed values) appear mainly in wide open space on which, usually, the rail is elevated so the height of the barrier needs to be increased additionally.

With rare exceptions, only populated objects under or near the bridges are exposed to noise larger than the maximal for the area from third degree of noise protection. On the sections without bridges berms are formed with the excavations of the rail allignement. That's why, almost all sound barriers, foreseen on this rail section, are on the bridges. In Table 77 a list of locations is provided where the sound barriers should be put, i.e. their location, length and height.

Table 77 List of needed barriers, their length and height

Bridge or distance to bridge	from (km)	to (km)	Side	Length (m)	Height (m) above the rail*
B03	65+841	65+980	Right	30	1.5
B19	71+038	71+127.5	Right	89.5	2
B20	71+323.5	71+419	R ght	95.5	2
B20	71+323.5	71+419	Left	95.5	2
B21	71+569	71+602	Right	33	2
B23	72+804	72+935	Right	137.5	1.5
/	72+935	73+300	Right	365	2
B30	75+340	75+480	Right	140	1.5
B37	79+793	80+003	Left	210	1.5
After B42	82+105	82+352	Left	247	2
Total length				1443	
*the height above the head of rail is calculated					

To preserve the landscape, the barriers should be made from transparent materials (polycarbonate) 20 mm thick. Considering that most of the barriers are on bridges, full concrete fence with thickness of 10 cm can be part of the barrier, and the difference to the required height should be supplemented by the polycarbonate elements.

Individual objects

On the locations where the individual objects are exposed on increased noise level, the noise protection with protection walls is not the most appropriate solution. In these cases it is much more economical to intervene with sound insulation on the object itself. In the following table a list of indifidual objects where intervention is needed are presented. This is not a definite list, because the characteristics of all identifiable objects are not known with certainty.

Table 78 List of individual objects that require individual sound protection

Chainage	Side	Type of object
69+790	Right	Two story house
69+800	Right	Two story house
70+030	Right	Two story house
70+200	Right	One story house
70+220	Right	One story house
81+100	Left	One story house

Residual impacts: There is a possibility for residual impact occurrence despite the use of measures for mitigation of the noise level, especially on conflict locations where an improvement of the sound insulation of the habitats is recommended, in which due to the configuration of the field and from economic reasons (non-profitability) sound barriers can’t be installed.

Measures for mitigation of residual impacts: If an occurrence of residual impacts is discovered, further analysis on the conditions, efficiency of applied measures will be performed, and according to this appropriate measures for decrease of residual impacts will be taken.

7.7 Vibrations

7.7.1 Impacts caused by vibrations

The construction of the new railway line Kriva Palanka-Border with the Republic of Bulgaria, as part of corridor VIII, both in the construction phase and in the operational phase will have potential impacts on the sensitive receptors in the area, due to exposure to vibrations from construction activities and rail traffic impacts (of what until now had not been exposed at all).

Below is a preliminary assessment of vibration and seismic effects from the construction of the new railway line in order to give a global overview of the measures and activities to be undertaken in the pre-construction phase in order to eliminate or reduce possible impacts in the construction and operational phase.

Detailed assessment and specific measures for reducing the impacts of vibration (for each facility separately) will be presented in the phase of preparation of the basic and performance project.

7.7.1.1 Basic concept of vibrations

- **General summary**

Vibrations and noise caused in the ground are present in the environment, but in most cases the level that reaches the receptors is below the perceptual limits.

Sources, which can cause a noticeable level of vibration and noise in the ground, are: transport systems (roads and railways), construction sites, industry, mines, explosions, etc.

Noise generated in the ground is a special case of noise generated in a construction, where the way of propagation is through the ground.

Noise generated on the construction is noise generated at an object from one location and transferred to another, through vibrations of particles on a solid body, in contrast to airborne noise that is directly transmitted through the air.

Vibrations are transmitted through the soil in the form of waves: longitudinal, transverse and surface (Rayleigh and Love) waves.

Each wave type has a different velocity of propagation, different consequences and impacts depending on the distance of the source.

Mechanical vibrations occur when a force acts upon one body, resulting in the release of kinetic and potential energy. Thus, vibrations can be measured as a result of this energy transfer, by moving from the equilibrium position (shift ***d*** in m), the vibration speed (velocity ***v*** in m/sec) and the acceleration ***a*** in m/s^2.

The displacement is measured by a defined axis, while the other two vector values are measured in a specified reference system (x, y, z).

All three quantities are time-varying and are characterized by their current value, maximum value and the so-called root-mean-square (rms), i.e. main value. These three physical quantities (acceleration-velocity-displacement) are uniquely defined for each frequency. By measuring any of them, the maximum or the main values can be obtained for the other two.

Measurement of vibrations can be expressed on a logarithmic scale with a unit of measure decibels (dB) as follows:

Acceleration level at a point:

$L_a = 20 \log (a_{rms} / a_{ref})$

Level of speed at a point:

$L_v = 20 \log (V_{rms} / V_{ref})$

Contrary to sound, where the reference value of the acoustic pressure is defined worldwide as:

p_{ref}= *20 x 10-6 Pa* (Level of noticeable sound), there is no consistent reference measure for vibration. The general values are: $a_{ref} = 10^{-6}$ m/sec^2 and $v_{ref} = 10^{-9}$ mm/s where:

$a_t = dv(t)/dt$

A harmonic vibration velocity signal with amplitude v_0 and a frequency f, where

$\omega = 2\pi f$

And we can write that:

$a(t) = \omega\, v_0 \sin(\omega t)$

So, for each frequency f, the acceleration is related to the speed of the formula:

$a = 2\pi f v$

Another parameter, used to estimate the vibration impact on humans, is the so-called Vibration Dose Value (VDV), which is defined in international and British standards (ISO 8041: 2005, BS 6472-1: 2008) and the reference value when VDV Is expressed in dB is 10-6 inch / s.

7.7.1.2 Factors that affect damaging and effects of vibrations

- **Effects on objects**

The literature[35] lists the following factors that influence the effects of vibration on objects:

- Frequency of vibration;
- Vibration intensity;
- The rigidity of the building;
- The characteristics of the attenuation of the object;
- The type of construction;
- The type of foundation (foundation);
- Duration of vibration;
- The waveform and
- The construction conditions, i.e. Initial (existing) static stresses.

When taking into account the effects of ground vibration on objects, the frequency range of vibration of the ground is of particular importance. If this frequency is the same or close to the natural, i.e. Its own frequency of the object, the effect of resonance occurs, where vibrations become stronger and damage can occur. The own frequency of a multi-storey building is usually taken as fn = 10 / N, where N is the number of floors. Housing objects usually have their own frequency, between 4-10 Hz. On the other hand, only the intensity of the acceleration is not a sufficient criterion for assessing the vulnerability of the facilities.

In seismically active areas and accelerations of 0.1 g, they can cause damage if they are low-frequency, while accelerations of 1 g and more are not dangerous if they are of high-frequency components. Figure 185 shows the relationship between the peak particle velocity (PPV), the frequency, and the possibility of damage to objects.

[35] Heckman & Hagerty (1978), Martin (1980), IVA (1983), Head & Jardine (1992), Stille & Hall (1995), Hintze et al. (1997), Svinkin (2005)

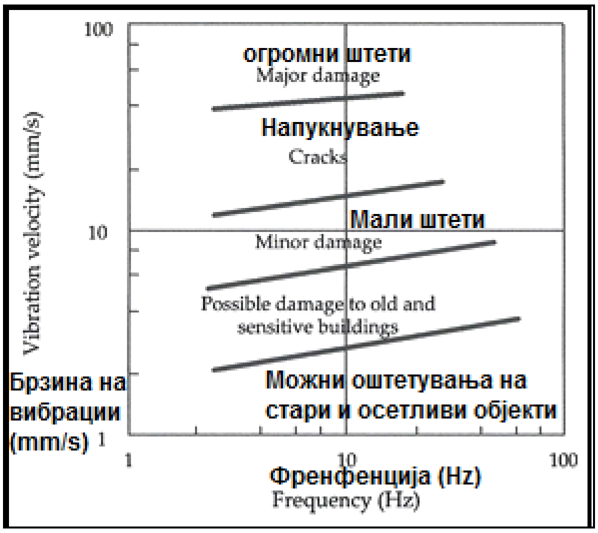


Figure 185 Possible damage to objects depending on speed and frequency (according to Mölleretal. (2000)

The following table[36] shows the relations of the connection: the frequency of the stimulus, the frequency of the object, the type of vibration, stresses and magnitude of significance.

Table 79 Relation frequency of the excitement, frequency of the object, type of vibration, stresses and magnitude of significance

Frequency of excitation (Hz)	0-5	5-10	10-60	>60
Impact on building resulting from	Machines			
	Earthquakes	Traffic, vibration hammer	Vibration hammer, blasting	Blasting
Natural frequency	Whole buildings		Walls, vertical vibrations on cealings	Walls, cealings
	Tall facilities	Low facilities		
Type of vibrations	Vibrations from bending and shearing of the whole building	Combination of both	Vibrations from bending and extension of walls and cealings	
Dynamic stress	Innertia forces	Combination of both	Stress caused by bending and extension	
Significant physical measure	Acceleration	Combination of both	Speed of vibration	

In terms of duration, as a factor for damaging of objects, it is known that short-term vibration, even with a higher intensity, is less dangerous to cause a response in the construction that would lead to damage. Medium-intensity vibration, which lasts longer can be more dangerous because it causes multiple cycles of object vibration, and thus the possibility of damage.

[36] Извор: Niederwanger (1999)

- **Effects on people**

People are very sensitive to vibration from the ground. Most often, the problem is associated with disturbing effects, so that dealing with them is of serious significance.

The degree of perception in humans and their tolerance in terms of the produced / measured vibration level (available mean values in the literature) is quite low, even thirty times lower than the level that can cause small non-structural damage in the objects.

Table 80 Approximate values of the intensity of vibration and sensitivity of people

Approximate level of vibrations (mm/s)	Degree of human perception
0.10	**Not percieved**
0.15	Perception threshold
0.35	Barely noticeable
1.0	Noticeable
2.2	Easily noticeable
6.0	Strongly noticeable

Factors that influence the reaction of people to vibration are:

- Duration of vibration;
- Current personality activity (standing or lying, working or relaxing, etc.);
- Vibration accompanied with sound;
- Frequency of vibration;
- Vibration characteristics (transient or continuous);
- Intensity;
- Physical and mental condition of the person and
- Period of the day.

It is noted that the level of tolerance is higher if people are aware of the possible and expected vibrations. The body is sensitive to low-frequency vibrations / acceleration, particularly frequencies of 2-5 Hz, which is the range of resonance frequencies of the human body. Frequencies higher than 20 Hz are no bigger problem. The duration of exposure to vibration is an important factor that must be considered. The following picture shows the reaction of people to transient vibrations with different duration of time.

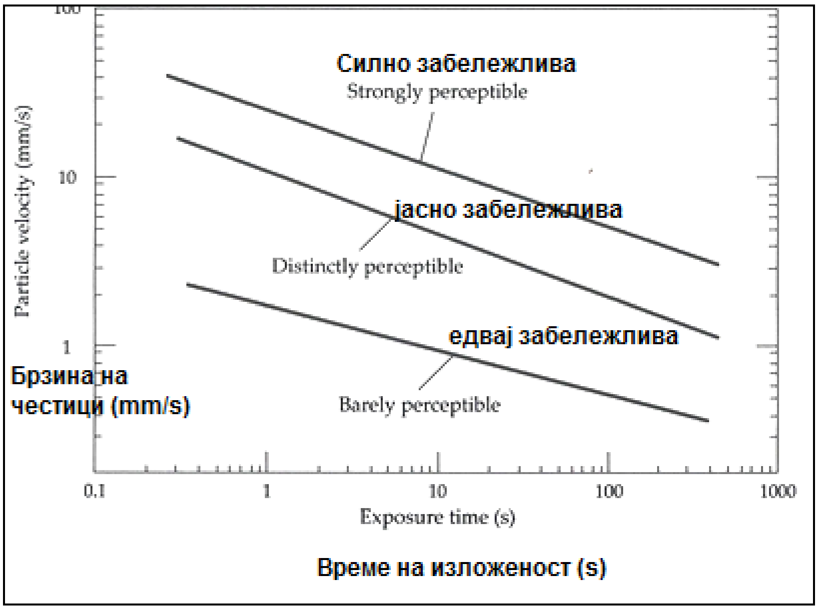


Figure 186 Reaction of people to transient vibrations of different duration, according to Woods (1997)

During the construction of this section of the railway (construction phase), and later during its operability (operational phase), different types of vibrations will be caused, which can have a significant impact on people as well as on objects that are nearby. This is of particular importance considering that so far such effects in the project scope have not been present.

The vibrations caused during the construction of the railway line will be mainly a result of the movement and operation of the construction machinery and blastings, which are necessary for the construction of the objects on the railway tracks, bridges, tunneling, etc.

In the operational phase, vibrations will be caused by railway traffic, that is, due to the movement of trains and the creation of dynamic forces as a result of passing of the train on the tracks.

7.7.1.3 Vibrations and seismic effects of blasting operations

During blasting, there is a sudden release of energy from which a significant part is converted into kinetic energy of the induced seismic waves, which from the site of the explosion radially spread to all directions. Part of the energy of explosive charge, which is not spent on crushing and rocking, turns into kinetic energy of various types of seismic waves (longitudinal, transverse, Rayleigh, and Love waves). They differ in each other in the speed of propagation, intensity and shape of deformations.

In the zone of action of these waves, there is no crushing of the rock, ie, no radial and concentric cracks appear, but elastic deformations in the form of tilting of particles of rock mass occur.

The arrival of seismic waves to an object, which has its own strength-deformation characteristics, causes dynamic strains in it that can cause permanent deformations.

Ground vibrations, caused by blasting, are similar to ground vibrations caused by earthquakes. The difference is mainly in the duration and the length of the oscillation time. Vibrations that occur during an earthquake last longer and have periods of oscillation of 0.5-5.0 s, while vibrations of the explosions last for a short period of time and have periods of 0.004-0.25 s.

- **Vibrations on the ground**

The distance to which the elastic deformations reach is in function of the diameter of the explosive charge:

$$r > 6D$$

Where:

- r- is the distance to which elastic deformations occur (m) and
- D- is the diameter of the blasting hole (m).

The energy of the seismic waves is dampened (is decreasing) by distancing from the place of the explosion. In addition, waves with higher frequencies are dampened faster. This means that at shorter distances from the blasting site, seismic waves with higher frequencies dominate, and at larger distance waves at lower frequencies dominate, since they are slower to dampen. The composition and structure of the rocks, porosity and cracking, the presence of water and so on influence the attenuation (dampening).

The duration of vibration and intensity depends primarily on the quantity and type of the explosive, the properties of the rock mass, the distance from the site of the explosion, the amount of the explosive and the method of activating the minefield.

The amplitudes of velocity, acceleration and displacement of the oscillations (vibrations) on the ground are the best parameters for estimating the possible damage to the surrounding objects and constructions, that is, the intensity of the oscillations is expressed with the measurement quantities greatest speed, displacement and acceleration.

The greatest force, by which the seismic waves of the explosions act on the object, can be represented by the following expression:

$$\mathrm{Fmax} = \mathrm{ma} = 4\frac{\mathrm{Q}}{\mathrm{g}}\pi^2\mathrm{f}^2\mathrm{A}$$

Where:

- Q- quantity of energy (J);
- g- Earth acceleration (m / s2);
- a-maximum acceleration (m / s2);
- f-frequency of oscillations and
- A - the largest amplitude (sm).

The kinetic energy that the seismic waves pass on to the object is:

$$\mathrm{Fk} = 0.5\mathrm{mV}^2 = 2\frac{\mathrm{Q}}{\mathrm{g}}\pi^2\mathrm{f}^2\mathrm{A}$$

The compact and solid rocks are characterized by considerably higher elasticity than the non-bonded soft soils, and because of this, the waves are diminished considerably more slowly. In the soft rocks, as a result of friction of the particles, energy loss and faster dampening of the waves results. In non-bonded materials, the amplitudes of the oscillations of the seismic waves are considerably larger compared to the compact ones with equal seismic energy.

The velocities of propagation of seismic waves and their range depend on the type of rock and dampening that occurs next to the rock. Much of the factors influence the dampening of seismic waves:

- composition and structure of the rocks;
- porosity and cracking;
- the frequency of seismic waves;
- water content;
- the temperature of the rocks;
- Absorption and adsorption of rocks and
- energy consumption and dissipation.

The ground oscillations consist of different types of waves, which differ in the type of deformation, the velocity of propagation and the dynamic properties of the oscillations. These waves are:

- Longitudinal (P-waves);
- transversal vertical (SV-waves);
- transversal horizontal (SH-waves) and
- Surface Rayleigh (R-waves).

Longitudinal waves vibrate in the direction of propagation and cause clamping and stretching of the rocks through which they pass. They are the fastest and first come to the geophones, and in the rocks they cause straining and straining pressure.

The velocity of propagation of the P and S waves (Vp and Vs) can be mathematically expressed depending on the elastic constants of the ground at the base of the foundation where the measurement is carried out:

$$Vp = \sqrt{\frac{E(1-\mu)}{\rho(1+\mu)(1-2\mu)}}$$

$$Vs = \sqrt{\frac{G}{\rho}}$$

Where:

- E – Young's modulus of elasticity of rocks and ground (MPa);
- G - Rock and ground shear modulus (MPa);
- μ - Poisson coefficient of rocks (ground) and
- ρ - density of the rock and the ground (kN / m3).

The speed of the ground oscillations, which occur during the blasting, can be measured in the ground and on the objects depending on the purpose of the test.

The action of seismic effects are the vibrations of the ground that appear as a consequence of the released energy of the explosive which has not been spent on crushing the rock. It is manifested in the form of elastic deformations that spread as seismic waves radially from the site of the explosion.

The intensity of the tremors predominantly depends on the geological composition of the ground, the amount of the explosive, the manner of blasting and the distance from the blasting site.

The radius of the endangered zone during the blasting can be determined by:

- Concrete measurements on the ground and
- Empirical formulas.

The measurements give real data, while with the empirical formulas the orientation scale is obtained for the endangered zone. The criteria for seismic safety during blasting are shown in Annex 19.

7.7.1.4 Vibration from construction machines (expected vibrations during the construction phase)

Activities that will be performed during the construction phase may result in varying degrees of vibration on the ground, depending on the equipment and methods used. The tunnels whose alignment goes through the settlements (especially tunnels in Kriva Palanka) will be constructed by using the method of drill and blast. These activities will be sources of vibration that may affect the sensitive receptors. The operation of the construction equipment causes vibrations that spread through the ground and lose their intensity with the distance. The nearby objects respond to these vibrations in a different way - from unnoticed effects to the effects of certain noticeable damage.

Vibration of the ground from construction activities, most often do not reach the level, which can lead to damage of objects, but can reach values close to the permissible noise and vibrations at the nearby buildings. A particularly sensitive case are the older buildings and historical monuments that are more vulnerable and require special care in order to avoid damage.

The procedure, which is recommended for assessing the impact of vibration from construction activities in humans and buildings, includes assessment of damage based on the selection of the equipment to be used, the appropriate reference level of vibration and their spread depending on the distance, based on the average values from numerous measurements of different types of construction machines. The following table gives an overview of the main sources of vibration from construction mechanization.

Table 81 Source of vibration from construction machinery and equipment (PPV-max value of particle velocity)

Mechanization		PPV at 25 ft (in/s)	Normalized L_V† at 25 ft
Placement of stakes Impact compaction	Upper threshold	1.518	112
	Normal	0.644	104
Pole placement Pneumatic compaction	Upper threshold	0.734	105
	Normal	0.170	93
Backhoe loader		0.202	94
Excavators with retractible bucket	For soil	0.008	66
	For rocks	0.017	75
Vibratory roller		0.210	94
Hydraulic backhoe loader (with auxiliary		0.089	87
Large bulldozers (compactor)		0.089	87
Rotational drill		0.089	87
Dump truck		0.076	86
Pneumatic hammer		0.035	79
Small bulldozer		0.003	58
† RMS speed in decibels (VdB)1 micro-inch/second			

Within this project, most of the work will be done out of populated areas, with no sensitive receptors. Additionally, the vibrations that will be generated during the construction of the railway line are a nuisance of transient and short-term nature.

7.7.1.5 Ground vibration due to railway traffic (operational phase)

Railways are a source of significant vibrations, the level of which should be determined and known, so as not to cause unwanted and unacceptable effects on people and objects nearby.

The source of vibration is the interaction that occurs between wheels and rails. Increased vibrations occur at turnouts and crossings, where the impact of the wheels is stronger. Most of the vibration energy is propagated as Rayleigh waves at certain distances of the line. If the ground is of several different layers, then the reflection of the longitudinal and transverse waves will also affect the vibration level (Figure 187).

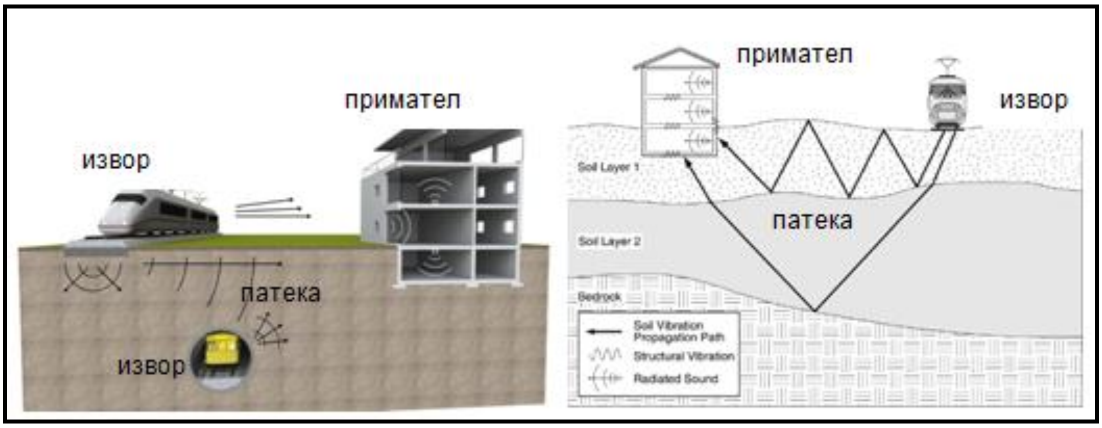


Figure 187 Propagation of soil waves-system source-path-recipient

The vibrations in the ground, caused by trains, are influenced by several factors, such as wheel and rail roughness, the individual support of the rails, the dynamic characteristics of the rotating parts, the rigidity of the substrate, the type of construction of the line, the characteristics of the soil and the type of objects . The resonance frequency in wave propagation is in the range 0-10 Hz for loose soils, and the frequencies are higher for soils with compacted material are higher.

Normally no damage to the objects is caused due to vibration resulting from movement of the trains. Damages may occur in the painting of buildings located near an underground tunnel or railway line. Figure 188 gives the level of acceleration, which causes a certain perception among the population.

Figure 188 Vibration perception

Rms average acceleration		Perception
(m/s^2)	**(mm/sec^2)**	
< 0,01	<10	Unnoticeable
0,015	15	Minimum perception threshold
0,015 - 0,02	15-20	Barely noticeable
0,02 - 0,08	20-80	Easily noticeable
0,08 - 0,315	80-315	Very noticeable
> 0,315	>315	Extremely noticeable

Ground vibrations, caused by rail traffic, can cause nuisance to people living near the railway or interfere with the operation of sensitive equipment in the facilities. Despite the fact that ground vibrations from the railways do not cause damage to facilities, the economic and environmental aspects justify the need to assess the harmful seismic impact caused by heavier and faster trains.

The model for assessing the harmful effects of vibrations should include three main components: the source, the pathway of the spread, and the recipient (Figure 188). Depending on the estimates of these components, three different classes can be identified:

- **First Class (I)**: covers models that can be used at the earliest stage of the project, for preliminary identification of parts along the alignment, which may have excessive ground vibration. The model is simple and quick to use and requires very little Input parameters available in the first phase of the project's development process. These parameters refer to: the type of railway systems, the trains that will travel the track, the typical geotechnical conditions of the ground and the sensitivity of the surrounding objects on the vibrations of the ground.

- **Second class (II)**: includes models that are more class-I class and suitable for more accurate classifying the severity of the problem. These models are suitable for more precisely quantifying the severity of the vibration problem on the ground and more accurately identifying their location along the railway line of the covered models.
- **Third Class (III)**: Includes models with the utmost accuracy, which can be used to support the design and specifications of the track and possible vibration mitigation measures. These models are used as part of the dimensioning process after a decision on the location of the track has been made.

***A source of vibration*-is the interaction of the train that moves the track, which lies on the ground beneath it**. The body of the wagon is connected to the mobile platform by means of a secondary suspension which in modern passenger trains consists of an airbag. The weight of the wagon is then transferred to the wheels through the frame of the movable platform which is connected to the wheels through the primary suspension system. The wheels transmitted the load on the rails one by one.

***The spreading path* is represented by the propagation medium of vibration, once it is created on the track**. Hanelius (1987) suggests that surface Rayleigh waves dominate, and the longitudinal P and transverse S waves of the body are present in the first 20 m. Nelson and Saunerman (1983) give the following equation for the motion (dampening) of the waves in the linear elastic half-space (Table 82 and Table 83):

$$v=v_o\left(\frac{r}{ro}\right)^{-n} e^{-a(y-yo)}$$

Where:

- v_o - velocity of the particles at the source;
- r_o - distance from the source to the reference point of the ground;
- r - distance from the source to the recipient;
- n -dimensional geometric dampening and
- a - Humidity factor.

Table 82 Values of geometric throttling coefficients

Type of wave	Point source	Linear source
Transverse	1	0.5
Longitudinal	1	0.5
Rayleigh	0.5	0
Love	0.5	0

Table 83 Values of humidity factor "a"

Type of soil	Soil humidity factor, a (m^{-1})
Clay saturated with water	0.04-0.12
Lime deposits, soil to lime	0.10
Sand and sludge	0.04

***The recipient* is the foundation of the surrounding objects, which receive vibrations from the medium, which then spread to other parts of the object.**

7.7.1.6 Effects of vibration

Once they are received from the foundations, vibrations are transmitted to other parts of objects. Vibrations can have adverse effects on tenants and sensitive equipment in buildings and can increase the risk of damage to buildings.

7.7.1.7 Reaction of people

The reaction of people to vibrations from the ground depends on several factors, which can be the physical amplitude and the duration of oscillations and physiological, population, age and gender of people. The reaction of people to vibrations is subjective and is different for different people and can be analyzed only statistically.

Shaking the windows, vessels and so on. results in a loud noise (noise on the ground), and there is an interaction between the exposure to noise and traffic vibration (Klebo et al., 2003). As mentioned earlier, people can be more disturbed if they are simultaneously exposed to noise and vibration as compared to when only vibrations are felt. Figure 189 gives a statistical assessment of the sensitivity and response of people to vibrations from high speed trains in residential buildings.

According to the US Department of Transportation (1996), the human threshold for the speed of particles is about 0.04 mm / s (65 dB). Criteria for the impact of ground vibrations on ordinary buildings and special buildings according to US-DOT-293630-1 (1996) are given in Table 84 and Table 85.

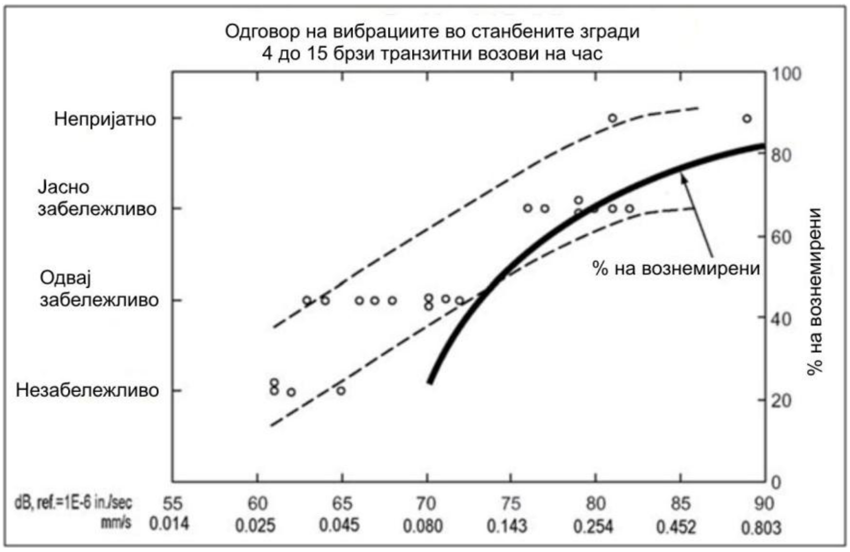


Figure 189 Reaction of people to the vibrations of apartment buildings with 4 to 15 high-speed trains per hour (DOT-293630-1)

Table 84 Criteria for influencing ground vibration (r.m.s. particle velocity) according to the US Department of Transportation (1996)

Category of land use	Level of vibration impact on the ground (dB, ref. $1e^{-6}$ in/s)		Level of vibration impact on the ground (mm/s)	
	Frequent occurences[a]	Rare occurences[б]	Frequent occurences	Rare occurences
Category 1: buildings where vibrations would interfere with the indoors work	65	65[в]	0.05	0.05

Category 2: dwellings and buildings where people usually sleep	72	**80**	0.10	0.25
Category 3: Use of land from institutions with a primary daily use	75	**83**	0.14	0.36

Notes:

a) Frequent occurences-when there more than 70 occurences with vibrations per day

b) Rare occurences-when there are fewer occurences with vibrations per day

c) This limitation criterium is based on the acceptable levels for most of the moderately sensitive equipment, like optical microscopes. Manufacture and research by using the sensitivity to vibrations will require a detailed assessment for defining the acceptable vibration levels. Establishment of lower vibration levels within a building often requires special designs of the HVAC systems and reinforced floors.

Table 85 Criteria for influencing ground vibration (r.m.s. particle velocity) for special facilities by the US Department of Transportation (DOT-293630-1.1996), reference speed vr = 1e-6in / s

Category of land use	Level of vibration impact on the ground (dB, ref. 1e^{-6} in/sec)		Level of vibration impact on the ground (mm/s)	
	Frequent occurences[a]	Rare occurences[б]	Frequent occurences	Rare occurences
Concert halls	65	65	0.05	0.05
TV studios	65	65	0.05	0.05
Recording studios	65	65	0.05	0.05
Amphitheatres	72	80	0.10	0.25
Theaters	72	80	0.10	0.25

Notes:

a. Frequent occurences-when there more than 70 occurences with vibrations per day;

b. Rare occurences-when there are fewer occurences with vibrations per day;

Table 86 gives the criterion for the impact of vibrations resulting from rail transport on the environment (1997). The values indicate a lower limit for a moderate environmental disorder.

Table 86 Environmental Impacts for ground vibration in accordance with the guidelines of Banverket and Naturvars in Sweden

Level of vibrations r.m.s (1-80 Hz)	Particle speed	Acceleration of particles
	0.4 mm/s	14 mm/s^2

7.7.1.8 Impact of vibration on sensitive equipment

Ground vibration, caused by traffic, may affect the operation of sensitive equipment. In ISO10811-1 (2000) and ISO10811-2 (2000), criteria / recommendations for measurement, assessment and classification of vibrations and impacts in the building with sensitive equipment are given. Usually, the guidelines for the maximum level of vibration are given by the equipment manufacturer and should be determined by appropriate measurements of vibration of the ground and facilities in accordance with ISO standards.

7.7.1.9 Impact of vibrations on buildings

There is only 5% probability[37] that buildings will undergo structural damage, due to speeds of particles less than 0.05 mm / s, that is, in normal buildings at speeds less than 15 mm / s.

[37] Nelson and Saurenman (1983)

ISO 4866 (1990) gives instructions to measure vibrations and their impact on buildings. This standard covers the characteristics of the vibrations (intensity and frequency), the type and condition of the buildings and the characteristics of the foundation soil.

It is unlikely (even negligible) that vibrations from rail traffic can cause damage to objects. Typically, the vibration amplitude threshold is about 3 times greater and therefore these vibrations are taken into account in the disturbance of tenants. However, in buildings sensitive to vibrations in the environment, such as cinemas, TV studios, concert halls, and laboratories equipped with sensitive equipment, the vibration effects should be studied separately and thoroughly when a new railway line passes through them. This type of objects are not identified in the project area.

- **Norwegian model for the assessment of vibrations caused by rail transport**

The Norwegian Geotechnical Institute NGI (Madschus et al., 1996) developed a semi-empirical model for estimating low-frequency vibrations of the railway traffic on soft soils.

Ground vibrations caused by rail traffic are influenced by: the source, the track and the receiver, that is, they are influenced by the wheels and rails, the support of the track, the dynamic characteristics of the vehicles, the strength of the rail fastenings, the design of the railway construction, the characteristics of the soil, the type of objects (by construction) and the speed of the train.

Based on certain knowledge of the substrate and on-site conditions, it is estimated that the most sensitive receptors of the vibrations of the railway traffic from the new railway line, section Kriva Palanka-Border with the Republic of Bulgaria, as part of corridor VIII, ie most exposed to the effects of vibration Will be people who live in facilities along the alignment of the railway.

Also, sensitive objects can be special objects of culture and objects with sensitive equipment (hydro meteorological station, above tunnel 8). They need to be considered with greater care in terms of vibration of the ground and taking appropriate protective measures.

According to the data from the performed geophysical and geotechnical investigations, local frequencies on the ground of 4-30 Hz are expected along the line, which can result in possible damage in some of the objects that are more rigid and have their own frequency between 4 and 10 Hz.

Based on the location of the sensitive zones in the project area and the predicted sources of vibration in the construction and operational phase of the line, it can be concluded that these can cause negative impacts on the sensitive receptors. In the construction phase, vibrations caused by blasting can cause negative impacts, which are thought to have small to moderate significance, while the effects caused by vibrations from construction machines are assessed with little significance. In the operational phase, vibrations caused by rail traffic can cause adverse impacts on sensitive receptors and are assessed with moderate significance.

Thematic area: Vibrations											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Sensitive zones (all places where there are cuts, tunnels and bridges) **Zone 5, Zone 6** **Zone 7 and Zone 8** **Zone 11, Zone 12** **Zone 13**	Blast operations / vibration source	Negative	Immediately	Directly	Local	Temporary / Short Term	Surely	Irreversible	Moderate	Negligible small a Moderate	Yes
Zone 3 (plateau 1) **Zone 4 (plateau 2)** **Zone 5, Zone 6** **Zone 7 and 8** **Zone 10, Zone 11** **Zone 12, Zone 13**	Work on construction machines / source of vibration	Negative	Immediately	Directly	Location	Temporary	Surely	Irreversible	Small	Negligible small	Yes
Operational phase											
Zone 3 (plateau 1) **Zone 4 (plateau 2)** **Zone 8** **Zone 11** **Zone 13**	Rail traffic / vibration source	Negative	Immediately	Directly	Location	Long-term	Surely	Reversible	Small to moderate	Moderate	Yes (Depending on the level of vibration)

7.7.2 Mitigation measures

Thematic area-Vibrations	
Pre-construction phase	
Impacts	**Impact mitigation measures**
Impacts on sensitive receptors from increased vibration level in the construction and operational phase	In order to protect this project from unforeseen risks, as well as the residents of the populated areas from possible negative consequences, related with damage of houses, it is recommended: • Record the current state of all houses located along the rail alignement, in certain area with width of 100 m. • Due to the monitoring the conditions of the houses, during the construction and operational phase of the rail, in the affected areas of the alignement, a documented state of the objects should be made, where the actual state of the objects will be described, before starting with construction activities. This will assist in fair compensation for damages as result of the occurred vibrations during the construction and operational phase of the rail. • Implementation of quantitave assessment of the expected vibrations from activities that include shock impacts, drillings, compaction using compactors, demolition, as well as diggings in the vicinity of sensitive objects (for example: masonry structures, historical monuments, as well as those not built aseismically). • The impacts from vibrations and seismic effect on objects on the rail alignment should be determined in the construction and operational phase.
Construction phase	
Impacts	**Impact mitigation measures**
Increased vibration level Increased vibration level caused by the construction works, blasting and work of contructions machines can affect the sensitive receptors along the rail alignment	• Construction operations (cuts, tunnels, bridges) should be done with application of work technique of the construction machinery, especially for drilling and blasting, which will not allow occurrence of harmful seismic effects with adverse impacts on the environment. Because of that, determing the harmful distances to the objects should be in accordance to the technical norms of the legal regulation. • Blasting should be done according to developed mining project for drilling and blasting, according to geological and geotechnical characteristics of the field and protection of objects. Otherwise, permament deformation of the objects in the vicinity above the portals or above the tunnels can be caused by the harmful seismic impacts from the explosions. This especially refers to construction of tunnels of the alignement in urban city area of Kriva Palanka, where the objects are on 5 to 20 m distance above the tunnels alignement. • Avoiding simultaneous performance of more operations that cause vibrations, i.e. working in phases is recommended, where cumulative vibrations impacts will be avoided which would be much larger from the one caused by individual performance of operations.

	• Avoiding activities during the night, beucase people are more sensitive on vibrations in their home during the night hours and in cases of demolition of existing objects, not to use methods involving hit (impact) if possible.
Residual impacts: During the detailed examinations in the pre-construction phase the possibility of occurrence of residual impacts will be established.	
Measures for mitigation of residual impacts: Measures for mitigation will be foreseen, If an occurrence of residual impacts is discovered.	
Operational phase	
Impacts	**Impact mitigation measures**
Increased vibration level Increased vibration level from railway traffic can cause negative impacts on sensitive receptors.	• In the operational phase, the characteristics of the train movement, the construction objects and the ground should be known, according to which the protection measures will be defined.
Residual impacts: During the detailed examinations in the pre-construction phase the possibility of occurrence of residual impacts will be established.	
Measures for mitigation of residual impacts: Measures for mitigation will be foreseen, If an occurrence of residual impacts is discovered.	

7.8 Climate change

7.8.1 Project impacts on climate change

Construction phase

The envisaged construction of the railway line Kriva Palanka-border with the Republic of Bulgaria includes activities that are sources of greenhouse gas emissions, such as:

- Construction and transport activities: use of construction equipment, heavy machinery and vehicles, which most often use diesel as fuel;
- Installations for the production of building materials (if they are placed in the project area or in its vicinity), also often use diesel fuel as propellant;
- Removing the vegetation and preparing the project area for construction works.

The combustion of diesel fuel generates greenhouse gas emissions, typical of diesel-powered vehicles. The quantities of generated greenhouse gas emissions in the project area will depend on the age and the condition of vehicles and equipment, ie the efficiency of internal combustion engines, as well as the duration of the performance of the activities.

When clearing the site, the removal of the vegetation will be carried out, in order to ensure the smooth execution of the construction activities and accessibility to the site. The removed vegetation, in the form of waste, if it is not handled in a timely manner, under the influence of various climate factors (increased humidity and temperature) can begin to decompose, which will generate methane, but odor emissions are also possible.

Considering the fact that most of the vegetation to be removed is forested, no emissions and impacts of this kind are expected, as it is assumed that the removed vegetation will immediately be handled, ie it will be sold as a wood mass.

Possible ignition of the vegetation (accidental or deliberate), as well as the possible occurrence of fires and other incidents in the construction site can be sources of greenhouse gases.

The removal of vegetation, or forest plantations, can cause microclimatic changes in the area. Also, with the removal of broadleaf forest plantations, the power / capacity of the forests for the utilization of CO_2 from the air has decreased, and its concentration decreased. Considering the fact that removal of 7,81 ha of forest and forest area is planned for construction of the railway line, significant changes and impacts on climate change are not expected.

Despite the fact that the abovementioned activities will undoubtedly contribute to the increasing of the greenhouse gas emissions and contribute to climate change, it is anticipated that the effects of these will not be significant as compared to the benefits of the Project implementation in the context of emission reductions of greenhouse gases, generally. Because construction activities in the immediate vicinity of the border include the construction of a cross-border tunnel only (the activities will be carried out exclusively on the territory of the Republic of Macedonia), therefore these impacts are considered insignificant.

Operational phase

As stated earlier, the construction of the Kriva Palanka-border Railway with the Republic of Bulgaria will make a significant contribution to the mitigation of climate change impacts at the national level. In addition to the fact that with the construction of the railway line part of the road traffic (identified as one of the important sources of greenhouse gases) will be replaced by rail, an additional benefit for mitigating climate change is that the railway will be electrified. Railway operation will contribute to the reduction of CO_2 emissions nationally by 27 (kt) by 2030 or the cumulative CO_2 emissions will be reduced by 229 kt.

From the operational activities that will take place on the railway line, emissions of greenhouse gases will be generated, mainly from:

- ✓ Use of diesel locomotives for maneuvering, auxiliary railway vehicles, railway maintenance machines, vehicles for transporting passengers to and from the station in Kriva Palanka and the halt in Zhidilovo, etc.;
- ✓ Regular disposal of vegetation along the railway line. Inadequate management of this type of waste (decomposition of waste or its ignition, accidental or deliberate) can cause the generation of methane and other greenhouse gases;
- ✓ Emergence of fires (forest fires due to burning of vegetation in the protection zone of the railway line or as a consequence of a major accident-overturning of tanks with flammable liquids or explosion of materials subject to transport), as well as other incidents in the operational phase of the railway.

Based on the foregoing, it can be concluded that as a result of the operation of the railway, greenhouse gases will be generated which will contribute to global climate change, but they will be negligible without particular adverse effects on the sensitive receptors in the area.

Thematic area: Climate change											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Climate change	Cutting the forest, for the purpose of carrying out construction activities - reduction of the absorption area for CO_2 from the air	Negative	Immediately / Delayed	Direct / Cumulative	Area	Mid-term	Probably	Reversible	Negligible	Negligible small	Yes
Climate change	Construction and transport activities, as well as inadequate management of biodegradable waste / GHG emissions	Negative	Immediately / Delayed	Direct / Indirect / Cumulative	Area	Short term	Little Probability	Reversible	Negligible	Negligible small	Yes
Operational phase											
Climate change	Rail traffic, as an alternative to road traffic - reduction of greenhouse gas emissions	Positive	Immediately / Delayed	Direct / Indirect / Cumulative	National	Long-term	Surely		Large	**Large**	**No**
Climate change	Rail traffic and maintenance of the railway line, inadequate management of biodegradable waste /	Negative	Immediately / Delayed	Direct / Cumulative	Location	Long-term	Little Probability	Reversible	Negligible	Negligible small	Yes

	Emissions of greenhouse gases										

7.8.2 Mitigation measures

Thematic area-Climate change	
Construction	
Impacts	**Mitigation measures**
Climate change Greenhouse gas emissions generated from the construction equipment, heavy vehicles, other vehicles, facilities for the production of construction materials (if they are in or near the project area), removal of forests, degradation of organic waste (from removed vegetation and clearing of the project area), can cause negative impacts on climate change	• Implementation of the measures from the **Vegetation Management and Removal Plan**, that will include methods and procedures for removal, storage, transport and further treatment of the removed vegetation in terms of reducing the greenhouse gas emissions • Incineration of the vegetation in the project area is not allowed • The Contractor should immediately (with the commencement of construction activities) take action for establishment of forest near the project area that will compensate the leaf surface capable of CO_2 • Implementation of the measures from the **Traffic Management Plan** that will include: - Optimization of the heavy vehicles traffic, i.e. to be performed in a way that will provide use of minimal number of trucks for the transport of maximal volume of material and shortest alignments for transport of materials and waste to a dumping ground - Adequate maintenance of the vehicles and the construction equipment in order to achieve compliance with the relevant emission standards etc. • The Contractor of the construction activities should prepare and implement **Waste Management Plan** as well as **Fire, Explosion and Hazardous Materials Management Plan** etc.
Residual impacts: By implementing the mitigation measures for greenhouse gas emissions, no residual impacts are expected. Residual impacts can appear due to the removal of vegetation, but they are insignificant.	
Residual impacts mitigation measures: If residual impacts are evident, an additional impact analysis will be carried out and additional measures will be undertaken.	
Operation	

<table>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>Climate change
Greenhouse gas emissions from the diesel locomotives and other auxiliary rail vehicles[38] for railway maintenance, vehicles for transport of passengers, inadequate management of the removed vegetation can cause negative impacts on climate change</td><td>• Implementation of good practice for railway maintenance and the equipment involved
• Training of the employees that maintain the alignment as well as preparation of educational material regarding the prohibition of incineration of the vegetation along the alignment (a procedure that is prohibited)
• PUC ”Macedonian Railways-Infrastructure” will prepare and implement Waste Management Program as well as Disaster and Other Accidents Protection and Rescue Plan (that includes measures for fire protection), as well as adequate personnel education</td></tr>
<tr><td colspan="2">Residual impacts: By implementing the mitigation measures for greenhouse gas emissions, no residual impacts are expected</td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: /</td></tr>
</table>

[38] HMD-heavy motor draisine for train pull, machine for construction of the permanent way, small maintenance machines, excavator for maintenance of slopes.

7.8.3 Impacts of climate change on the railway

The impacts on the railway, caused by climate change, will mainly come from possible temperature changes, the occurrence of long-lasting drought periods, strong torrential rains and floods, increased frequency and power of wind, sudden heavy snowstorms and the appearance of more frosty days .

The configuration of the terrain of Section 3 of the eastern part of the railway Corridor VIII, which abounds with dry valleys of ephemeral streams, the valleys of seasonal and constant watercourses, steep slopes, relatively high mountains, as well as the planned robust structures that will comprise the railway (bridges, viaducts and tunnels) are sufficient indicator of the vulnerability of the railway line to Section 3 of the possible impacts caused by climate change.

Climate change can affect the railway and contribute to possible risks of damage that may affect:

- railway infrastructure (which includes electrical installations, communication, water supply), parking lot and other railway assets;
- railway operations and maintenance;
- employees and passengers, etc.

Therefore, this chapter focuses on the possible impacts on the railways that may be caused by climate change, affect its stability, and the stability of other railway structures.

- **Impacts caused by increased ambient temperature**

The average annual temperature in the Kriva Palanka region is 10.2 °C, and the average annual minimum temperature is 5.5 °C, while the average annual maximum temperature is 15.9 °C. While the absolute maximum air temperature is in summer (August) – up to 36.6 °C in Kriva Palanka.

In the Republic of Macedonia there are no specific scenarios for possible temperature changes in the northeastern region, that is, in the region of Kriva Palanka. Due to this disadvantage, the information on the climate scenarios outlined in the Third National Climate Change Plan[39] will be used here, which provides climate scenarios for the Republic of Macedonia.

The scenarios for the changes in the air temperature in the Republic of Macedonia are considered in relation to two selected points, point A with coordinates 41.25 °N, 21.25 °E, which is representative for almost three quarters of the territory of Macedonia, and point B with coordinates 41.25 °N, 23.75 °E, which is representative of the most eastern parts of the country.

[39] Third National Climate Change Plan, Ministry of Environment and Physical Planning, 2014

Figure 190 Location of points A and B in relation to which the temperature of the air (and precipitation) is assessed

From the figure it can be seen that the alignment of Section 3 is within the scope of impact of point A, i.e. the assessments made for point A are applicable to Section 3 of the railway Corridor VIII, which extends from Kriva Palanka to the border with the Republic of Bulgaria.

The predicted changes in air temperature for point A for a period of four years (2025, 2050, 2075 and 2100) for all seasons (winter, spring, summer, autumn) are given in the following table.

Table 87 Predicted changes in air temperature for point A for a period of four years (2025, 2050, 2075 and 2100) for all seasons

Winter				**Spring**				**Summer**				**Autumn**				**Annual value**			
2025	2050	2075	2100	2025	2050	2075	2100	2025	2050	2075	2100	2025	2050	2075	2100	2025	2050	2075	2100
1,1	2,4	3,8	5,0	1,4	3,0	4,6	6,2	2,4	4,8	7,9	10,6	1,5	3,0	5,0	6,7	1,6	3,3	5,3	7,1
0,9	1,9	3,0	3,9	1,1	2,4	3,6	4,8	1,9	3,8	6,2	8,2	1,2	2,4	3,9	5,2	1,3	2,6	4,2	5,5
0,8	1,5	2,2	2,7	1,0	1,8	2,7	3,3	1,7	3,0	4,6	5,8	1,1	1,9	3,0	3,7	1,2	2,0	3,1	3,9
0,7	1,0	1,5	1,7	0,9	1,3	1,9	2,1	1,6	2,1	3,4	3,9	1,0	1,3	2,2	2,5	1,1	1,4	2,2	2,5
0,5	0,8	1,1	1,1	0,7	0,9	1,4	1,4	1,2	1,5	2,4	2,7	0,7	1,0	1,6	1,8	0,8	1,0	1,6	1,7

Legend:

High intensity change
Moderately high intensity change
Moderate intensity change
Moderately low intensity change
Low intensity change

Based on the scenarios, an increase in annual temperatures can be expected, as follows:

- increase from 0.8 to 1.6 °C for 2025;
- increase from 1.0 to 3.3 °C for 2050;

- increase from 1.6 to 5.3 °C for 2075; and
- increase from 1.7 to 7.1 °C for 2100.

The expected increase in temperature as a result of climate change can directly affect:

- ✓ The structure of the rails by causing rail buckling, which would endanger the safety of the railway traffic. Namely, at an increased ambient temperature, compression forces are developed in the steel of the rail, which triggers buckling. This type of damage to the rails is the reason for the higher costs of maintaining the rail, than usual, and also affects the travel time and safety of passengers, machines and workers involved in maintaining the railway.

Figure 191 Bending the rails as a result of high ambient temperatures[40]

- ✓ Since Section 3 consists of multiple bridges and viaducts, the so-called bridge expansion is possible as a result of the increased ambient temperature. If no appropriate measures are taken during the design phase of the bridge, as a result of this effect, disturbances in the stability and the static of the bridge are possible.
- ✓ Heating of the electrical equipment and occurrence of interruptions or permanent damages, which will lead to interruption of the railway traffic, as well as the possibility of unwanted accidents;
- ✓ Distortion of overhead line structures;
- ✓ Increased frequency of fires along the railway, can occur in sections of track with wooden sleepers (the turnouts), but it can damage the system for signaling and telecommunications, as well as overhead catenary from which the train is powered by electricity through the pantograph. Fires can spread to the railway station in Kriva Palanka and halt in Zidilovo and cause damages and losses of human lives and material goods (private and state-owned).

[40] Source: Marteaux Olivier: Tomorrow's Railway and Climate Change Adaptation: Executive Report, May 2006

- ✓ The extension of the vegetative period of plants as a result of an increase in temperature can lead to an extension of the summer maintenance of the line, particularly regarding the application of herbicides, which again in turn can impact the total annual amount of herbicides used along railway tracks for the removal of vegetation that will pollute the soil and water, but will also affect the increase of the cost of maintenance of the tracks.

- **Impacts caused by heavy rains and floods**

The results from the analysis of the changes in precipitation in the scope of Impact of point A, for four selected years (2025, 2050, 2075 and 2100) and in all seasons of these years are given in the following table.

Table 88 Predicted changes in the amount of precipitation (%) in the central point A for the four seasons and annually

Winter				Spring				Summer				Autumn				Annual value			
2025	2050	2075	2100	2025	2050	2075	2100	2025	2050	2075	2100	2025	2050	2075	2100	2025	2050	2075	2100
-1	-3	-2	-1	-2	-5	-7	-9	-4	-12	-29	-36	-1	-5	-8	-9	-2	-6	-8	-8
-1	-4	-3	-2	-2	-6	-10	-12	-6	-15	-38	-47	-1	-7	-10	-13	-3	-8	-10	-12
-3	-6	-7	-9	-3	-8	-13	-17	-13	-25	-46	-57	-2	-9	-14	-20	-4	-10	-15	-19
-4	-8	-11	-16	-4	-9	-17	-23	-20	-38	-54	-66	-4	-11	-21	-27	-5	-11	-21	-27
-5	-10	-14	-20	-5	-12	-21	-29	-25	-48	-68	-80	-5	-14	-25	-34	-6	-14	-25	-33

Legend:

High intensity change
Moderately high intensity change
Moderate intensity change
Moderately low intensity change
Low intensity change

From the table it can be concluded that in the period from 2025 to 2100 it is expected that the precipitation will decrease in all seasons (spring, summer, autumn, winter), but also on an annual basis. However, the biggest decrease is expected during the summer period.

Despite such scenarios, it should be emphasized that at increased ambient temperature, the amount of evaporated water is greater, and therefore the condensation of water vapor into the atmosphere. Short-term but heavy rains, which are expected as a result of future climate change, can increase the risk of flooding. Floods pose a particular threat to the railways which are mainly in flat areas, which is not the case with section 3, but also in cuts and railway tunnels (which are numerous in section 3).

Short and heavy rains are the cause of erosion and landsliding that can be a threat to earth works (embankments, etc.), as well as the stability of railway bridges, viaducts and cuts. The facilitated melting of the snow, caused by high temperatures in the spring period, can cause floods and the occurrence of torrential waters in the dry valleys and rivers.

The erosion caused by such phenomena can cause destabilization of the structures of the railway line with the appearance of an unsafe surface for the trains (and thus additional costs for maintenance and repair of the damage caused). Landslides are more common in cuts, where full blockade can occur, and if they are located near a tunnel, then it can be completely buried / closed.

Figure 192 Erosion of the embankments before entering the tunnel - a potential threat to the safety of the railway traffic[41]

If the eroded material reaches the surface watercourse, it can pose a threat to the stability of the pillars of the bridges, due to the pressure it will exert on them.

Disturbance of the stability of bridges and viaducts may be caused by large amounts of water, which flows faster around the pillars of the bridge, and may cause scouring. Section 3 will pass dry valleys and valleys with steep slopes, which during heavy rains could create strong rapids. The worst possible scenario is demolition of a bridge or viaduct.

Figure 193 Bridge scouring and effects (Zagreb, 2009) [42]

Inadequate dimensioning[43] of the culverts and drainage systems (planned along the railway line) can contribute to the accumulation of water, which can remove the ballast on which the rails are laid (that is, damaging the embankment and permanent way of the railroad). This would jeopardize the stability of the railway itself, which would entail a range of security issues (passenger and cargo security).

Flooding of the railways can damage the signaling and telecommunication system, located along the railway line, as well as the electrical equipment. This would pose a serious risk to the safety of rail traffic, both passenger and freight.

From the point of view of the increased risk of flooding, it should be mentioned that up to the bridge B32 on the river Kiselicka, the railway line is located on the right side of the river Kriva Reka, which is a south side that is exposed to solar radiation for longer time. This is especially important in the winter period when the snow cover lasts much shorter time and melts.

[41]Source: Stipanovic-Oslakovic Irina: Risk assessment of climate change impact on railway infrastructure – Dutch case study

[42]Source: Stipanovic-Oslakovic Irina: Risk assessment of climate change impact on railway infrastructure – Dutch case study

[43]Dimensioning not taking into consideration climate scenarios, more precisely – flows of water caused by climate change

- **Impacts caused by droughts**

In the municipality of Kriva Palanka, on average in the year there are 79 warm and 20 hot days. This data, as well as the general conclusion from the scenarios for changes in precipitation that says they will decrease in the future (see Table 88), especially in the summer period of the year (for the months of July and August, a full absence of rainfall is predicted), which impies the possible occurrence of droughts with more intense character and with a higher frequency of appearance.

Long periods of drought can cause drying of the soil, which in turn can cause displacement of the elements of the permanent way, as well as to reduce the volume of soil around the funded elements of the structures of the railway (pillars, retaining walls, catenary, etc.). This can cause instability in the structures, deterioration of structure, etc., which in turn may be the reason for interruptions of normal operation of the railways.

- **Impacts caused by strong winds**

Kriva Palanka is a windy area. Winds in Kriva Palanka are blowing almost from all directions and at any time of the year.

In the Republic of Macedonia so far no analysis has been made for the change in the frequency and speed of the winds, which usually occur in the region of Kriva Palanka. However, despite this, the possible impacts that strong winds can cause on the railroad will be described here.

Strong winds can jeopardize the safety of rail traffic. They increase the probability of rolling over the carriages, and they can also affect the stability (pushing, folding, breaking) of the installed electrical equipment and signaling along the railroad. In case of strong winds, it is possible that the overhead cables will be unplugged from the power supply network.

Strong winds can cause trees to fall on the track, as well as increased presence of leaves along the track which can lead to stagnation or slipping / overturning of wagons or objects that are located next to the railroad, with consequences for the safety of passengers and the freight being transmitted. This may also be the reason for derailing of freight wagons carrying dangerous material with severe consequences for the environmental media.

- **Impacts caused by snowstorms and frost**

For most of the territory of the Republic of Macedonia, there are 20 to 60 days with frost. The average value for days with ice in the highest mountain regions is from 80 to 125.

During periods of very low ambient temperatures, the temperature of the rails can be up to five degrees below the ambient, which increases the tensile strength (pressure) in the steel. This is the reason for rail breaking, a problem that presents a significant risk to the safety of the railway traffic.

Figure 194 Impacts caused by snowstorms

Due to the breaking of the rail, the occurrence of a major accident in the track circuits is also possible. It is a series of devices along the track that allow to find out the exact position of a given train, thereby coordinating the safe distance between the trains. By breaking this circuit, the signaling system becomes dysfunctional.

In case of large snow drifts, snow can get into the engines of the locomotives and there will be a break in the traffic.

In heavy snowstorms, large snow-fall on the railway is possible, which can make a complete blockade. Particularly critical locations on section 3 are the parts that are not in tunnel and are located on the right side of the Kriva Reka valley, after the bridge of the Kiselicka Reka. This region is distinguished by many larger watercourses, but also with much larger snow drifts in winter, which last for a long time. But, at this stretch, right up to the border crossing, the line will go through several tunnels, which will protect it from climatic disasters. The most sensitive point on this section is expected to be the horseshoe curve upstream of the village, which is completely open and directly exposed to the effects of climate disasters.

- **Risks to passengers and staff**

Any endangering of the safety of rail traffic, which is due to the impacts of climate change, poses a threat to the health and life of people.

In addition, rising temperatures can have a negative impact on the comfort of passengers, if there is no proper ventilation system on the train, especially in overcrowded trains and trains that are in a halt. Disturbance of passengers' comfort can also occur in railway stations that have large glazed walls and / or windows. The lack of security from direct sunlight can increase the risk to human health.

High temperatures pose a risk factor for train staff as well as railway maintenance workers.

Heavy rains and winds can pose a risk factor for the safety and health of passengers and staff. High-power winds can turn a man, while rains can contribute to slipping.

- **Socio-economic effects that will arise due to the impacts of climate change on the structures of the railway**

The socio-economic effects that can arise due to the impacts of climate change on the railway line are diverse. More precisely, the time required to reparate certain damage caused by climate change causes a delay or a cessation of railway traffic for a certain period. This affects the normal performance of everyday obligations of all passengers dependent on rail traffic.

The interruption in rail traffic, on the other hand, would increase the frequency of other types of traffic, primarily the road. Local human communities in this way could be affected by the occurrence of traffic jam, as well as by increased levels of emissions of exhaust gases in the air. Traffic jam would have consequential effects on accessibility to work place, schools, hospitals, and so on. Increased air pollution increases the risk to human health (frequent allergies, airway problems, etc.).

Also, if the damage to the railway infrastructure occurs near another type of infrastructure, such as the road, then there could be a disruption of the services provided by the given infrastructure, which would expand the socio-economic impact.

Especially, impact is expected on the supply of the energy sector with coal and biomass since these resources are mostly transmitted through railway traffic, as well as the supply of oil to various other industrial sectors.

The economic impact is perceived in the prices and costs that are needed to repair the damage caused by climate change. These are additional costs that would arise from the impacts of climate change, or if the railways are not adapted to future climate change. Certain aspects, such as the prolonged vegetation period, will also increase the cost of maintaining the railways.

The wider socio-economic impact is represented by the effects on the overall competitiveness of the state within the European market and beyond, as well as the impact on economic development and well-being (reduced trade).

Thematic area: Climate change											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Operational phase											
Railroad	Climatic changes (increased and / or decreased temperature, heavy rainfall and snow, ice occurrence) / rail deformations (bending of rails, breaking of rails and track circuits, spreading of bridges, signaling damage and power supply system, Occurrence of a fire, etc.	Negative	Immediately / Delayed	Direct / Indirect	Location	Long-term	Probably	Reversible	Moderate/Large	Moderate	YES
Population (passengers, personnel, business sector)	Climate change (increased and / or decreased temperature, heavy rainfall and snow, frost) / risk to the safety and life of passengers and employees, delayed travel, slowdown, economic losses, etc.	Negative	Immediately	Direct	Regional / National	Long-term	Probably	Reversible / Irreversible	Negligible / Moderate	Moderate Large	YES

7.8.4 Mitigation measures

Thematic area-Climate change	
Pre-construction and construction	
Impacts of climate change on the railway Climate change can cause deformations on the rail and bridges, tunnel encumbering, impairment of the signal and electronic system that can lead to interruption and threaten the safety of the railway traffic	In order to avoid the possible impacts of climate change on the railway, it is recommended to implement the following measures during the pre-construction and construction phase: • Adequate dimensioning of the drainage infrastructure during the designing of the railway • In order to reduce the risk of bridge scour, the placement of large stone blocks at the base of the bridge piers and enforcement of foundations with concrete is recommended. The critical points where protection works are envisaged are given in the table: Protection works at bridges • Stabilization with retaining walls at all possible areas prone to erosion • Stabilization of the inclines in cuts, as well as slopes, by means of installing a drainage system or by implementing the technique “soil nailing” – placement of reinforcing elements in the soil, e.g. reinforcement steel bars • Reduction of the alignment angle • Raising of the track and the signaling equipment at locations prone to flooding. • During designing, consider the installation of expansion joints at bridges that will contribute to bridge adaptation to temperature changes, which will alleviate the effects of thermal expansion of the bridge
Operation	
Impacts	**Mitigation measures**
Impacts of climate change on the railway	The mitigation measures, i.e. climate change adaptation measures for the built

Climate change (elevated and/or lowered temperature, heavy rain and snow, ice etc.) can lead to deformations of the railway (rail buckling, rail breaking and track circuit failure, bridge expansion, damage of the signalisation and the electric power system, higher risk of fire etc.) that can jeopardize the safety of the railway traffic	structures of the railway should alleviate the damage from the expected climate change, that can otherwise affect the structural integrity of the railway, the signalling infrastructure, electric power system and safety of railway traffic. The adaptation measures are shown below, which will help to alleviate the future impacts of the climate change and would strengthen the resilience/adaptation of the railway to the future climate change
Impacts due to increased temperature and occurrence of droughts The increase of temperature can directly impact the: structure of the rail (rail buckling, bridge expansion), frequent occurrence of fire, warming of the electric equipment, extension of the vegetation period, instability of built structures, scouring etc. These manifestations may cause delay in train traffic and increase of the maintenance expenditures	**Adaptation measures** <u>Rail buckling can be prevented with the implementation of the following measures:</u> • Monitoring the temperature in order to detect a possible increase • Avoid railway repairing or maintenance activities that can immediately deteriorate the stability of the track during exceptionally high temperatures in the summer period[44], since this will increase the probability of rail buckling • Coloring the rails with a white color at points that are most prone to buckling, which will make the steel to absorb less heat • Speed restrictions of trains at vulnerable sections, since slower trains exert less force on the rail which reduces the probability of buckling <u>Reduction/prevention of fires</u> In order to prevent fires, the following measures are recommended: • Preparation of Vegetation Management Plan • Clearing of the flammable waste around the railway • The trains generating sparks to be supplied with sufficient amounts of firefighting water and firefighting equipment • Compliance with the appropriate standards in tunnels (described in the part for fire risks)
Impacts due to heavy rains and floods Short-term heavy rains can increase the risk of floods, and they also may cause erosion	**Adaptation measures** The described possible impacts from heavy rain and floods triggered by climate

[44] The temperature range at which the rail does not buckle (at high temperatures) nor breaks (at low temperatures) in continuously welded rail (as the Section 3 will be) is 21°C to 27°C (NR/L2/TRK/3011). Thus, above 27°C the risk of rail buckle increases.

and landslide that can jeopardize the earthworks (embankments etc.) as well as the stability of railway bridges, viaducts and cuts	change can be managed with the following measures: • Establishing a communication system with the country's Hydro-meteorological department (or other relevant institutions) in order to get timely notifications for possible floods • Regular presence of equipped teams for taking timely action (water pumping etc.) • Setting of flood defense systems (barriers lined with a membrane that will prevent the water from fleeing towards the railway infrastructure) • Regular maintenance of the culverts, clearing of branches and leaves from the ditches and culverts along the railway • Installation of pumping stations at sites that are prone to flooding
Impacts due to strong winds Strong winds can jeopardize the safety of the railway traffic due to the increase of probability for wagon overturning, and can affect the stability of the electric equipment and signalization along the railway	**Adaptation measures** The impacts from strong winds can be reduced if the following measures are implemented: • Installation of instruments for measuring the magnitude of winds or online communication with the Hydro-Meteorological Department • Restriction of the railway traffic during strong winds
Impacts due to extreme low temperatures, snowstorm and ice Low temperatures can cause rail breaking and track circuit failure, while large snowdrifts can lead to snow infiltration in the motor of the train and cause traffic delays. During a heavy snowstorm, large snowdrifts are possible that can block the railway	**Adaptation measures** In order to reduce and/or prevent the impacts from low temperatures, snowstorm and ice, the following measures are proposed: • Use of rail vehicles for winter maintenance and clearing of the railway equipped with a system for application of hot air on snow and ice, snow/ice shovels • At the sites that are most prone to freezing risk or snow blockades, to set barriers that will prevent the snow from falling at the track. These sites are located at the shaded side of the Kriva Reka's Valley, at the village of Uzem • Prevention of snow and ice accumulation by applying antifreeze liquid and placing heating belts at the contact rail • Clearing of the vegetation that is too close to the track (due to snow

	burdening of the branches which can lead to twisting towards the track, causing damage on the track or traffic delay) Prevention of track circuit failure (track circuits are part of the signaling equipment) by: • Monitoring of the condition of track circuits in order to take action before a track circuit failure can happen • Restriction of the railway traffic until the track circuit is repaired • Maintenance of the track circuits – replacement of the older and worn out circuits
Risks for staff and passengers Increased temperatures can cause passenger discomfort if appropriate ventilation system is not available in the train and the railway station. If the halt is not protected from direct sunlight, it can increase the passenger health risks. High temperatures as well as heavy rains and strong winds are a risk factor not only for passengers, but for the personnel working in the trains, too, as well as for the workers that maintain the railway.	***Mitigation measures*** In order to alleviate the health&safety risk of the passengers and the personnel that works in trains, the following measures are recommended: • Installation of an adequate ventilation system within the trains • The railway station and the halt should enable protection of passengers from climate change impacts (mostly high temperatures, direct sun radiation, rain etc.)
Socio-economic impacts due to climate change The impacts that can be triggered by climate change can lead to socio-economic losses due to increase of maintenance costs, train delay or termination of railway traffic for a certain period of time, increase of the frequency of road transport etc.	***Mitigation measures*** Impacts on socio-economic aspects can be eliminated/mitigated if the measures for climate change mitigation (mentioned previously) are implemented. Thus, no special measures for mitigating the impacts on socio-economic aspects are recommended
Residual impacts: By implementing the measures for adaptation of the railway to climate change, avoidance of possible impacts is expected. Still, even after the implementation of the measures it can't be confirmed for sure whether residual impacts are possible	
Residual impacts mitigation measures: If residual impacts are evident, further analysis will be carried out and additional measures will be recommended	

7.9 Biological diversity (landscape, flora, fauna, protected areas)

7.9.1 Impacts on the landscape

7.9.1.1 Impacts on the visual characteristics of the landscape

- **Construction and operational phase**

The Osogovo rural mountain landscape possesses a great value from an aesthetic point of view, because of which it has great potential for development of rural tourism. The most attractive parts of this area are located in the upper part of the envisaged alignment of the railway Kriva Palanka-Border with the Republic of Bulgaria.

The sensitivity of the regional units, along the project area, in terms of the impacts from the construction of the railway and its functioning on the disturbance of the quality of the landscape, can be described as follows:

1. The first section of the railway (from km 64 + 940 to about km 70 + 500) extends through a region with a lower visual value compared to the final part of the railway line. In this part, the Osogovo region lost its values (aesthetically and functional) as a result of recent development activities along the Kriva Reka valley. The hilly and mountain villages are gradually abandoned and new settlements of compact type appear in the valley, close to the road leading to Bulgaria. On the other hand, this area is relatively well populated and people, as receptors, will notice significant changes in the visual characteristics of the landscape as a result of setting up new objects created by man. This will be especially pronounced in areas which are not forested (especially from km 64 + 940 to km 66 + 100 and from km 69 + 000 to km 69 + 200). However, most of the railway line will not be visible from the densely populated parts of the valley, due to the terrain, and will be more visible from the abandoned upper parts of the valley. Based on the criteria for assessing the significance of the impacts, it can be concluded that the impact on the area of construction of the railway and its operation will be of **moderate significance** (see table below). This impact can be significantly reduced by the implementation of mitigation measures.
2. The middle part of the alignment (from km 70 + 500 to approximately km 73 + 800) passes through Kriva Palanka. In fact, it passes through the new part of the city, which was built in the last three decades, on the right side of the Kriva Reka valley. Accordingly, the line will be visible from the more developed part of the city, which extends to the left sides of the valley. However, new development activities (construction of a railway, including a railway station) will not significantly contribute to changing the landscape, because the whole area possesses many anthropogenic features. Additionally, a significant part of the alignment passes through tunnels (underground alignment) with a length of more than 1 km. As a result of this and based on the criteria for assessment of the intensity of the impacts, it can be concluded that the construction of the railway and its operation will cause negative impacts on the visual aspects of the landscape along the project area, which will be of **little** significance (see table below). This impact can be significantly reduced by the implementation of mitigation measures.
3. The third (final) part of the railway (from km 73 + 800 to the end km 88 + 360) passes through a landscape with a typical structure and appearance, which are characteristic of the Osogovo rural landscape. As a result of the visual characteristics and potential for rural tourism development, the value of the landscape as a whole is assessed as high. The construction of the railway and its operation can cause a significant reduction in the visual value of the landscape, but only a small part of the sections listed below. However, these possible impacts are significantly reduced due to the following design solutions and relief features: 1) a significant part of the alignment (more than 50%) passes underneath the ground (tunnels),

which means that the alignment will not be visible and 2) a significant part of the rest of the (surface) alignment is not visible from the road and the small villages, as a result of the relief (cliff valley) and the relatively large forested area. However, two locations must be highlighted, where the landscape will be significantly altered. These locations have a small length and here two bridges are envisaged to be build: a large bridge no. 32 at km 76 + 402 to km 76 + 611.5 and small bridge no. 43 at km 84 + 094.5 to km 84 + 107.5, as well as the 9 meter long underpass. In the first case, the line will pass Kiselicka Reka and high massive columns and railway will dominate in the area, while in the second case the attractive narrow valley with rural character of Kriva Reka near the village of Kostur will be significantly destroyed. Having in mind the small impact on the landscape, for the most part of the project area, as well as the more significant impact only on these two important locations, the overall impact on the landscape in the construction and operational phase is assessed with moderate significance (see table below). *But it must be emphasized that there are no mitigation measures for the location at Kiselicka Reka that could reduce the impact*.

Environmental Components - Visual features of the landscape											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction and operational phase											
Osogovo rural landscape with low visual value (section 1 of the text above)	Construction activities and built railway	Negative	Immediately	Direct / Cumulative	Local/ Regional[45]	Long-term	Surely	Irreversible	Moderate [46]	Moderate	Yes
Rustic rural landscape with urban character (section 2 of the text above)	Construction activities and built railway[47]	Negative	Immediately	Direct / Cumulative	Local/ Regional[48]	Long-term	Surely	Irreversible	Negligible	Negligible small	Yes
Osogovo rural landscape with	Construction activities and	Negative	Immediately	Direct / Cumulative	Local/ Regional[49]	Long-term	Surely	Irreversible [50]	Moderate[51]	Moderate	Yes

45 Cumulative impacts can cause a regional effect, which will increase the degree of significance of impacts

46 Densely populated place - people as receptors - low visibility

47 This is an already built area and much of the line will not be visible - it will pass through the tunnel

48 Cumulative impacts can cause a regional effect, which will increase the degree of significance of impacts

49 Cumulative impacts can cause a regional effect, which will increase the degree of significance of impacts

50 Mitigation measures can partially reduce impacts, but not along the entire length of the alignment of this area

low visual value (section 3 of the text above)	built railway										

[51] 1. A significant part of the alignment (more than 50%) passes underground; 2. a significant part of the rest, above ground, the alignment is not visible from the road and the small villages as a result of the relief (cliff valley)

7.9.1.2 Mitigation measures

Environmental components–Visual aspects of the landscape	
Pre-construction	
Impacts	**Mitigation measures**
Visual aspects of the landscape The construction and operation of the railway may negatively impact the visual features of the landscape	Development of a Landscaping Design which will be implemented during the construction and operation of the railway[52]
Construction	
Impacts	**Mitigation measures**
Visual aspects of the landscape The project requires significant excavations and cuts which will permanently change the microterrain of slopes, thus causing change in the visual aspects of the landscape along a great deal of the alignment. The project area spreads across the Osogovo rural landscape which has relatively small landscape values; this is backed up by the design solutions that include a great number of tunnels, thus mitigating the negative impact. Therefore, the effects of the construction and operation of the railway in most part are assessed as “medium”, while those along the section that passes nearby Kriva Palanka are assessed as “non-significant”	In order to mitigate the impacts during construction, the following general measures are recommended: • Implementation of “good construction practice” along the whole alignment-excess excavations, temporary dumping sites for the excavated material and the construction of new haulage roads (except the ones envisaged with the project documentation) are not allowed • During construction, the dust reduction measures should be implemented thoroughly, as recommended in Chapter 7.5.2 • The disposal of excavated material from cuts on slopes or in seasonal watercourses is not allowed. The excavated material should be transported to sites previously designed for that purpose (filling of depressions, construction of protective slopes or final dumping grounds) • The removal of vegetation, especially woody plants, must be reduced to minimum and limited to the part of the alignment where the permanent way will be set and the adjacent areas • Use of the cleared areas of the alignment as haulage road for heavy

[52] The Design will include data on localities, modes of plantation and types of plants for landscaping. The plantation of native trees and shrubs is recommended due to protection of the local biodiversity. The Design should envisage the creation of a plant nursery for native trees that will be used for landscaping of the project area.

	vehicles and freight vehicles, as the construction activities progress. Where not applicable, the use of the existing rural road network is recommended. If there is an exceptional need of new haulage roads, these must be reduced to minimum in relation to number and width • Revitalization/rehabilitation of the disturbed areas to be performed immediately after the end of construction activities at the consequent locations, i.e. not at the end of construction of the railway at large. The revitalization/rehabilitation of the area will be performed in accordance with the project documentation/program prepared for that purpose which will include at least mechanical works and land stabilization, as recommended in **7.2.4**, as well as removal of unintentionally cut-off material (large stones, rocks etc.) at the slopes, and grassing and afforestation with native species of trees etc.
Operation	
Impacts	**Mitigation measures**
Visual aspects of the landscape The railway will impact the visual features of the landscape	**Measures that should be implemented immediately after the end of construction and during operation** • Besides the aforementioned stabilization and revitalization of the affected areas, implementation of detailed activities for landscaping of the area around the alignment are required. The landscaping should include horticultural measures with some specificities for this project: 1. Reducing the visibility of the railway (which means preservation of the visual character of the landscape to maximum, i.e. as far as the natural conditions allow) by planting woody plants along the alignment. But, plantation can’t be simply made in a linear manner along the whole alignment since it would mean introduction of another linear structure in the area, which also interferes with the visual character of the landscape (even if the plants are trees). Thus, plantation of trees in a forest-patch pattern is required at some locations (depending on the terrain and in accordance with the previously prepared Landscaping Design). However, a complete mitigation of the disturbed visual character of the

	landscape at bridges can't be achieved (see residual impacts) 2. The landscaping of the area should be done using native species of trees and shrubs for the purpose of local biodiversity protection. Hence, a prior preparation (with the commencement of the railway construction) is required in terms of creating a plant nursery for native trees 3. Plantation of higher trees near the piers of longer bridges should be envisaged, but not in the vicinity of watercourses (where poplar and willow plantations are possible). Still, the complete reduction of the already disturbed visual character of the landscape near the bridges cannot be achieved **Measures that should be implemented during railway operation** During railway operation, vegetation maintenance measures should be implemented, that will alleviate the visual impacts from railway construction (see above)
Residual impacts (construction and operation): Even if the mitigation measures are implemented, residual impacts on visual charactersitics of the landscape are expected, especially at bridges, but the landscape change is expected to be accepted by the local population as its main receptor	
Residual impacts mitigation measures: Implementation of good construction practice, maintenance of the newly constructed structures or the revitalized sections and a good practice for railway maintenance at large	

7.9.1.3 Impacts on the functional characteristics of the landscape

- **Construction and operational phase**

For the purposes of this study, the impacts on landscape are defined as changes in the structure, nature and quality of the landscape (in terms of its function in preserving biological diversity), then direct impacts on specific elements of the landscape and impacts on designated areas and protection areas.

It is evident that with the implementation of this infrastructure project, the structure of the landscape will be under a lasting impact as a result of fragmentation of the numerous patches of natural habitat (hilly pastures and forests), some of which are small and their further division into two smaller spots will cause a significant reduction in their functional value, in terms of their ability to support the wildlife. However, if the railway does not have a protective fence, which is a common practice in Macedonia regarding railways, this fragmentation will cause negligible damage. The full description of the impacts of this type are given below in the section dealing with biocoridors.

Osogovo rural area is of high importance for biodiversity, although it is necessary to define more precisely the form and potential of forest corridors linking major forest areas (core areas of the Osogovo Mountains and the area for restoration on Bilina Mountain) for a more precise assessment of the significance of the landscape for conservation of biodiversity.

The impact on the functional values of the landscape, in terms of biodiversity, are assessed in detail in the section on the impact on habitats, separately for each habitat that comprises the landscape

7.9.1.3.1 Impacts on biocoridors

- **Construction and operational phase**

As already mentioned, the function of biocoridor is to provide various daily, periodic or seasonal movements and migrations of various animal species, as well as the distribution of plants. The most important role in the project area belongs to two corridors extending south-north direction, listed as important corridors for large mammals in the Macedonian ecological network, in particular:

1. Landscape biocorrid Osogovo-German;
2. Line biocorrid Osogovo-Bilina Mountain.

Basically these corridors represent a connection between the Osogovo Mountains (as a key area for large mammals) with a number of mountains on the border with the Republic of Serbia (northern Macedonia). These mountains are Kozjak, German and Bilina Mountain (from west to east). The alignment of the railway line cuts both of the aforementioned biocoridors.

In accordance with the criteria for impact assessment, it can be concluded that the implementation of the project in the construction and operational phase (particularly operational), will cause significant negative impact on the functions of the two wildlife corridors.

However, it should also be noted that the Preliminary Design for the 3rd section of the Railway Corridor VIII provides engineering solutions for many tunnels, bridges, viaducts and culverts as a result of the specificity of the terrain along the alignment of the railway, which greatly reduce impacts on biocoridors. Specifically, 22 tunnels are planned, with a total length of about 10.7 km, of which:

- 0.69 km along the biocorridor section 1 (approximately 21% of the length of the alignment passing through the biocoridor); and
- 7,50 km along the biocoridor section 2 (approximately 62% of the length of the alignment passing through the biocoridor).

The total number of bridges and viaducts will be 52 (of which one bridge is replaced by a culvert), with a total length of 5,12 km, of which:

- 0.98 km along the section of the biocorridor 1 (about 30% of the length of the alignment passing through the biocoridor); and
- 1.74 km along the biocoridor 2 (approximately 15% of the length of the alignment passing through the biocoridor).

Thus, 51% of the alignment that passes through biocorridors will not affect the habitats along biocorridor 1 (landscape corridor) and 77% of the alognment that passes through biocorridors will not affect habitats along biocorridor 2. The length of the biocorridors, which remains untouched by the future infrastructure object, is more than sufficient to meet the needs of animals and their movements, especially if one unit length (several hundred meters) of some structures (tunnels and bridges) is taken into account. In accordance with international practice, this length is appropriate and there is no need to plan the "green bridges" that are man-made structures positioned over the highways.

As a result, the impact of the railway (construction and operational phase) on the biocoridor function can be assessed with moderate significance.

The following table shows the impacts on the functional characteristics of the landscape-biocorridors in the construction and operational phases.

Environmental Components - Functional characteristics of the area - Biocorridors											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction and operational phase											
Landscape biocorrid *Osogovo-German*	Construction and operation of the railway / fragmentation of habitats	Negative	Immediately	Direct / Cumulative [53]	Regional	Long-term	Surely	Irreversible [54]	Negligible [55]	Moderate	Yes[56]
Line biocorrid *Osogovo-Bilina Mountain*	Construction and operation of the railway / fragmentation of habitats	Negative	Immediately	Direct / Cumulative [57]	Regional	Long-term	Surely	Irreversible [58]	Negligible [59]	Moderate	Yes[60]

[53] Cumulative impacts can increase the degree of significance of impacts

[54] If no mitigation measures are applied

[55] See explanation in the text above for tunnels and bridges

[56] For small segments of the alignment that is not in the tunnel or on a bridge

[57] Cumulative impacts can increase the degree of significance of impacts

[58] If no mitigation measures are applied

[59] See explanation in the text above for tunnels and bridges

[60] For small segments of the alignment that is not in the tunnel or on a bridge

7.9.1.4 Mitigation measures

Environmental components–Functional characteristics of the landscape-Bio-corridors	
Pre-construction	
Impacts	**Mitigation measures**
Functional characteristics of the landscape A certain danger of reducing the permeability of the landscape in terms of seasonal migrations of smaller animals (amphibians and reptiles) exists, especially near permanent and seasonal watercourses (ponds and streams in particular) that serve as breeding habitats for frogs	The project documentation for railway construction contains data on culverts; hence, probably there would be no need for additional interventions. Still, for the final assessment of the need for additional culverts that will also serve as animal passages, a biomonitoring should be carried out in spring, prior commencing the construction activities
Construction and operation	
Impacts	**Mitigation measures**
Functional characteristics of the landscape Due to the large number of tunnels and bridges along the alignment, it is expected that the functional characteristics of the landscapoe won't be significantly affected in terms of migration of large animals	Due to insignificant impacts, no measures are recommended in terms of additional wildlife crossings that would facilitate the movement of animals
Residual impacts: No significant residual impacts are expected	
Residual impacts mitigation measures: /	

7.9.2 Impacts on habitats

- **Construction phase**

The envisaged activities in the construction phase, such as clearing the location from vegetation, in order to establish an area for construction work execution and providing access to the construction site, will cause negative impacts on the habitats in the project area and in the wider surrounding. Also, at this stage, the possible occurrence of incidents is possible, which will result in negative impacts on habitats.

Below are the habitats in the project area, which are distinguished as the most sensitive and can be affected during the construction of the railway:

1. Submontane beech forests (HD and BC);
2. Riparian forests of willow and poplar and riparian belts of willow and poplar (HD and BC);
3. Gravel and sand river banks (BC);
4. Hilly pastures (HD and BC);
5. Rivers and streams-epipotamous and hyporhithral streams (HD);
6. Meadows-mesophilic (HD and BC).

- **Submontane beech forests**

For the construction of the railway, the edge part of the beech forest, near the village of Kostur will be cleared from km 81 + 500 to 82 + 600 km. The total area to be cleared is approximately 1.1 ha, if the width of the corridor is 10 m. The rest of the forest will remain untouched, because the line will pass through a tunnel. In construction work, fragmentation of habitats is not expected because this is the edge of the forest, that is, this part represents a forest border. Possible impacts on these habitats were assessed as impacts with with moderate significance.

- **Riparian forests and belts of willow and poplar**

These forests and forest belts are very important for the overall ecology of the project area, especially for the ecology of streams and rivers in the area, as well as for biodiversity, because they serve as shelters and a corridor for many animals. The expected impact does not originate from the clearing of the trees, since most of these rivers will be bridged. However, during the construction of the bridges (piers), significant damages are expected on the riparian forests and willow and poplar belts (although with a reversible character). Below are the affected habitats and locations:

- Riparian forests of willow and poplar:
  - on km 74 + 020 to km 74 + 300 and around km 75;
  - km 81 + 200 to km 81 + 600.
- Riparian belts of willow and poplar:
  - at km 74 + 200;
  - from km74 + 800 to km 75 + 000;
  - km 75 + 760;
  - at km 76 + 500.

The possible impacts on these habitats were assessed as impacts great significance.

- **Gravel and sand river banks**

The only locations where these habitats are distributed along the envisaged alignment of the line are located at the chainages: km 74 + 750 to km 75 + 000 and km 76 + 500. Similarly, like the riparian vegetation, the construction of bridges can have negative impacts on the gravel and sandy river banks.

Possible impacts on these habitats were assessed with moderate significance.

- **Hilly pastures**

Construction of the railway line can cause a double negative effect on the hill pastures as a result of the clearing of the vegetation for the construction of the alignment: a) destruction of a significant area of the habitats; and b) fragmentation of the habitats caused by the separation of the spots with the alignment of the railway line.

As described in the chapter on the landscape, the fragmentation of habitats will not cause significant effects on large animals, as opposed to effects on small animals - insects, amphibians and reptiles, as well as small mammals. These impacts will be particularly significant in the following locations:

- Hilly pastures:
    - km 73 + 700 to km 73 + 760;
    - km 73 + 400 to km 73 + 560;
    - Km 74 + 600;
    - km 85 + 600 to km 85 + 700;
- Hilly pastures on rocky ground:
    - km 75 + 260 to km 75 + 360;
    - km 75 + 480 to km 75 + 580;
    - km 75 + 650 to km 75 + 760;
    - Km 77 + 700 to km 77 + 770;
    - km 85 + 800 to km 85 + 840;
    - km 87 + 060 to km 87 + 150.

Possible impacts on these habitats were assessed with negligible significance.

- **Rivers and streams - epipothamous and hyporhithral streams**

Construction of the railway can cause a double negative effect on rivers and streams as a result of partial destruction of habitats (due to similar reasons as in coastal vegetation and gravel banks) and pollution caused by incidental spillage of pollutants (for example, lubricating oils and Fuel from construction mechanization, eroded soil, etc.). The impacts will be particularly significant in the following locations:

- km 74 + 250;
- km 74 + 870;
- km 75 + 770;
- km 76 + 500;
- km 79 + 850;
- km 81 + 060 to km 81 + 170;
- km 81 + 760 to km 82 + 170;
- km 84 + 100.

Possible impacts on these habitats were assessed with moderate to large significance.

- **Meadows - mesophilic**

Meadows are a highly endangered habitat type within the Republic of Macedonia (and Europe), due to their gradual disappearance and abandonment of traditional agricultural practices. Because these habitats have small dimensions, however, further destruction and fragmentation can cause significant adverse effects. The meadows, which may be endangered by the construction of the railway line, are located in the following locations:

- km 74 + 800 to km 75 + 000;
- km 75 + 700;
- km 81 + 100.

The possible impacts on these habitats were assessed with great significance.

- Based on the presented criteria for assessment of the intensity of impacts, the following table shows the possible impacts on sensitive habitat types, during the construction phase, separately for each habitat. Construction work is not expected to cause negative transboundary impacts on habitats.
- **Operational phase**

The significance of the impacts on habitats during rail operation is lower compared to the impacts arising from the construction phase. However, in the operational phase of the railway, the clearing and maintenance of the vegetation around the railway line, as well as the potential pollution from incident situations, can cause negative impacts on the habitats. From the analysis of the possible impacts one can conclude that the railway line operation can cause negative impacts on the hill pastures with negligible importance, while the impacts on the other habitats are assessed with moderate significance.

The following table shows the impacts on sensitive habitat types, separately for each habitat, which may be caused in the operational phase of the railway.

Environmental Components - Habitats											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Submontane beech forests	Site clearing/Complete removal of vegetation along the railway and destruction of habitats	Negative	Immediately	Directly	Local	Long-term	Surely	Irreversible	Small	Moderate	Yes
	Performance of construction activities, presence of workers, increased level of noise and emissions in the air / disturbance of the fauna and covering the vegetation with dust	Negative	Immediately	Indirectly	Local	Long-term	Surely	Irreversible	Small	Moderate	Yes
Rural forests and belts of willow and poplar	Performing construction activities in the immediate vicinity of rivers and building bridges/Removing vegetation at some locations and incidentally destroying other locations	Negative	Immediately	Direct / indirect / cumulative	Local	Medium to long term	Very likely	Irreversible and partially reversible	Large	Large	Yes
Gravel and sand river banks	Construction of construction activities in the immediate vicinity of rivers and rivers and construction of bridges / Disruption of the formed sediment on the shore	Negative	Immediately	Direct / indirect / cumulative	Local	Medium to long term	Very likely	Irreversible and partially reversible	Small	Moderate	Yes

Hilly pastures	Performance of construction activities/Complete removal of vegetation along the alignment	Negative	Immediately	Direct / Cumulative	Local	Long-term	Surely	Irreversible	Negligible	Negligible small	Yes
	Performance of construction activities, presence of workers, increased level of noise and emissions in the air / Harvesting of fauna and covering of vegetation with dust	Negative	Immediately	Indirectly	Local	Short term	Surely	Irreversible	Negligible	Negligible small	Yes
Rivers and streams	Performance of construction works near rivers and riverbeds/Destruction of habitats	Negative	Immediately and delayed	Direct / Cumulative	Local to regional [61]	Mid-term	Very likely	Irreversible and partially reversible	Medium to large	Moderate Large	Yes
	Performance of construction works near rivers and river beds/Incident destruction during construction and water pollution	Negative	Immediately and delayed	Indirectly	Local to regional (may show upstream effect)	Mid-term	Very likely	Irreversible and partially reversible	Medium to large	Large	Yes
Meadows	Performance of construction works, site clearing, increased noise level and the presence of workers/Destruction of habitats	Negative	Immediately	Directly	Local	Long-term	Sure or probably	Irreversible	Large	Large	Yes
Operational phase											

[61](There may be a downstream effect)

Submontane beech forests	Rail traffic and maintenance of the railway / increased noise level and incidental pollution	Negative	Immediately	Indirectly	Local	Long-term	Not likely to Probably	Reversible	Small	Moderate	Yes
Rural forests and belts of willow and poplar	Railway Traffic and Railway Maintenance/Incident Pollution	Negative	Immediately	Indirectly	Local	Long-term	Not likely to Probably	Reversible	Small	Moderate	Yes
Hilly pastures	Rail traffic and maintenance of the railway/Incidental pollution and fires	Negative	Immediately	Indirectly	Local	Long-term	Not likely to Probably	Reversible	Negligible	Negligible small	Yes
Rivers and streams	Railway Traffic and Railway Maintenance/Incident Pollution	Negative	Immediately and delayed	Indirectly	Local	Long-term	Not likely to Probably	Reversible	Small	Moderate	Yes
Meadows	Railway Traffic and Railway Maintenance/Incident Pollution	Negative	Immediately	Indirectly	Local	Long-term	Not likely to Probably	Reversible	Small	Moderate	Yes

7.9.3 Mitigation measures

Environmental components – Biodiversity: Habitats	
Pre-construction	
Impacts	**Mitigation measures**
Biodiversity The construction and operation of the railway will cause negative impacts on habitats and the biodiversity at large (plants and animals)	In order to provide prevention, elimination, mitigation and/or compensation of the effects from the negative impacts on habitats, plant species and the biodiversity at large, the implementation of the following measures is recommended prior the commencement of construction activities:

	• During pre-construction phase, the future Contractor, together with the MOEPP, Ministry of Economy, Ministry of Transport and Communication, and the Municipality of Kriva Palanka to identify locations (mostly on public land) where previous surveys (hydrogeological and geodetic) will be carried out that will represent a base for project documentation and documentation regarding the environmental impact assessment, in accordance with the Law on environment and the appropriate bylaws • The borrow pits for stone and other resources must be defined in advance in order to enable the biodiversity impact assessment. The use of resources for the purpose of railway construction is not allowed at the following habitats: - Alluvial sediments (riparian gravel banks and poplar and willow stands) – for sand and gravel excavation, - Rivers and streams – for sand and gravel excavation, - All types of forests (degraded forest stands could be an exception, but the impacts should be identified in advance) • The excavated inert material to be used (as much as possible) as construction material and to propose borrow pits that the future Contractor will inspect for the quality of material, production capacity, distance to the project area and the existence of project documentation, including documentation in accordance with the requirements of the Law on environment • To consider all the strategic and developmental documents regarding nature conservation and utilization of natural resources • To avoid installation of worker camps and parking lots for heavy vehicles near the habitats described in the chapter: Impacts on habitats during construction • To design an adequate monitoring system for the implementation of the biodiversity protection measures as well as monitoring of the quality of surface waters • Implementation of the measures for risk management summarized in Chapter **11**; • To prepare an in-depth Biodiversity Management Plan (plant and animal species). The plan will include the recommendations from the monitoring program proposed within this Study, but in more detail and for designated locations, then indicators, timeframe and frequency, responsibilities, budget etc., in accordance with the final Detailed Design for the railway

Construction	
Impacts	**Mitigation measures**
Biodiversity The construction of the railway will cause negative impact on habitats (plants and animals)	**General measures** In order to provide habitat protection and protection of the whole biodiversity (plant and animal species) along the alignment of the railway, i.e. at sites where construction works will be carried out and during the whole period of construction, the implementation of the following general measures is recommended: • Avoid the occupation and degradation of adjacent land (in the vicinity of sites where construction activities are performed). Any kind of land use which is not envisaged in the Detailed Design must be carried out with consent of the landowner/manager of the land or other type of permit, if necessary • Continuous presence of a firefighting vehicle, for timely intervention in case of a fire • Provision of adequate storage sites for hazardous materials (e.g. fuels for heavy vehicles), appropriate storage and handling of these materials • The storage of hazardous materials at the construction site should be reduced to minimum • Avoid installation of worker camps, storage sites and dumping sites (soil heaps) on alluvial terrain due to the possible risk of high groundwater levels and their pollution. Additionally, these locations are habitats that were assessed as sensitive to disturbance and the level of significance of the impacts is high (if riparian vegetation is present) or moderate (in case of gravel and sandy sites) (see chapter on impacts) • After the completion of construction activities, if there is no need for further use of the organized sites, the objects should be dismantled and the terrain should be rehabilitated. The rehabilitation of the terrain will be implemented with the use of adequate project documentation, and native materials and plants
Important habitats Clearing of the project area and the permanent removal of the vegetation in order to prepare the project area for the construction activities and providing access to locations will cause negative impacts on habitats in the area and beyond	Besides the general measures (listed above) that generally apply for all the habitats along the alignment, the following additional measures are recommended for some particular sites and localities: • The haulage roads must not be traced in the following habitats: - Beech forests; additional disturbance of these habitats is not allowed in particular at km 81+500 to km 82+600, except for the clearing of vegetation

	for the purpose of the project and rail placement - Wet and mesophilic meadows, in particular at km 74+800 to km 75+000; km 75+700, and km 81+100 where this type of habitat is strongly affected from the railway construction - Willow and poplar woodlands, stands and tree belts wherever encountered during the construction - Gravel banks of watercourses (rivers and streams) wherever encountered during the construction - Across rivers and streams wherever encountered during the construction • If stream crossing is necessary due to construction specifics, then the watercourse should be crossed with a bridge and should remain intact/non-disturbed (including the riparian vegetation, if any) • Randomly disposed waste (concrete, iron, rocks and stones etc.) should be removed immediately from the aforementioned habitats on a daily base • All the locations that will serve as temporary dumping sites for the excavated topsoil or other non-usable material must be previously designated by the designer and the construction company, so the possible negative impacts on habitats (and the environment in large) can be assessed in time at these particular locations[62]. The following habitats should not be used as temporary dumping grounds: - Willow and poplar woodlands, stands and tree belts, - Wet and moderately wet (mesophilic) meadows, - Beech forests, - Rivers, streams and their riparian zones • During the construction of bridges, the habitats listed below must remain intact as much as possible. The bridges should cross these habitats without causing significant damage. Regular monitoring should be carried out by an independent expert (biologist/ecologist) at the following habitats: - Willow and poplar woodlands, stands and tree belts; - Willow and poplar woodlands at: km 74+020 to km 74+300, and near km

[62] Based on previous surveys, a Dumping Ground and Borrow Pit Design should be prepared, which will be accompanied by appropriate documentation in accordance with the Law on environment

	75; km 81+200 to km 81+600; – Riparian willow and poplar belts: at km 74+200; from km74+800 to km 75+000; at km 75+760; at km 76+500; – Gravel and sandy banks at km 74+750 to km 75+000, and at km 76+500; – Rivers and streams at km 74+250; km 74+870; km 75+770; km 76+500; km 79+850; km 81+060 to km 81+170; km 81+760 to km 82+170, and km 84+100. • Occasional or regular professional supervision (biologist/ecologist) is recommended for the following habitats: - Willow and poplar woodlands, stands and tree belts; - Wet and mesophilic meadows; - Beech forests; - Hilly pastures; - Rivers and streams. **Mitigation measures for forest habitats** The mitigation of impacts on forest habitats is described in Chapter 7.10.1. **Mitigation measures for rivers and streams** Implementation of the measures described in **Chapters 7.9.7 and 7.9.9.** **Mitigation measures for the rest of the habitats** No special measures are recommended for the other habitats, except the ones recommended above as general measures
Residual impacts: In normal operational conditions, most of the impacts are expected to be significantly mitigated with the implementation of the recommended measures. The strict adherence to the good construction practice and the special measures for avoidance of construction activities in particular habitats will contribute in significant reduction of the negative impacts or their elimination	
Residual impacts mitigation measures: /	
Operation	
Impacts	**Mitigation measures**
Habitats The clearing and maintenance of the vegetation around the railway, as well as	• Avoid use of herbicides for vegetation management adjacent to the railway (alternatively to avoid excess use of herbicides)

the potential pollution from accidents, may lead to negative impacts on habitats	• Implementation of measures for accident protection • No other specific mitigation measures are recommended
Residual impacts: With the implementation of the mitigation measures, no residual impacts are expected	
Residual impacts mitigation measures:/	

7.9.4 Impacts on plant species (flora)

- **Construction phase**

As stated in the previous chapters (description of species and valorization), the plant species listed in the annexes of the international documents for biodiversity conservation are not found in the project area. There is no national red list for endangered plants. Rare or endangered plant species are not found along the alignment nor during the site visit. Also, prominent specimens from old trees are not found in the project area, nor are they noticed during the site visit.

Construction of the railway will cause negative impacts on plant species in the project area, but they are not of major importance for biodiversity. The assessment of the impacts on plant species is presented in the following table. Based on the criteria for assessment of the impacts, it can be concluded that they have small to moderate significance. The construction activities are not expected to cause negative transboundary impact on plant species.

- **Operational phase**

Operational activities for maintaining the vegetation along the alognment, as well as possible incidental events (especially occurrence of fire), can cause negative impacts on plant species (flora).

The impacts on plant species in the operational phase of the railway can be analyzed from the aspect of their sensitivity (the more the number of species that are important in terms of conservation, the more sensitive plant species). Because there are no sensitive plant species in the project area, the effects of the operational phase (ie after the railway is built and some of the plant populations will be damaged) can be considered as negligible. In addition, the possible negative effects of the operational phase on the plant species are much less intense compared to the destruction of parts of plant populations during the construction phase.

The type and significance of the impacts on plant species from the construction and operational phase are described in the following table.

Environmental Components-Plant species											
Affected media / Areas / Receptors	**Source of influence / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Plant species	Construction of works, clearing of vegetation, excavation, construction / Destruction of plant units	Negative	Immediately	Direct / Indirectly	Local	Mid-term	Surely	Irreversible	Moderate	Moderate	Yes
Operational phase											
Plant species	Railway traffic and maintenance of the railway line/destruction of plant units during maintenance of the railway and incidental pollution	Negative	Immediately	Direct / Indirectly	Location	Long-term	Probably unlikely to Probably	Reversible	Negligible	Negligible small	Yes

7.9.5 Mitigation measures

<table>
<tr><th colspan="2">Environmental components – plant species (flora)</th></tr>
<tr><th colspan="2">Pre-construction and construction</th></tr>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>Plant species (flora)
The construction of the railway will cause negative impacts on plant species within the project area due to execution of construction works, clearing of vegetation, excavation etc.</td><td>Based on the data from the botanical literature and the data obtained during the site visit (for the purpose of this Study) it can be concluded that no specific measures are required for protection of particular plant species, since no endemic, rare or other type of sensitive species are recorded along the alignment.
Still, in order to avoid the excess and redundant destruction of individual plants and their populations, the implementation of following measures is recommneded:
• In order to detect the possible presence of plant species of conservation importance, a detailed insight of the alignment should be done prior commencing the construction works by appointed independent expert (biologist/forest engineer)</td></tr>
<tr><td colspan="2">Residual impacts: In normal operational conditions, most of the impacts are expected to be mitigated with the implementation of the recommended measures. The strict adherence to the good construction practice and the special measures for avoidance of construction activities in particular habitats will contribute in significant reduction of the negative impacts or their elimination</td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: If necessary, additional measures will be proposed</td></tr>
<tr><th colspan="2">Operation</th></tr>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>Plant species (flora)
The railway traffic and maintenance as well as accidental pollution may lead to the destruction of particular plant individuals</td><td>Plant species growing along railways are usually cosmopolitan and therefore have a very low conservation status. Hence, no special measures are recommended for the protection of plant species along the railway during its operation</td></tr>
<tr><td colspan="2">Residual impacts: No residual impacts are expected if mitigation measures are being implemented</td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: /</td></tr>
</table>

7.9.6 Impacts on animal species (fauna)

- **Construction phase**

The performance of construction work in the project area can cause negative impacts on animal species. The most significant impacts on invertebrate species populations are related to the destruction and degradation of their habitats. The identified impacts and proposed mitigation measures relating to habitats are sufficient to identify the impacts and protect the invertebrates. Significant direct effects on certain types of invertebrates are not expected in the construction phase.

Impacts on the vertebrate fauna will mainly be manifested as harassment of species, due to disrupting / destroying nesting sites for birds and other vertebrates, as well as mortality caused by excavations and direct killing of amphibians and reptiles by workers, due to unfounded fear, aversion to certain species or illegal hunting of birds and mammals. The assessment of these impacts shows that there are no significant impacts, but in spite of that, mitigation measures are provided for most of them.

Among the more significant (indirect impacts) we can mention the destruction and degradation of natural vegetation and habitats (forests, riparian forests). This impact is relevant to all fauna groups. Mitigation measures are foreseen for such impacts, which mostly concern the protection of habitats. The cumulative effect of the degradation and fragmentation of habitats is strongly related to the survival of species of wildlife, which must be considered. This is done in the part referring to the landscape structure and the functionality of the biocorridors.

The disruption of the structure of river ecosystems (accumulation, diversion, pollution) can have a negative impact on the overall aquatic ecosystem including the organisms. Such impacts are expected to be short-term. Given the relatively low biodiversity in the rivers of the investigated area, the degree of significance of such impact was assessed as moderate. In this case, the cumulative impact of the existing anthropogenic pressure on the rivers in the area, especially the pollution from the Toranica mining complex, as well as the current agricultural activities in the contact zone of the Project, should be taken into account. The construction is not expected to cause negative transboundary impacts on animal species.

- **Operational phase**

Railway operation can cause negative impacts on animal species.

Particularly significant impacts on vertebrates are expected as a result of:

- Increased level of human activities and increased levels of noise in the project area, which can cause harassment of species and disturbance of nesting sites, so that certain species can avoid these sites.
- Fragmentation of habitats (has a significant impact on fauna), but this aspect has been developed in the area of impacts on the landscape including the impacts on biocoridors. From the aspect of the fauna, the impact of the railway in the operational phase, on the "population" of otters in the Kiselicka Reka, should be emphasized in particular. With the construction of the bridge one can expect destruction of some of the riparian vegetation as well as changes in the riverbed, impacts that will remain during the operation of the railway;
- Directly induced mortality, as a result of deadly animal collisions with trains;
- The maintenance of the railway line will have an impact on the fauna. For example, clearing the snow along the track will allow a lighter path for moving of animals that can lead to increased mortality of animals as a result of collisions with trains.
- The management and control of vegetation (mowing, cutting, use of herbicides) will have a direct and indirect impact on the fauna. A direct impact from the use of chemical protective agents is expected in the case of invertebrates, but this impact, though inevitably, will have little intensity and will only apply to the narrow space around the railway. Also, the indirect impact on the vertebrate animals will be of little intensity. The most significant indirect impact

is expected on fish and other aquatic organisms due to pollution of water in rivers from the use of means and procedures for dealing with vegetation on the railway line.

- An increase in the number of deadly collisions can also be expected due to the increased presence of food (waste) and dead animals on the railway line. This influence is relevant to the vultures (birds, mammals, and rarely amphibians and reptiles).
- Electrical installations may have a negative impact on birds caused by an electric shock, which may result in direct death. Birds that rest on power lines and power cables may die due to the creation of the so-called "short circuit". There are many cases of bird mortality recorded in the world as a result of inadequate electrical installations along the railways, when they are used for observation, rest and nesting by birds. Electric shock is not only dangerous for birds, it is a threat to the safety of rail traffic. It is expected that the poles carrying the electrical conductors needed to power the trains will be used by birds as halts, but also as potential nesting places. In such cases, mortality of birds is well known and extremely high, especially during the migration period. The impact of an electric shock on the birds occurs when the bird makes a closed circuit ("short circuit") with its wings or body (contact through grounding and phase or between two phases). Thus, larger birds are more prone to electric shock, that is, stork, heron, and bird of prey are common victims of electrocution.

Based on the foregoing, it can be concluded that line operation can cause significant impacts on fauna of vertebrates (direct influences), while the impacts on invertebrate fauna (indirect impacts due to habitat loss, soil and water pollution) are evaluated as less significant.

Environmental Components: Animal Species											
Affected media/ Areas/ Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Fauna of invertebrate animals	Construction activities and the presence of workers/Mortality caused by excavation, trampling or forcible killing	Negative	Immediately	Directly	Location	Short-term / mid-term	Surely	Irreversible	Small	Negligible small	Yes
	Construction activities and the presence of workers/Destruction and degradation of habitats	Negative	Immediately	Indirectly	Location	Short-term / mid-term	Surely	Irreversible	Small	Negligible small	Yes
Amphibians and reptiles	Construction activities / Mortality caused by excavations	Negative	Immediately	Directly	Location	Short-term / mid-term	Very likely	Irreversible	Moderate	Moderate	Yes
	The presence of workers/Direct killing by workers	Negative	Immediately	Directly	Location	Short-term	Probably	Irreversible	Small	Negligible small	Yes
	Labor presence/ Destruction and degradation of habitats	Negative	Immediately	Indirectly	Location	Short-term - mid-term	Very likely	Irreversible	Moderate	Moderate	Yes
Birds	Construction work/ Disturbance of nesting sites	Negative	Immediately	Directly	Location	Short-term - mid-term	Very likely	Irreversible	Small	Negligible small	Yes

Mammals	Construction work/ Destruction and degradation of habitats	Negative	Immediately	Indirect / Cumulative	Local	Short-term / mid-term	Surely	Irreversible	Small	Moderate	Yes
Fish	Construction work in river basin or near rivers/Can destroy tunnel in small sections	Negative	Immediately and delayed	Directly	Local to regional	Short-term / mid-term	Very likely	Irreversible	Moderate	Moderate	Yes
	Construction works in river basins or near rivers, incidental phenomena/ degradation and pollution of rivers and streams	Negative	Immediately and delayed	Indirect / Cumulative	Local to regional	Short-term / mid-term	Very likely	Irreversible	Moderate	Moderate	Yes
Operational phase											
Fauna of invertebrate animals	Maintenance of the railway / Destruction and degradation of habitats (deferral of waste, pollution, harassment and disturbance), use of herbicides	Negative	Immediately and delayed	Indirectly	Location	Long-term	Surely	Reversible	Negligible	Negligible small	Yes[63]
	Rail maintenance/ Vegetation control and use of herbicides	Negative	Immediately and delayed	Directly	Location	Long-term	Surely	Reversible	Negligible	Negligible small	Yes[64]

[63]Through the application of measures for the protection of habitats

[64]Through the application of measures for the protection of vegetation

Amphibians and reptiles	Rail maintenance/ Fragmentation of habitats	Negative	Immediately and delayed	Directly	Location	Long-term	Very likely	Reversible	Moderate	Moderate	Yes
	Rail maintenance/ Destruction and degradation of habitats	Negative	Immediately and delayed	Indirectly	Location	Long-term	Very likely	Reversible	Moderate	Moderate	Yes
Birds	Rail traffic, increased noise/Harassment of species and disturbance of nesting sites	Negative	Immediately and delayed	Directly	Location	Long-term	Very likely	Reversible	Small	Negligible small	Yes
	Railway operation / Mortality from electric shock	Negative	Immediately and delayed	Directly	Local	Long-term	Probably	Irreversible	Small to Moderate	Moderate	Yes
Mammals	Rail traffic /Fragmentation of habitats; Harassment of species	Negative	Immediately and delayed	Directly	Local	Long-term	Very likely	Reversible	Moderate	Moderate	Yes
	Maintenance of the railway/Destruction and degradation of habitats	Negative	Immediately and delayed	Indirectly	Local	Long-term	Very likely	Reversible	Moderate	Moderate	Yes
Fish	Rail traffic / Incidents	Negative	Immediately and delayed	Directly	Local to Regional	Long-term	Very likely	Reversible	Moderate	Large	Yes
	Rail traffic/Railway maintenance and passenger transport (waste generation) / Degradation and pollution of rivers and streams	Negative	Immediately and delayed	Indirect / Cumulative	Local	Long-term	Very likely	Reversible	Moderate	Moderate	Yes

7.9.7 Mitigation measures

<table>
<tr><th colspan="2">Components of the environment – Animal species (fauna)</th></tr>
<tr><th colspan="2">Pre-construction</th></tr>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>The construction of the railway will negatively impact the animal species</td><td>• Due to the presence of otter (Lutra lutra), adequate designing of the bridges is recommended. There are two bridges that are significant from this aspect, and focus should be put on the long bridge no. 32 at km 76+402 to 76+611.5. The foundations of bridge piers should be designed out of the riverbed and at least 5-10 m from riverbanks
• Application of new design solutions applied in some European countries[65], in order to reduce impacts on birds by electric shock.
• Implementation of a biomonitoring of the amphibians and reptiles during spring season in order to determine the need for placing additional culverts for protection of smaller animals (amphibian and reptile fauna)</td></tr>
<tr><th colspan="2">Construction</th></tr>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>Animal species (fauna)
The construction of the railway will cause negative impacts on animal species, disturbance of species due to destruction of bird and other vertebrates' nests, and mortality as a result of excavations and killing of amphibians and reptiles by workers due to unfounded fear, repulsion to certain species or illegal hunting of birds, mammals etc.</td><td>In order to avoid the negative impacts on fauna, the implementation of the following measures is recommended:
• To avoid unnecessary destruction of important habitats (see mitigation measures for impacts on habitats)
• Do not kill and pose serious injuries to the native fauna during clearing of vegetation. This especially goes for mammals, birds, reptiles, amphibians and fish
• To inform and educate the workers that killing of animals is prohibited within the project area during construction (amphibians, reptiles, birds, mammals). Information materials to be prepared for this purpose
• To inform hunting societies for the timeframe of construction works. Hunt should be prohibited within the project area (2 x 500 m)
• To minimize large trees destruction</td></tr>
</table>

[65] See the details regarding this issue in the impacts on animal species during the operational phase.

	• The injured or abandoned native wildlife juveniles to be transported to the nearest veterinary ambulance in Kriva Palanka or Kumanovo
Operation	
Impacts	**Mitigation measures**
Animal species (fauna) The operation of the railway may cause negative impacts on animal species due to railway traffic and maintenance. These activities may lead to destruction and degradation of the habitats (waste disposal, pollution, disturbance of animals), mortality due to electrocution, noise nuisance and disturbance etc.	In order to reduce the mortality rate due to direct impacts (collision with trains and electrocution), the following measures are recommended: • Removal of carcasses from the vicinity of the railway • Removal of food or any other type of waste from the vicinity of the railway. The removal of the potential food sources will reduce the presence of wildlife near the railway, which will reduce the mortality rate resulting from direct impact • To not plant fruits and nuts within the buffer zone of 2 x 100 m from the railway • Clearing of the snow under the viaducts. In this way the animals that would otherwise move on the railway can escape to the clearings on time, which will reduce the mortality due to collision with trains and will increase the traffic safety. This measure will have direct positive impacts for passengers, too, mostly because of raising the safety level and lowering the risk of injury/death • Restriction of fishing at Kriva Reka and its tributaries in order to preserve fish populations. Fishing should be prohibited at each water body near the railway (100 m). People will also benefit the measure because of lowering the health risk and risk of injury/death since the risk of traffic accidents will be lowered • Revegetation with willows should be carried out within a range of 25 m along the river, from both sides of the bridge (total of 50 m) • Piers carrying the electrical conductors (required for electrical traction of trains) is expected to be used by birds as halts, and even as potential breeding sites. In this case, the mortality of birds is exceptionally high, primarily in the migratory period. Therefore the preparation of new designs implemented in some european countries[66] is recommended. There are solutions for reducing the impacts of electrocution that provide significant reduction of mortality in birds and they are based on preventing the bird of getting closer to the circuit (mutual distancing of the cables, as well as from the main pier, to a distance

[66] So far piers have not gained the appropriate attention, but since recently in Germany new designs of piers are being considered.

	larger than the wing span of the bird): • Supporitng elements (insulators) should be mounted downwards (to hang), and not upwards at the horizontal part of piers • The minimal distance between adjacent cables should be larger than 140 cm • The distance between the top of the pier and the first cable under it, as well as the distance between the insulator and the non-insulated part of the cable should exceed 60 cm. If the cables are placed laterally on the pier, then they should be distanced from it on a insulated supporting element which is at least 140 m long • At each pier, at least 60 cm of the cable should be insulated with a plastic envelope, mounted on both sides of the supporting element
Residual impacts during construction and operation: If all recommended impact mitigation/avoidance measures are implemented during construction and operation of the railway, it can be said that residual impacts relevant for fauna will appear for sure. The residual impacts are expected to be negligible during the construction. More significant residual impacts are expected during the operation of the railway: the existance of a small fragmentation effect is expected, as well as a certain mortality rate from collisions, and insignificant indirect impacts from water, air, soil, and vegetation pollution.	
Residual impacts mitigation measures: To record and quantify the residual impacts, a monitoring of the conditions of the populations of animals, the fragmentation effect, and mortality at the railway should be implemented. The results will serve to recommend additional residual impacts mitigation measures, such as reforestation, establishment of daily bio-corridors, strengthened hunt and fishing control etc.	

7.9.8 Impacts on diatoms and macroinvertebrates in rivers and streams

The impacts on aquatic ecosystems can be divided into two groups: the construction phase and the phase of the operation of the railway (operational phase). Generally, the impacts on river ecosystems are expected to be much higher in the construction phase, in relation to the phase of the railway's operation.

- **Construction phase**

The effects of the railway construction can be direct or indirect. In most cases, the impact is related to pollution or the introduction of substances from the environment in the rivers. One possible impact on aquatic life is pollution with solid and liquid municipal waste that causes eutrophication or pollution of water habitats. Pollution may be physical or chemical. Physical pollution can be reflected in the intake of solids from the soil, sand, parts of materials used in the construction of the railway including stones, rocks, cement, iron constructions, plastics and packaging. Such substances could be introduced directly into the riverbed and cause a change in the hydrological regime, even partition of the river. In such a case, habitats are changing considerably, and the extinction of part of the wildlife may occur. In addition to physical influence, the input of materials from construction activities can change the chemical composition of the water. In addition to the increased turbidity and the amount of organic and inorganic materials, it is possible to change the pH value (cement input), concentration of heavy metals (iron constructions), concentration of organic matter (soil input, plants) and reduction of oxygen . This would lead to the reduction or disappearance of numerous species in river ecosystems.

On the other hand, water contamination may occur in the event of inadequate handling of mobile toilets, kitchens and disposal of solid municipal waste. The effects in this case can vary from very strong to insignificant. Pollution can also be caused by vehicles and mechanization used in the construction of bridges, manifested by the discharge of oils and fuels in the river, which would lead to the extinction of many species.

The impacts on diatoms and macroinvertebrates, caused by the construction of the line, are assessed with moderate significance, while in situations of incidents they can be assessed with great significance. The construction of the railway is not expected to cause negative transboundary impacts on diatoms and macroinvertebrates.

- **Operational phase**

It is considered that the effects of railway operation on river ecosystems are smaller compared to impacts that originate from the construction phase. However, in the operational phase of the railway, maintenance of bridges, as well as potential pollution from incident situations, can cause negative impacts on wildlife in river ecosystems. The impacts in the operational phase are assessed with moderate significance.

Components of the environment - Diatoms and macroinvertebrates											
Affected media / Areas / Receptors	**Source of influence / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Diatoms and macroinvertebrates	Construction work in river beds and near rivers and river beds / Water pollution	Negative	Immediately and delayed	Direct / indirect / cumulative	Local to regional [67]	Short term	Very likely	Reversible	Moderate / Large	Moderate Large[68]	Yes
Operational phase											
Diatoms and macroinvertebrates	Railway traffic and railway maintenance / Water pollution	Negative	Immediately and delayed	Direct / indirect / cumulative	Local to regional [69]	Long-term	Probably unlikely to Probably	Reversible	Small / Moderate	Moderate Large[70]	Yes

[67](There may be a downstream effect in major incidents)

[68] Exclusively for incidental events

[69](There may be a downstream effect in major incidents)

[70] Exclusively for incidental events

7.9.9 Mitigation measures

Environmental components – Diatoms and macroinvertebrates	
Construction	
Impacts	**Mitigation measures**
Diatoms and macroinvertebrates The execution of construction activities in rivers and their vicinity, as well as the occurrence of accidental pollution or input of substances in rivers can cause negative impacts on river ecosystems (diatoms and macroinvertebrates)	According to the Water Framework Directive, all the aquatic habitats should have a good ecological status, based on the composition of benthic flora and fauna, as well as the macrophytic and riparian vegetation. Therefore, adequate measures need to be taken that are generally part of the “good construction practice” by which the pollution, eutrofication and modification of the aquatic habitats would be avoided. By protecting the aquatic habitats, the aquatic organisms are protected, too. More precisely, in order to mitigate the impacts on river ecosystems, the implementation of the following measures is recommended: - Avoid the disturbance of natural habitats as well as the input of pollution substances - The material resulting from the construction of haulage roads, bridges and tunnels (rocks, pebbles, cobbles, soil, plants) should not be thrown into rivers, - The haulage roads should not be traced along the riverbed and sufficient areas with riparian vegetation should be left in order to prevent the direct input of dust, sand and other materials during the use of the haulage roads, - To prevent any kind of storage of construction materials near the rivers, - The waste materials from construction activities should be properly disposed and removed from the rivers or their vicinity, - Barrels or tanks where hazardous materials are being stored (oil, fuel, dyes) must be placed on appropriate and marked sites which are distanced from rivers. These materials should be handled very carefully in order to avoid leaks of hazardous materials into rivers, - Handling of wet cement must be done in a careful and controlled manner in order to avoid its input within the river ecosystems. During the construction of bridge piers, the leak of cement into rivers should be prevented, - Installation of mobile toilets or providing appropriate facilities located near the construction activities, - Protection of the riparian vegetation, since it will represent an important buffer zone and

	protection of rivers, - Prevention of interventions in the riverbed. According to the results of the survey on diatom flora and macroinvertebrate fauna, an insignificant number of sensitive species to the activities from the construction or operation of the railway were determined. Still, regular monitoring of the populations of dragonfly species of *Cordulegaster heros* and *Caliaeschna microstigma* is recommended, especially in the river of Gabarska Reka, in order to determine on time the possible negative impacts from the construction of the railway.
Operation	
Impacts	**Mitigation measures**
Diatoms and macroinvertebrates Maintenance of bridges as well as the potential pollution from accidents may negatively impact the aquatic organisms	The aquatic species of diatoms and macroinvertebrates inhabiting the aquatic ecosystems in the project area have a minor conservation importance. Generally, ubiquitous species of diatoms and macroinvertebrates are found. On the other hand, lesser impacts are expected from the operation of the railway when compared to construction. Thus, no specific protection measures are recommended for the operational phase
Residual impacts during construction and operation: With the implementation of the mitigation measures, no residual impacts are expected.	
Residual impacts mitigation measures: /	

7.9.10 Impacts on proposed protection areas and internationally recognized areas

- **Construction and operational phase**

The alignment of the railway passes through several proposed protection areas or identified areas in accordance with international conventions and initiatives:

- Proposed area "Protected area Osogovo Mountains",
- Proposed Protected Area Nature Park "Gorge of Kiselichka Reka",
- Emerald site Pchinja-German,
- Emerald site Osogovo Mountains.

The envisaged alignment passes on the periphery of the mentioned areas, except in the case of the proposed area Kiselichka Reka.

Emerald sites

The alignment of the railway passes through the Emerald site Pchinja-German from km 75 + 213 to km 77 + 070 ie in the length of 1,857 km (this will include pine plantations, black locust plantations, degraded thermophilic oak forests and mesophilic oak forests). Of these, 1,427 km pass through tunnels or bridges. From the significant forests, the alignment passes through thermophilic oak forests from km 76 + 550 to km 76 + 740 of which 130 m pass through a tunnel, and the remaining 60 m below the bridge. On this basis, it can be concluded that these habitats will not be significantly degraded, nor fragmented, that is, the impact is quantified as negligible.

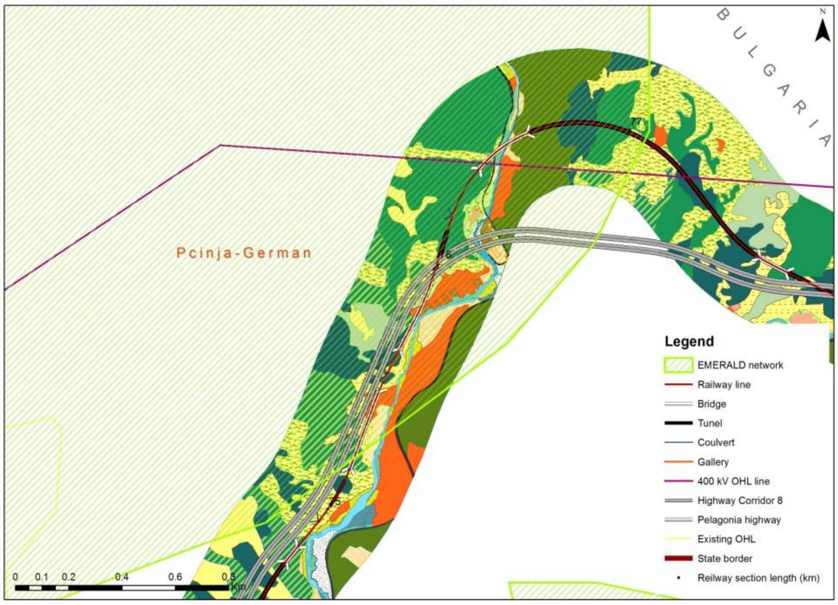


Figure 195 Overview of the alignment of the railway in the Emerald site Pchinja-German

In the Emerald site of Osogovo Mountains, the alignment of the railway passes from km 83 + 080 to km 83 + 630 ie through a space in which no significant populations of species with high conservation significance have been identified. The construction of the railway will cover only one significant habitat, which has a conservation significance under Resolution No. 4 of the Bern Convention:! 41.1 beech forests, in the length of the alignment from km 83 + 080 to km 83 + 630. Thereby, the impact on the beech forests will be negligible since the construction of a tunnel is envisaged in this area.

Figure 196 The alignment of the railway within the Emerald site Osogovo Mountains

Proposed area for protection

A similar conclusion applies to the proposed area "Protected Landscape of Osogovo Mountains". In this case, beech forests in the length of the alignment of 282 m (km 82 + 376 to 82 + 658) will be affected. Beech forests from km 82 + 656 to km 84 + 056 will not be degraded during the construction of the railway, because in that part of the alignment the construction of a tunnel is envisaged. Most of these forests are in the segment of the alignment, in which the tunnel is planned. Also, the alignment of the railway passes through the area for sustainable exploitation of the area, in which the construction of infrastructure facilities is permitted. It is necessary to emphasize that this area is not yet part of the formal system of protected areas, but is only a proposal made within the framework of the project Representative Network of Protected Areas (MES 2011).

Figure 197 Submontane beech forests in the proposed area "Protected Landscape Osogovo Mountains"

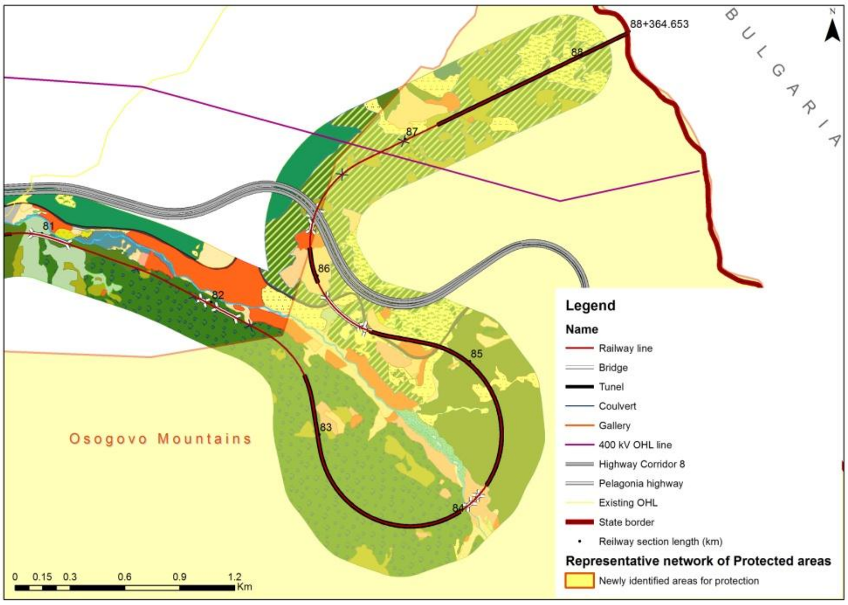


Figure 198 Overview of the alignment of the railway in the proposed area "Protected area Osogovo Mountains"

The basic criterion for identification of the proposed protected area-Nature Park "Gorge of Kiselichka Reka" is the presence of the otter. Through this area, the railway crosses a total length of 2,366 km (from km 75 + 146 to km 77 + 512), of which, 1,911 km pass through tunnels or bridges.

However, in this area, an impact is expected in the construction of bridge no. 32 (km 76 + 402 to 76 + 611.5) due to the possible degradation of the habitats of the otter (the riparian habitats and the river), disturbance and reduction of the flow and water quality, which provides for appropriate mitigation measures.

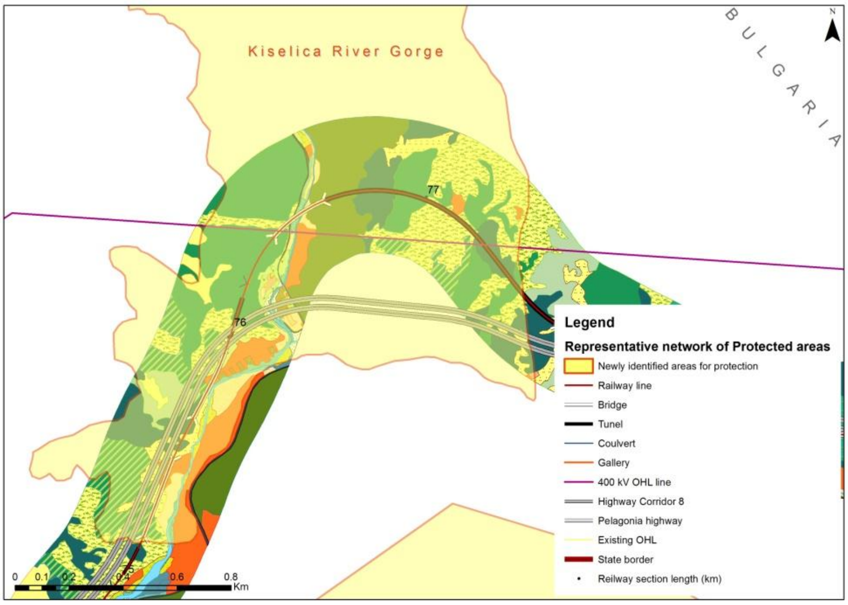


Figure 199 Overview of the alignment of the railway in the proposed area Nature Park "Klisura of the Kiselicka Reka"

It can be concluded that the impacts, which are relevant to protected areas, have already been elaborated in the sections dealing with impacts on flora, habitats, landscapes, fauna, but also on other components of nature. Particularly important is the fact that no significant impacts are expected on the areas proposed for protection, especially since the railway line is mainly through tunnels within the scope of the proposed protection areas. It is also important to emphasize that the areas under consideration do not yet have legal protection, that is, there is no legal act for their protection, management and appointed managers for none of them. Therefore, mitigation measures in the proposed areas for future protection will relate only to the species diversity, habitats, landscapes, as components of nature. In addition, most of the impacts on the proposed protected areas relate to the construction phase (forest and other habitats degradation, river diversion, etc.), while the relevant threat during the operational phase is the fragmentation of habitats (which will occur in the construction phase, but will also have consequences in the operational phase), and will be manifested as an impairment of the function of biocoridors.

The following table shows the quantification of impacts on proposed areas for protected and internationally recognized areas during the construction and operational phase.

Environmental Components: Proposed Protection Areas and Internationally Recognized Areas											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Emerald site "Pchinja-German"	Construction work / Degradation and fragmentation of forest habitats, especially thermophilic oak forests	Negative	Immediately	Direct / indirect	Location	Long-term	Not likely	Reversible	Negligible	Negligible small	Yes
Emerald site "Osogovo Mountains"	Construction works / Destruction and degradation of forest habitats, especially beech forests	Negative	Immediately and delayed	Direct / indirect	Location	Long-term	Not likely	Reversible	Negligible	Negligible small	Yes
Proposed area for protection - protection zone "Osogovo Mountains"	Construction works / Destruction and degradation of forest habitats, especially beech forests	Negative	Immediately and delayed	Direct / indirect	Local	Long-term	Not likely	Reversible	Negligible	Negligible small	Yes
Proposed area for protection - natural park "Gorge of Kiselichka	Construction work near or in a river bed / Destruction, degradation and fragmentation of coastal habitats, river	Negative	Immediately and delayed	Direct / indirect	Local	Long-term	Probably	Reversible	Moderate	Moderate	Yes

River"	diversion, water pollution										
Operational phase											
Proposed area for protection - natural park "Gorge of Kiselichka river"	Operational activities of the railway, maintenance of the alignment / Fragmentation of the rugged habitats	Negative	Immediately and delayed	Direct / indirect	Location	Long-term	Probably	Reversible	Moderate	Moderate	Yes

7.9.11 Mitigation measures

<table>
<tr><th colspan="2">Environmental components: Proposed protected areas and internationally recognized areas</th></tr>
<tr><th colspan="2">Construction and operation</th></tr>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>Proposed protected areas and Emerald sites
The construction and operation of the railway may negatively impact the proposed protected areas.
The impacts on the proposed protected areas relate to the construction phase (degradation of forests and other habitats, river diversion etc.), while a relevant threat during the operation is fragmentation of habitats (which will arise during the construction, but will have effects in the operational phase, too), which will be manifested as disturbance of the function of bio-corridors</td><td>No specific impacts were identified for the proposed area “Protected landscape Osogovski Planini”, the Emerald site “Pchinja-German” and the Emerald site “Osogovski Planini”. Hence, the recommended measures relating to habitats and fauna are completely applicable and sufficient for impact mitigation in the proposed and internationally designated protected areas.
Very similar is the situation with the proposed protected area-nature park “Kiselichka Reka Gorge”, where certain impacts were identified, but they refer to the riparian habitats and the otter, and are not specific for the whole area. As described in the fauna mitigation measures, more attention should be given to the construction of the bridge no. 32 (km 76+402 to 76+611.5), i.e. the foundations of the bridge should be distanced 5-10 m off the riverbanks of Kiselichka Reka and the plantation of a willow belt by the river is necessary</td></tr>
<tr><td colspan="2">Residual impacts: The identified impacts on protected areas and the implementation of the mitigation measures will result in residual effect on all of the biodiversity components. The destruction and degradation of nature is impossible to be completely avoided. But the implementation of the mitigation measures will contribute to minimization of the impacts to acceptable residual effects</td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: Although there aren’t any protected areas now, a certain amount of help can be offered in the future to the managers of the protected areas by the institutions/companies that manage the railway traffic, which would be a significant compensational measure</td></tr>
</table>

7.10 Forestry

In this part of the Study, forests are considered primarily as an economic component, and less as habitats, which is done above, in the area of impacts on habitats.

7.10.1 Impacts on forestry

- **Construction phase**

The foreseen project activities for the construction of the railway line - Section 3 of Corridor VIII-Kriva Palanka-Border with the Republic of Bulgaria, foresee clearing of the site, both for the construction of the railway line and for construction of access roads, worker camps, formation of dumpsites. Clearing of the location and performance of the construction works can cause negative impacts on the forests, ie they will contribute to the destruction and degradation of the forest plantations and the forest area, and will also affect their renewal.

During the clearing of the alignment and performance of construction works, as a result of a certain loss of wood mass, the following forest communities will be most affected:

1. In the forestry unit Dlabocica-Kiselica: ass. Qurco-Carpinetum orientalis macedonicum Rud.1939 ap.Ht.1946-a community of pubescent oak and oriental hornbeam, and ass. Quercetum frainetto-cerris macedonicum Oberd. 1948 Em. Ht.1959-a community of Italian oak and Turkey oak,
2. In the forestry unit Kriva Palanka - Anishte: ass. Quercetum frainetto-cerris macedonicum Oberd. 1948 Em. Ht.1959-a community of Italian oak and Turkey oak, and ass. Orno-Quercetum petreae Em 1968-a community of sessile oak forests, and
3. In the forestry unit Kriva Reka-Stanechka Reka: ass. Orno-Quercetum petreae Em 1968-sessile oak Forests, and Ass. Festuco heterophyllae Fagetum Em 1965 - a community of submontane beech forest.

Besides these, the construction of the railway line will also affect parts of artificially raised plantations of black pine and black locust, where there will also be some loss of wood mass.

Annex 14 provides data on the impact of the construction activities within the contact zone within the corridor, 500 m to the left and right of the axis of the line, with quantitative indicators for direct and indirect impact on the forest and the forest areas for each subsection and a commercial unit separately.

As stated in Annex 14, it can be concluded that during the construction of the railway line, approximately 7.81 ha of forest and forest land will be permanently lost, as well as 480.95 m^3 of timber. Of this amount, 3.59 ha and 165.32 m^3 are in the forest-economy unit Dlabocica-Keselica, 1.75 ha and 210.70 m^3 in the forestry unit Kriva Palanka-Anishte and 2.47 ha and 104.93 m^3 in the forestry unit- Kriva River-Stanechka River.

Due to the small representation in the project area, in one hand, and the great significance from the aspect of protection and conservation of biological diversity, on the other hand, the following are particularly sensitive: the riparian forests of willow and poplar, located in the belt between km 74+ 020 and km 81 + 600, the riparian belts of willow and poplar, located between km 74 + 200 and km 81 + 300 and submontane beech forests from km 81 + 500 to km 82 + 600.

Taking into account the condition of the other types of forests in the project area, which in the past were under strong zooanthropogenic pressure, and are now in a certain stage of revitalization, it can be concluded that the construction activities will hinder the processes for renewal of the forest in the entire project area.

The performance of the construction works, the removal and degradation of forest plantations and surfaces can cause loss of natural habitats, changes in the climatological characteristics of the area, reduction of the absorption power of the soil, erosive processes etc.

The construction of the railway and accompanying structures can affect the fragmentation of habitats, with negative consequences on the food chain, movement and reproduction of animal wildlife (which is detailed in the chapter on biodiversity).

Removal of forest plantations and forest degradation can cause negative impacts on the air as a result of the loss of green mass, which participates in the assimilation of CO_2 and reduction of air pollution. Removed forest plantations can cause microclimate changes in the area. Considering the fact that about 7.81 ha of forest and forest land should be permanently converged for the construction of the railway line, it can be concluded that these impacts will be insignificant.

Construction activities will contribute to the disruption of soil quality, ie sealing of the soil as a result of conversion from productive to unproductive land, as well as permanent conversion from forest to construction land, which will lead to permanent loss of the economic and commonly used functions and values of the surrounding forest communities.

Removal of forests, permanent loss of forest land, loss of wood mass and disruption of natural regeneration will indirectly affect the erosive processes at the sites where the construction works are carried out.

The construction activities will cause fragmentation of the forest (units and sub-units), which will contribute to changes in the planned activities in the forest management, changes in the boundaries of the forest plantations, changes in the plans for coppicing, delivery, transport, afforestation, which will require the entire management concept to adapt to the newly created condition, caused by the construction of the railway line. This will also cause financial repercussions due to the need to update the Special Forest Management Plans for further management of the three forestry units: Dlabochica-Kiselica, Kriva Palanka-Anishte and Kriva Reka-Stanechka Reka.

The construction of the railway line will cause changes in the management of private forests, which will result in the confiscation of private properties and the reduction of private forest land. The confiscation of private forest lands may affect owners who use the forests for securing livelihoods. The inadequate compensation in case of expropriation of this type of land is elaborated in more detail in the chapter on social impacts. At this stage of the Project, it is not possible to determine with certainty the extent of private forest land affected by the construction of the railway line, therefore the significance of the impacts can not be determined.

During construction activities, there is a risk of fire and other incidental events, which can cause significant negative impacts on forests and forest areas. The risk of occurrence of forest fires is analyzed in more detail in the chapter Risk of accidents.

Based on the foregoing, it can be concluded that the possible impacts on the forests in the construction phase, which relate to: permanent loss of forest land, loss of timber and loss of natural renewal, which are long-term and irreversible phenomena will be of a great degree of significance, and will additionally have an indirect impact on the occurrence of erosion processes. During normal conditions, the construction of the railway is not expected to cause negative transboundary impacts.

- **Operational phase**

In the operational phase of the line, the removal of vegetation (herbaceous and forest vegetation) will be carried out in order to maintain the railway and avoid the risks of the occurrence of a fire.

The maintenance of the railway line will mean clearing of the vegetation resulting from natural reforestation in the immediate vicinity of the railway line (right-of-way), which will prevent or reduce the potential of the forest for recovery. The maintenance of the railway line will cause negative impacts on the forest plantations along the alignment, but they are assessed with little significance.

Rail traffic can be the cause of a forest fire (caused by sparks during braking and other operations on tires, negligent passengers, etc.) and other incidental events that can cause adverse impacts on forest plantations. In case of forest fire, the most affected are black pine plantations, which usually suffer from forest fires (due to their light flammability and higher accumulation of flammable material per unit area). The occurrence of fire can cause long-term effects on forests. The risk of occurrence of forest fires is analyzed in more detail in the chapter Risk of accidents.

Environmental Components: Forestry											
Affected media / Areas / Receptors	**Source of influence / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
			Construction phase								
Forest	Preparation of the construction site and performance of construction activities / removal of forest vegetation, loss of forest area, loss of wood mass, loss of natural redevelopment	Negative	Immediately	Directly	Local	Long-term	Surely	Irreversible	Large	Large	Yes
Population	Preparation of the construction site and performance of construction activities / Loss of forest area in private ownership	Negative	Immediately	Directly	Local	Long-term	Probably	Irreversible	Can not be determined	Can not be determined	Yes
	Operational phase										
Forest	Maintenance of the railway / Removal of vegetation / reduction of opportunities for forestation	Negative	Immediately	Directly	Location	Long-term	Surely	Reversible	Small	Small	Yes

7.10.2 Mitigation measures

Thematic area-Forestry	
Pre-construction	
Impacts	**Mitigation measures**
Impacts on forestry The construction of the railway will negatively impact the forestry sector due to deforestation/loss of forestland, loss of wood mass, loss of natural restoration, loss of private property forestland, change of land use from forestland into construction site etc.	• Prior commencing the construction works, the Contractor should prepare Forest Management and Removal Plan which will precisely define the procedure for execution of all the activities in order to mitigate the negative impacts in the project area • Timely implementation of the expropriation procedures and fair reimbursement for the loss of ownership (for private landowners of forests and forest land) • Timely commencement of the procedures for permanent change of land use (private and public property) into construction site, in accordance with the Law on expropriation, Law on forests, the Rulebook for determinig the reimbursement costs for permanent change of forests and forest land, as well as with other relevant laws and bylaws
Impacts	**Mitigation measures**
Impacts on forestry The construction of the railway will negatively impact the forestry sector due to deforestation/loss of forestland, loss of wood mass, loss of natural restoration, erosion, loss of private property forestland etc.	• Implementation of the measures from the Forest Management and Removal Plan • Avoid execution of construction works, tracing of haulage roads, establishment of borrow pits, storage of materials and waste near the riparian poplar and willow woodlands (km 74+020 and km 81+600), the riparian willow and poplar belts (km 74+200 and km 81+300) and the submontane beech forests (km 81+500 to km 82+600); • Minimization of the areas where construction works are carried out and minimization of logging by adequate solutions in the Execution Designs • Avoid tracing new haulage roads and maximal use of the existing ones for supply of raw materials, machines or removal of waste etc. • Avoid storage of materials, excavations or embanking at sites where there is forest replenishment • Partial landscaping of the area, as well as reforestation of sites where construction works have been completed in order to achieve partial compensation of the negative impacts and

	reduction of the erosion risk, establishment of natural balance, the function and dynamics of the ecosystems and habitats • Implementation of the mitigation measures for biodiversity, air, soil etc. • Implementation of the measures from the Fire, Explosion and Hazardous Material Management Plan
Residual impact: With the implementation of the forestry impact mitigation measures there is a possibility for residual impacts due to deforestation	
Residual impacts mitigation measures: If residual impacts are evident, an additional analysis of impacts will be carried out and additional measures will be recommended	
Operation	
Impacts	**Mitigation measures**
Impacts on forestry The maintenance of the railway and vegetation removal, as well as accidental fires etc. may negatively impact the forestry sector	• Deforested areas should be restored by taking measures for natural or man-made forest restoration with native species, which are also more adapt to climate change. If there is no possibility for reforestation, other land area should be designated for that purpose (compensation, which will be implemented by the Investor) • The natural disaster and accident should be assessed within a Natural Disaster and other Accidents Protection and Rescue Plan
Residual impacts: In normal operational conditions, no residual impacts are expected	
Residual impacts mitigation measures: /	

7.11 Waste

7.11.1 Impacts from waste

- **Construction phase**

The construction of the new railway line, section Kriva Palanka-Border with the Republic of Bulgaria, includes a series of construction activities that will generate waste such as:

- clearing and removal of vegetation along the alignment of the railway;
- dismantling and demolition of existing buildings and other objects, as well as dwelling facilities;
- earthworks, concreting, asphalting, welding as well as activities related to the provision of telecommunication networks and power supply;
- use of mechanization;
- presence of workers and others.

The aforementioned activities will generate the following types of hazardous, non-hazardous, inert and biodegradable waste, ie:

- excavated land;
- different types of construction waste;
- waste from metal parts (parts of rails and joints);
- mixed municipal waste (generated by construction activities and workers who will be involved in construction activities);
- biodegradable waste (grass, trees and shrubs from the process of clearing of the locations);
- packaging waste;
- waste paint;
- insulating materials and building materials containing asbestos, as a result of demolition of old buildings;
- waste oil;
- filters, adsorbents, wiping towels;
- contaminated soil from accidental leakage;
- waste from electrical and electronic equipment, etc.

The following table shows the types of waste that are expected to be generated in the preparatory and construction phase of the project activity, in accordance with the List of wastes ("Official Gazette of the Republic of Macedonia" No. 100/05).

Much of the generated waste (ie the waste shown in the table below) will have a usable value, such as excavated land, waste from metal parts (parts of rails and joints) etc.

Table 89 List of wastes anticipated to be generated during construction

No.	Waste type	List of wastes code
	17 – Construction and demolition wastes	
	Concrete, bricks, tiles and ceramics	**17 01**
1	Concrete	17 01 01
2	Bricks	17 01 02
3	Tiles and ceramics	17 01 03
4	Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances	17 01 06*

5	Mixture of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06	17 01 07
	Wood, glass and plastic	**17 02**
1	Wood	17 02 01
2	Glass	17 02 02
3	Plastic	17 02 03
4	Glass, plastic and wood containing or contaminated with dangerous substances	17 02 04*
	Bituminous mixtures, coal tar and tarred products	**17 03**
1	Bituminous mixtures containing coal tar	17 03 01*
2	Bituminous mixtures containing other than those mentioned in 17 03 01	17 03 02
3	Coal tar and tarred products	17 03 03*
	Metals (including their alloys)	**17 04**
	Soil (including excavated soil from contaminated sites), stones and dredging spoil	**17 05**
1	Soil and stones containing dangerous substances 17 05	17 05 03*
2	Soil and stones other than those mentioned in 17 05 03	17 05 04
3	Dredging spoil containing dangerous substances	17 05 05*
4	Dredging spoil other than those mentioned 17 05 05 17 05	17 05 06
5	Dredging gravel from rivers containing dangerous substances	17 05 07*
6	Dredging gravel from rivers other than those mentioned in 17 05 07	17 05 08
	Insulation materials and asbestos-containing construction materials	**17 06**
	Gypsum-based construction material	**17 08**
	Other construction and demolition waste	**17 09**
	Wastes form the manufacture, formulation, supply and use (MFSU) and removal of paint and varnish	**08 01**
12 Wastes from shaping and physical and mechanical surface treatment of metals and plastics		
1	**Welding wastes**	**12 01 13**
13 Oil wastes and wastes of liquid fuels		
1	Waste hydraulic oils	13 01
2	Waste engine, gear and lubricating oils	13 02
3	Oil/water separator contents	13 05
4	Wastes of liquid fuels	13 07
15-Waste packaging; absorbents, wiping cloths, filter		

materials and protective clothing not otherwise specified		
1	Packaging (including separately collected municipal packaging waste)	15 01
2	Absorbents, filter materials, wiping cloths and protective clothing	15 02
20-Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions		
1	Separately collected fractions	20 01
2	Garden and park wastes	20 02
3	Other municipal wastes	20 03

The impacts of waste on receptors (surface water, soil, groundwater, biodiversity, landscape and population) are assessed as negative with low intensity, ie with a negligible significance. However, the impacts of the waste on air quality during the activity of storage and transport of waste (dumping of dust and minor fractions of waste) are assessed negatively with a moderate significance, and regarding the activities of storage and transport of waste-decomposition of biodegradable waste (removed vegetation) are negative with low intensity, ie negligible significance and are not expected to cause transboundary impacts.

- **Operational phase**

In the operational phase of the railway line Kriva Palanka-Border with the Republic of Bulgaria, different fractions of waste will be generated as a result of the following activities:

- maintenance of the railway line;
- repair of the railway and
- transport of passengers.

In fact, the types of waste that will be generated during the operational phase are the following:

- biodegradable waste (grass, trees and shrubs from clearing along the alignment of the railway line);
- mixed communal waste;
- spare parts and waste from repair of the railway;
- waste from electrical and electronic equipment, as a result of maintenance of the railway, electronic and electric waste from the equipment in the station and other accompanying facilities
- spare parts of machinery for railway maintenance, wagons etc.

The dynamics of generating these types of waste is related to the maintenance of the railway and the frequency of passengers.

Improper management and handling of generated waste can cause significant impacts on soil, water, biodiversity, people, etc. Since waste management will be carried out in accordance with legal obligations, significant impacts are not expected.

The following table lists the types of waste that are expected to be generated during the operational phase.

Table 90 List of wastes anticipated to be generated during operation

No.	Waste type	List of wastes code
1	Biodegradable waste	20 02 01

2	Mixed municipal waste	20 03 01
3	**Spare parts from machine for maintenance of the railway and waste from railway repair**	
3.1	Damaged rail vehicles, wagons, rails, turnouts and other spare parts	17 04 05
3.2	Concrete sleepers	17 01 01
3.3	Wooden sleepers covered with creosote	17 02 04*
4	Discarded electrical and electronic equipment	20 01 35*

The impacts on the receptors (air, soil, water) from the waste during the operational phase are assessed as negative with negligible significance.

Thematic area: Waste											
Affected media / Areas / Receptors	**Source of impact / emissions**	**Nature of the impact**	**Time of Appearance**	**Type**	**Scope**	**Duration**	**Probability**	**Reversibility**	**Intensity / Magnitude**	**Degree of significance**	**Mitigation measures**
Construction phase											
Air	Storage and transport of waste / dumping of dust and minor fractions of waste	Negative	Immediately	Direct / Cumulative	Local	Short term	Surely	Reversible	Moderate	**Moderate**	YES
	Storage and transport of waste / decomposition of biodegradable waste (removed vegetation)	Negative	Immediately	Direct / Cumulative	Local	Short term	Low probability	Reversible	Small	**Negligible -small**	YES
Surface waters	Storage and transport of waste / discharge and flushing of waste, generation of leachate	Negative	Immediately/ delayed	Direct / Indirect / Cumulative	Area	Short term	Probable	Reversible	Small	**Negligible -small**	YES
Soil	Storage and transport of waste / discharge and washing of waste, generation of organic fraction discharge	Negative	Immediately	Direct / Indirect / Cumulative	Local	Short term	Low probability	Reversible	Small	**Negligible -small**	YES
Groundwater	Storage and transport of waste / disposal and rinsing of waste, generation of leachate	Negative	Immediately	Direct / Indirect / Cumulative	Local	Short term	Low probability	Reversible	Small	**Negligible -small**	YES
Area	Storage and transport of waste / irregular removal of generated waste, waste disposal	Negative	Immediately	Direct / Indirect / Cumulative	Local	Short term	Surely	Reversible	Small	**Negligible -small**	YES
Population	Impairment of media quality (water, air, soil) and landscape as a result of inadequate waste management	Negative	Immediately/ delayed	Direct / Indirect / Cumulative	Area	Short term	Low probability	Reversible	Small	**Negligible -small**	YES

Biodiversity	Disruption of the quality of the media as a result of inadequate waste management	Negative	Immediately/ delayed	Direct / Indirect / Cumulative	Area	Short term	Low probability	Reversible	Small	**Negligible -small**	YES
Operational phase											
Air	Storage of waste / decomposition of biodegradable waste (removed vegetation and communal waste)	Negative	Immediately/ delayed	Direct / Indirect / Cumulative	Local	Long-term	Low probability	Reversible	Negligible	**Negligible /small**	YES
Soil	Waste storage / leachate generation (biodegradable waste), flushing of metal waste from maintenance of the railway	Negative	Immediately/ delayed	Direct / Indirect / Cumulative	Local	Long-term	Low probability	Reversible	Negligible	**Negligible /small**	YES
Water	Waste storage / leachate generation (biodegradable waste), flushing of metal waste from maintenance of the railway	Negative	Immediately/ delayed	Direct / Indirect / Cumulative	Local	Long-term	Low probability	Reversible	Negligible	**Negligible /small**	YES

7.11.2 Mitigation measures

Environmental components-Waste	
Pre-construction and construction	
Impacts	**Mitigation measures**
The inadequate waste management may negatively impact the environmental media and components and pose threat to the health of the community	The Contrector of the construction works should prepare Waste Management Program for the construction phase. The program should at least contain the following: • Identification of the different types of waste and envisaged quantities of waste that will be generated at the construction sites, in accordance with the List of wastes („Official Gazette of the Republic of Macedonia“ no. 100/05) • Selection and classification of the different types of waste in accordance with the List of wastes and handing them over to authorized companies • Determination of the way of treatment of the different types of waste • Establishment of a procedure for waste management • Providing containers and sites for waste storage • Defining the time of waste collection and transportation of the generated waste from the construction site • Re-use of excavated earth and the construction waste as much as possible • Re-use of other types of waste • Determination of the estimated value of the reusable or recyclable waste • Recording the type and quantity of generated waste and preparation of annual reports for waste quantities that are handed over to authorized companies • Establishment of a monitoring of the measures taken for waste management • Training of the employees for proper waste treatment It is also recommended: • Full implementation of the measures and recommendations from the Waste Management Program: contracting authorized companies for collection, transport and treatmeant of waste, as well as accepting the waste • Engaging an expert-waste manager that will provide a complete implementation of the Plan in accordance with the legal requirements

	• Municipality of Kriva Palanka to appoint/designate sites for dumping of the inert waste/construction waste and excess excavated earth which cannot be used in the construction of the railway
Operation	
Impacts	**Mitigation measures**
The inadequate waste management may negatively impact the air quality, water, soil etc. due to the generation of different types of waste, regular maintenance of the railway, equipment (railway vehicles, railway wagons etc.) and other railway components (station, halt, railway maintenance objects), as well as during passenger transport	• Establishment of waste management procedures • For proper waste management, containers with different colors will be placed for disposal of different waste streams, especially at the station, halt and in objects where there will be workforce • The Operator of the railway should contract authorized companies for collection and transport of the different waste streams • If the Operator of the railway, from the beggining of its work, generates more than 200 kg of hazardous waste and/or more than 150 t of non-hazardous waste during a period of one calendar year, it is obliged to prepare Waste Management Program and to implement it in accordance with the Art 21 of the Law on waste management
Residual impacts: No residual impacts are expected	

8 SOCIAL IMPACT ASSESSMENT AND MITIGATION MEASURES

8.1 Methodology for assessment

Activities, related to changes in the current human environment, always create different social impacts, which at some time can have a negative sign. It is therefore necessary to adequately identify the potential problems and consequences that they carry with them, and consequently to propose appropriate measures to mitigate the impacts that will compensate for the damage incurred.

The purpose of the assessment of social influences is to assess the temporary and permanent impacts of the proposed project. It should emphasize the need to create positive effects and benefits for the community, not just for investors.

In the assessment of possible social impacts, the following topics were considered:

- Demographic changes
- Changes in the health and safety of the community
- Changes in housing and infrastructure
- Changes in lifestyle and economic change
- The use of land, changes in ownership and land lease
- Changes in social cohesion
- Changes in quality of life
- Work force and working conditions

The Social Impact Assessment Approach (SIA) follows the standard procedure of the established international practice for assessing social impacts: a description of the current social / social environment (taken as a starting point), reviewing the changes in that social environment caused by the Project, determining the significance of those impacts and address appropriate mitigation measures.

The objective of the SIA process is to create a situation where the project will have no major residual impacts (impacts that will remain despite the application of mitigation measures); especially those that are long-lasting or that cover a larger area. However, it is possible for some aspects to have residual impacts, although all practical measures for reducing impacts have been exhausted.

The SIA identifies the social impacts arising from the realization of the project at its various stages: pre-construction, construction and operational phase. The pre-construction phase is the phase preceding the construction activities and includes the preparation of the necessary plans, tender procedures, planning activities and project organization. The construction phase encompasses the preparation of the construction site and the construction activities themselves. The operational phase follows the activities undertaken in the life cycle of the project, i.e. the functioning of the railway, its regular maintenance, repair and use.

Criteria for assessing possible social impacts of the project are given in the following table.

Table 91 Criteria for Impact Assessment

Criteria	Score	Description
Nature	Positive	Impact that creates an improvement in the current situation or introduces a positive change
	Negative	Impact creates negative changes in the existing situation or introduces unwanted elements in the same
Type	Immediate (Direct)	Impacts are the result of direct (immediate)

Criteria	Score	Description
		interaction between project activity and resources / receivers
	Indirectly	Impacts that are the result of non-project activities that occur as a result of the project
	Cumulative	A product of multiple environmental / social impacts on a single receiver or effects that result as a combined effect of various development projects
Area	On the spot	Impact effects limited to 1 km from the project area
	Local	Effects of impact in width 1-20 km from the project area
	Regional	Effects of impact, 20-50 km from the project area
	National	Effects of impact over 50 km from the project area
Duration	Short term	Impacts predicted to last for a short time, usually only during construction
	Mid-term	Impacts foreseen to last a mid-term until the completion of the construction / realization of the entire construction part of the project
	Long term	Impact and its effects will continue or will last throughout the operational phase of the project
	Permanently	The impact and its effects will continue or will last even after the life cycle of the project
Probability	Surely	The impact will occur under normal operating conditions
	Probably	Influence may appear in some time, under normal operating conditions
	Not likely	Impact is not expected to occur, but may occur under normal operating conditions
Reversibility	Reversible	Potential impact is occasionally and reversible
	Nonreversible	Potential impact is permanent and irreversible
Magnitude	Negligible	There is no noticeable change in the assessed situation
	Low	A noticeable, but slight change in the assessed state
	Medium	A noticeable change in the assessed state, which does not result in a fundamental temporary or permanent change
	High	A fundamental change in a given assessed condition resulting in a long or permanent change, typically spread in nature, and requiring substantial intervention to return to the original state, exceeding national standards and limitations
Significance	Negligible	Impact of negligible meaning exists when the resource or receiver is not affected in any way by the activity given, or the intended effect is

Criteria	Score	Description
		inconspicuous or inseparable from the natural background levels
	Small	Influence with little significance, when the effect is felt, but the magnitude is small enough and quite within the permissible limits and / or the receiver is of low sensitivity
	Moderate	The impact of moderate significance is within the permissible limits and standards. The emphasis of moderate influence is placed on the display that the impact is reduced to a level of reasonably acceptable limits. This does not mean that moderate impacts should be reduced to small ones, but that moderate consequences are properly and effectively managed.
	Large	Impact of great importance is what exceeds the permissible limits and standards, or an impact with great significance occurs in highly valued / sensitive resources / resources

Determining the significance of impacts relies on a reasonable argument, a professional judgment, and consideration of the views and considerations of the respective organizations.

On some topics, possible impacts are evaluated by quantitative thresholds and scaling in determining significance. In determining any impact in one of the four categories of significance, it allows different topics to be set on the same scale, which allows direct comparison.

Significance is considered as a function of the magnitude of the impact and the likelihood of its occurrence. The significance matrix is described in the following table.

Table 1 Matrix for determination of significance

SIGNIFICANCE=Magnitude x Probability		**PROBABILITY**		
		Not likely	Probably	Surely
MAGNITUDE	Negligible	Negligible	Negligible	Negligible
	Low	Negligible	Small	Small
	Moderate	Small	Moderate	Moderate
	Large	Moderate	Large	Large

Since all the social impacts considered in this study are not always negative, but have influences that are favorable to the local or wider community and to affected groups, the next color coding is created to offer assistance in visual identification of the impacts that this project will cause.

Table 2 Color Significance Coding

Negative assessment	**Positive assessment**
Negligible	Negligible
Small	Small
Moderate	Moderate
Large	Large

8.2 Brief description / Summary of social impacts

This international traffic link, the Kriva Palanka-Border Republic of Bulgaria, will contribute to the economy in the city of Kriva Palanka as well as the surrounding settlements, to revive to a higher level, because the products that will leave the municipality will have a reduced price for transport and transport of materials and goods will not depend only on the condition and the quality of the roads, but also on the railroad.

Construction of the railway line will increase labor demand in the area, where some of the unemployed can find temporary employment and support their household incomes. It will reduce the intensity of migration village-town and city-capital. In fact, the migration to Skopje and beyond will be reduced to the stable world economies, especially among the young, thus opening the possibility for social capital to implement their professional skills, knowledge and education in their municipality.

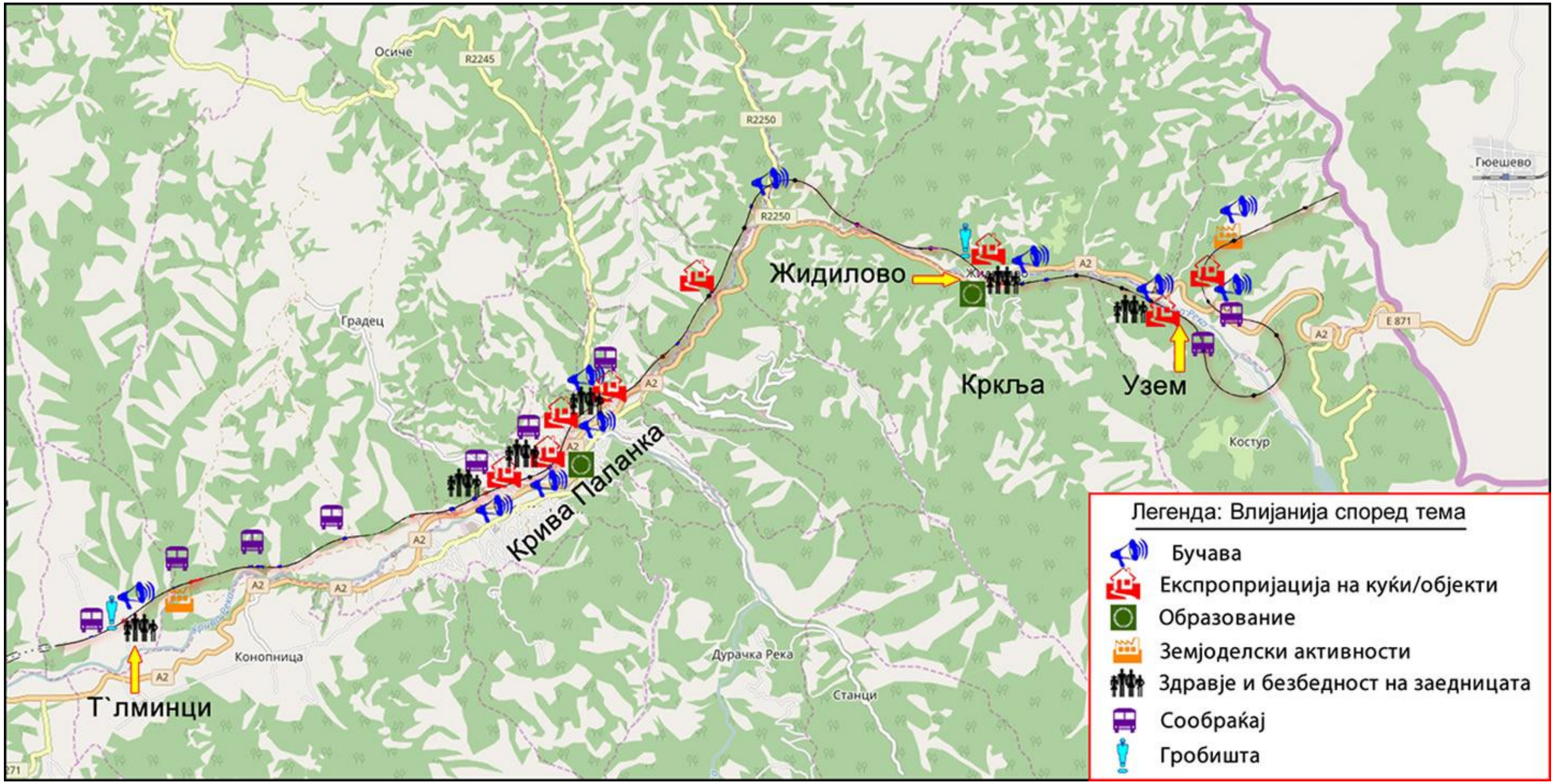
The most affected settlement in the project scope is the city of Kriva Palanka because the railway will pass through a section that is highly populated (although through a tunnel) and where certain activities will be carried out to seize property located on the alignment itself. The other four rural settlements will be affected to a lesser extent. The remaining settlements in the Municipality will feel certain influences, which will be peripheral, but not insignificant.

The alignment of the project dominantly passes through forests, pastures, partly construction land (settlements), through tunnels and very few agricultural land. Most of the land on the alignment is neglected and is not used. Similarly, most of the land is state-owned, although there is also private land.

The biggest negative social impacts are related to expropriation. Resettlement of homes is expected, especially in the city of Kriva Palanka.

As a result of the construction and operation of the railway line, under normal conditions, negative transboundary impacts on the social environment are not expected, but on the contrary, improvement of the transport infrastructure connection with the Republic of Bulgaria, improvement of the transport of people and goods, which will make a significant contribution to the economic development of the both countries.

The following picture shows a map of the social impacts, and in the following chapters, the social impacts that are caused by the construction of the railway line are explained in detail, as well as measures for their reduction, mitigation or avoidance are given.



(Source: OpenStreetMap)

Figure 200 A review map of the social impacts

8.3 System for managing the social environment

The social management system is a dynamic continuous process, initiated and supported by the developer's leadership of this project, and it involves essential communication between the developer, its employees and the local population affected by the project and / or other activities to the investor, and, where appropriate, other interested parties.

8.3.1 Management of the social environment management system

8.3.1.1 Pre-construction phase

Impact 1: Improper management of the implementation of the social environment management system

Implementation of the social environment management system requires a good organization and dedicated employees to take into account any recommendations derived from this document, IFI contracts that could fund this project and the corresponding programs related to community development and the application of good international practices.

Based on the set criteria, this influence can be defined as: negative, indirect, of a local character, short-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, reversible, with low magnitude and low significance (impact can be mitigated and managed).

Impact 2: Delay in the implementation of the project due to the company's non-compliance with the requirements of the IFIs

Certain delays in procurement may arise due to non-compliance with IFI requirements with regard to dealing with contractors as a whole. The IFI standards apply to contracting parties (companies) and subcontractors. It is often not easy and simple to hire a contractor who has all the necessary resources necessary for successful realization of the construction work.

All standards and requirements in terms of environmental and social policies must be met, and this may cause another effect - increasing the cost of the investment.

Based on the set criteria, this impact can be categorized as: negative, indirect, of a regional character, short-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, irreversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.3.2 Land acquisition

8.3.2.1 Pre-construction phase

Impact 3: Delay in the project implementation due to poorly expropriated and dissatisfaction of the affected persons

The most sensitive and most emotional moment of this project is the need to relocate people whose homes are on the alignment of the railroad. If the expropriation procedure is not carried out properly and according to the already established good international practice for resettlement of persons and means of living, then the situation may come to an end and the prolongation of the projected construction activities of the project and / or it should be stopped for a longer period / unrealized.

Local civil protests and disobedience are possible, which would result in the halting of the project's activities and, relatively speaking, the chasing of potential IFIs that could financially enable this project. Protests, as an expression of dissatisfaction, will be linked to low-paid assets for property expropriation.

Based on the set criteria, this impact can be defined as: negative, indirect, of a regional character, short-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, irreversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.3.3 Involving stakeholders

8.3.3.1 Pre-construction phase

Impact 4: Increased anxiety among the population due to the lack of communication of local owners of properties near the project area by the investor

Owners and land users, along the alignment of the line, will be interested in whether their property will be affected and whether it will be market-valued, if it comes to its expropriation. There will be significant interest in the project and in the media, especially local, but also in the population. It is possible for it to be subject to daily political topics and thus become subject to general suspicion and distrust. Such suspicion can create a negative public attitude (public opinion) about the project. Then when the project becomes the subject of a negative public opinion, people will try to take actions to protect their interest and stop the changes that this project needs to bring.

Uninformed and partially informed stakeholders, as well as the absence of timely communication with the local population, by the competent institutions and the investor, are a potential threat to the realization of the planned project.

Based on the set criteria, this impact can be defined as: negative, direct, of a local character, short-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.3.3.2 Construction phase

Impact 5: Reduced stakeholder involvement in the construction phase

Once the construction of the railway is started, most often investors and the engaged companies redirect their resources to improving the efficiency of the company itself and often forget about the necessity of maintaining good relations with all stakeholders. It must be taken in consideration that during the construction period there may be some changes in the structure of the stakeholders and their interests and concerns. Things can easily get out of control if there is insufficient communication between the investor company and the stakeholders.

Based on the set criteria, this impact can be defined as: negative, direct, of a local character, short-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, reversible, with low magnitude and low significance (impact can be mitigated and managed).

8.3.4 Organization of labor

8.3.4.1 Pre-construction phase

Impact 6: Problems related to the organization of the workforce

Sometimes the contractors do not possess the skilled workforce, necessary for the successful implementation of the project. Often they create a consortium or engage third-party companies that regularly borrow staff from completely different enterprises. When it is necessary to quickly engage the workforce, companies do not follow the planned steps and recruit employees who are not fully qualified and are not ready for work. The same applies to contractors and subcontractors.

Such cheap resources are later able to return as problematic because there are standards and procedures that need to be followed and comply with the best international practices, and they do not meet them. This, so-called borrowed staff who does not always have the necessary training and experience, is a potential threat to the construction process, to the realization of the project, to people (colleagues, locals, passers) and the human environment.

Unskilled workers need to undergo good training to meet those standards, and this will take time and financial resources.

Based on the set criteria, this impact can be defined as: negative, indirect, of a local character, short-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, reversible, with low magnitude and little significance (impact can be mitigated and managed).

Impact 7: Incomplete compliance with International Financial Institutions Standards (IFIs) with regard to workers and working conditions

Overlooking the application of IFI standards and requirements can make the developer (contractor, subcontractor) a loss of a significant amount of resources, especially if an incident occurs at the workplace.

The investor, as well as the contractor and the subcontractor, are obliged to follow the national regulations for safety and health at the workplace, but sometimes, inadvertently, they pay less attention to job-related requirements, such as workers' rights, negotiation rights , which may result in endangering the health and safety of workers.

Based on the set criteria, this impact can be defined as: negative, indirect, of a local character, short-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, reversible, with low magnitude and low significance (impact can be mitigated and managed).

8.4 Demography

8.4.1 Migration

8.4.1.1 Operational phase

Impact 8: Reducing migration

The project is expected to positively influence migration processes village-city. It is expected that the migration will decrease in the countryside and city-capital, ie, the reduction of the migration to Skopje and beyond to stable world economies, especially among the young, thereby opening the possibility of social capital, professional skills, knowledge and education they are realized in their municipality.

Based on the set criteria, this impact can be defined as: positive, indirect, of a local character, medium-term (it will be manifested only in the pre-construction phase), with the possibility of occurrence-probably, reversible, with medium magnitude and moderate significance (no mitigation measures are required).

8.5 Community safety and health

8.5.1 Safety

8.5.1.1 Construction phase

Impact 9: Increased threat to the population and livestock due to the presence on the construction site

Construction of line infrastructure implies construction activities that will take place in a certain territory, long and narrow in width. Knowing that the project area abounds with hilly relief, and that the line will cut hills, it will bridge the valleys and create tunnels, it can be expected that the entire alignment and the contact zone will become a construction site for a certain period. Such a situation will be very difficult to control by fencing the construction site as it will be a big financial burden for the project.

The safety of the local population, especially the inhabitants of the city, positioned on the north side of Kriva Reka, will be lowered to a very low level. The accessibility of the population to the construction site will be high because they will have to cross the same to reach the city. Additionally, children from the same part of the city will find it curious to realize their games in the immediate vicinity, if not on the construction site, which will extend on a long earth surface.

Experience with incidents at construction sites suggests that some are related to the illegal presence of persons or goods at the construction site. When it comes to infrastructure projects such as this, where the construction site extends over a relatively long territory and most often intersects populated areas, as well as established directions of movement of people, goods and materials, occurrence of incidents is possible.

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, short-term (it will be manifested only in the construction phase), with the possibility of occurrence - probably, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

Impact 10: The emergence of accidents by transporting materials for and after the railroad

The railroad, as a traffic infrastructure, is intended to transport passengers, goods, including dangerous and flammable materials.

The alignment of the railway line, especially through a tunnel under a densely populated part of the city, indicates that in the event of an accident, more damage may occur than the same would occur outside the frames of settlements or outdoors.

If an accident or an incident occurs and there is damage caused by the spillage or incineration of the materials stored or transported by road and by rail, local and national authorities will have to respond immediately. The need for organized and prepared institutions that can react quickly in case of accidents and disasters can reduce the negative consequences for the local population and the environment.

Based on the set criteria, this impact can be defined as: negative, indirect, of a local character, short-term (it will be manifested only in the pre-construction phase), with little possibility of occurrence - unlikely, irreversible, high magnitude and moderate significance (mitigation measures can partially help to recover from the impact).

Impact 11: Problems related to workers' behavior towards the local environment

Often, the Contractor is not part of the project's development process, and therefore there is no complete picture of the sensitivity of the project area, because its approach, more or less, is mechanical without paying too much attention to the local human environment. Contractors' employees, if they do not come from local populations, most often have less understanding of the needs and values of the local population, especially if they are about neighborhoods that are in close proximity to construction activities. There are cases where workers are subject to conflict between the developer and the local community.

These conflicts arise due to anxiety over property loss, endangered home security, robberies and disruption of domestic peace of the local population.

The narrow distance between the houses and the construction site, in settlements, can become a source of frustration that will problematize the relationship between the contractor and the local residents / property owners. The presence of workers, unknown persons, close to homes / property has a great impact on the fear of the Project and the nervous reaction of the local population.

Based on the set criteria, this impact can be defined as: negative, indirect, local, short-term (it will be manifested only in the construction phase), with the possibility of occurrence-probably, reversible, with low magnitude and low significance (impact can be mitigated and managed).

Impact 12: Fear for personal health and safety due to the increased volume of traffic across settlements

It is likely that the increased traffic intensity and volume will hinder the normal traffic regime in the project area. Increased presence of freight vehicles and traffic on local roads will reduce the security of local streets and roads and may increase the rate of traffic accidents.

The following table presents the level of risk of accidents in the affected settlements. The increased presence of heavy goods vehicles and construction mechanization and the increase in the volume of traffic on the main and secondary roads can cause an increase in the local road traffic accidents, especially during the summer season, when most of the residents are more mobile.

Table 92 Level of traffic risk in the affected settlements

No.	Inhabited place	Level of risk
1.	T`lminci	High
2.	Kriva Palanka	Very high

3.	Zhidilovo	High
4.	Uzem	High

Based on the set criteria, this impact can be defined as: negative, direct, local, short-term (it will be manifested only in the construction phase), with the possibility of occurrence, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.5.1.2 Operational phase

Impact 13: Possible incidents at the railway crossings

The new road crossings will present an unknown experience for the local population, which does not often take into account the road signalization, because until then there was no such intensive traffic in the settlement.

If the set signaling at the road crossings is not respected, traffic accidents and incidents with material and human losses are possible.

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, long-term, with the possibility of occurrence - probably, reversible, with low magnitude and low significance (impact can be mitigated and managed).

Impact 14: Possible incidents with crossings across the railway at illegal crossings

The presence of the railway, in the immediate vicinity and through settlements, will not change the habit of using the existing established paths of movement, although they will be interrupted by a railroad. The population, in accordance with its old habits, will continue to use the trails, illegally crossing the line. This will cause incidents of human and material losses. Additionally, freely released goods can also cause material damages (loss of goods, damage to railroad vehicles and communication network, etc.), if they find themselves on a railroad while passing a train.

Based on the set criteria, this impact can be defined as: negative, indirect, on the spot, long-term, with the possibility of occurrence - probably, irreversible, with low magnitude and minor significance (impact can be mitigated and managed).

8.5.2 Health

8.5.2.1 Construction phase

Impact 15: Disturbance from noise and vibration due to construction activities

Noise and vibration will undoubtedly be the main problems in the construction phase. Apart from earthworks and mines, the increased volume of traffic of people, vehicles and materials on local roads through Kriva Palanka and other directly affected populated areas will contribute significantly to the anxiety of the population in these settlements.[71]

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, short-term (it will be manifested only in the construction phase), with the possibility of occurrence - probably, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.5.2.2 Operational phase

Impact 16: Noise and vibration disturbance due to railway traffic

The newly created track will alter the lifestyle of the locals in the immediate vicinity of it. Rail traffic will generate noise and it will disturb the residents of the settlements Kriva Palanka, T`lminci, Zhidilovo and Uzem. Particularly concerned will be those who live in the immediate vicinity of the railroad, especially during the night time, as well as in the transit of freight traffic because the compositions are usually longer.

Most people will get used to the newly emerging situation and over time will not even count on them. But there will be those who will not get used to and will try to change their place of living.

[71] More detailed in the section: Impacts of noise and vibration.

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, long-term (it will be manifested only in the construction phase), with the possibility of occurrence - probably, irreversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.5.3 Social protection

8.5.3.1 Construction phase

Impact 17: Adults in remote areas

The elderly in the project area, especially in remote rural settlements, are the most vulnerable social category of persons. Migration causes the disappearance of well-known social networks by placing older people in an isolated state and often at high risk of poverty. Construction activities will hinder access roads to remote settlements for a short period of time. During this period, there may be a delay in the delivery of social or health care. Social and health institutions must be able to deliver the necessary care and assistance to recipients of such assistance even though the access road is interrupted.

Based on the set criteria, this impact can be defined as: negative, indirect, on the spot, short-term (it will be manifested only in the construction phase), with the possibility of occurrence-probably, reversible, low magnitude and low significance (impact can be mitigated and managed).

8.6 Housing, communications and communal services

8.6.1 Communications

8.6.1.1 Construction phase

Impact 18: Disruption of everyday life, caused by limited access to settlements, land and property

Part of the existing road network in the settlements that will be affected by the Project will suffer a certain interruption, and part will be restructured, for example in Kriva Palanka. In addition, some construction activities will contribute to temporary stopping of some roads, where in accordance with the main and construction project it will be necessary to intervene. For some settlements, these roads are the only way to the main roads, through which they can procure groceries and use services from communal, health and social institutions. Local residents may be disturbed by difficult access to desired destinations, even in the short term. Such anxiety can cause minor social tensions between local residents on one side, and the contractor and developer of the other party.

The next picture shows the road, which will be interrupted in order to build a railway station. It is the most commonly used route of the inhabitants living in the part of the settlement located above the railway station, which leads to the main road in the city of Kriva Palanka. Local self-government will have to open another road that connects the part of the settlement above the railway station with the rest of the City.

Figure 201 Notion for the position of the bridge after the railway station in Kriva Palanka

(Photo: Boris Stipcarov)

Above the text, on the Review Map of the social impacts along the alignment, it is indicated on which locations the traffic was expected to be expected.

Based on the set criteria, this impact can be defined as: negative, direct, local, short-term (it will be manifested only in the construction phase), with certainty of occurrence, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

Impact 19: Degradation of local roads due to construction-related transport related to the project

The increased presence of trucks, trucks, and machinery on local roads will degrade the quality of the local road infrastructure, which is also used by the local population. This means that such quality of infrastructure will cause a decline in the quality of life of the local population.

Based on the set criteria, this impact can be defined as: negative, direct, local, short-term (it will be manifested only in the construction phase), with certainty of occurrence, reversible, with low magnitude and low significance (impact can be mitigated and managed).

8.6.2 Housing and physical resettlement

8.6.2.1 Pre-construction phase

Impact 20: Expropriation of houses / homes

In several places along the alignment, existing homes, or houses of physical persons, are expected to be expropriated.

The first objects, which are most affected, are located after the railway station and around the first tunnel behind it, in Kriva Palanka. The following figure gives an overview of the objects in relation to the elements of the line.

Figure 202 Placement of the railroad in relation to the cemetery in Zhidilovo *(Source: Google Earth)*

The house / building marked with No.1 is a private house and is located 10 meters from the projected bridge.

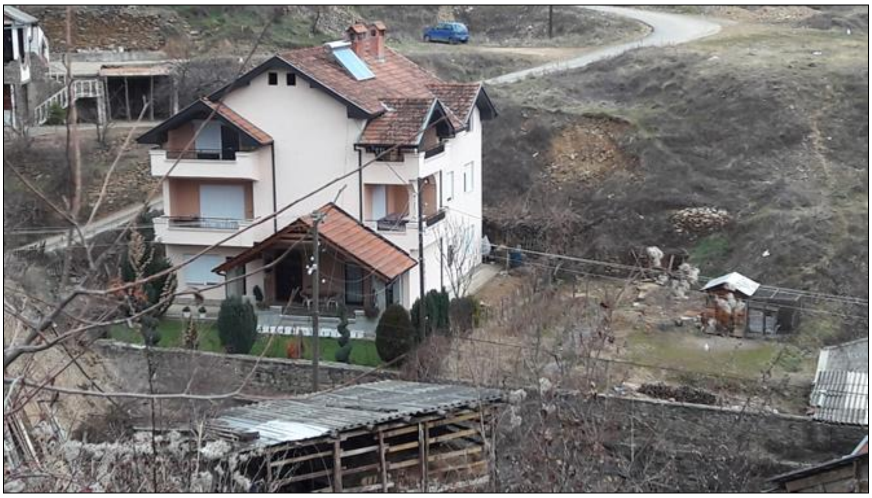


Figure 203 House adjacent to the first projected bridge after the train station (Photo: Boris Stipcarov)

Objects number 2 and number 3 enter the zone where the supporting elements for the projected bridge should be made or in the immediate vicinity. The house / building number 4 is located above the entrance to the first tunnel after the railway station in Kriva Palanka. These three objects, as well as the location of the entrance to the tunnel, are presented in the following figure.

Figure 204 Entrance to the first tunnel, after the train station (Photo: Boris Stipcarov)

The space, between the first tunnel after the train station and the longest in the city, also covers several houses that will be affected in some way, and the precise concern should be laid down in the official Elaborate for Expropriation.

The following picture provides an overview of the potentially affected housing facilities that are located between the first tunnel after the city's longest tunnel.

Figure 205 Entrance to the first tunnel after the train station (Source: Google Earth)

The next, potentially affected housing facility is located at the exit of the longest tunnel in Kriva Palanka. Shortly after the exit from the tunnel, the railway continues through a bridge connecting the two hills between which there is an active road to the peripheral parts of the city, but also to other villages in the north, as well as homes of individuals, active agricultural areas (gardens) and economic entities , shown on the following pictures.

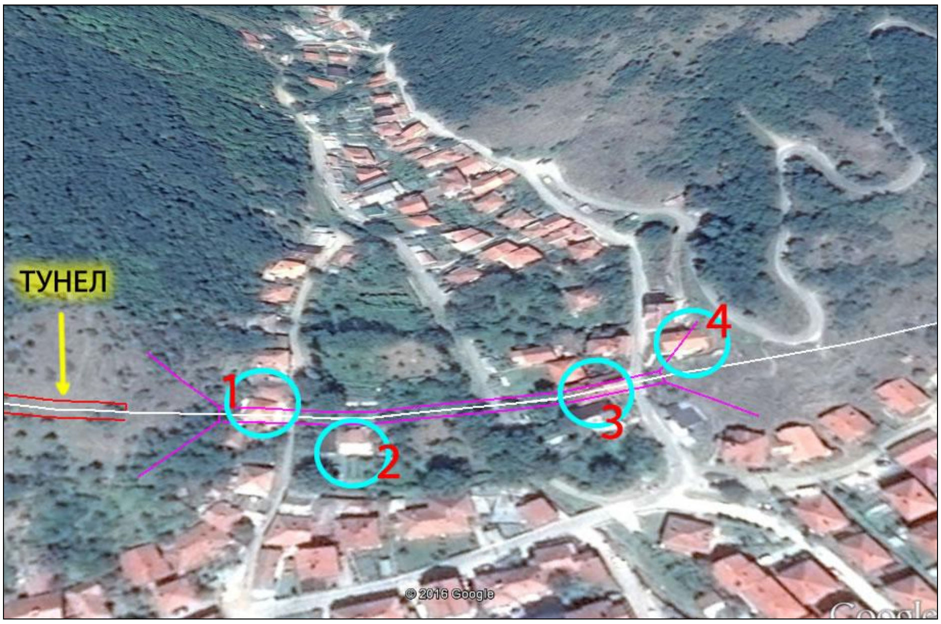


Figure 206 Exit of the longest tunnel in Kriva Palanka (Source: Google Earth)

Figure 207 House on the exit of the longest tunnel in Kriva Palanka, the beginning of a bridge (Photo: Boris Stipcarov)

Figure 208 A commercial entity under the bridge (Photo: Boris Stipcarov)

Figure 209 Location of objects around the end of the bridge (Photo: Boris Stipcarov)

The next object, which will have visible impacts and is on the expropriation limit, is located on the other side of the Pashina water mill site. Namely, under the bridge that is planned to build between two hills there is a housing facility, in the immediate vicinity of which there are three other objects (see the next picture).

Figure 210 Placement of the affected object, location: Pashina watermill (Source: Google Earth)

The penultimate location, where expropriation of homes is expected, is the village of Zhidilovo. Namely, the exit of the tunnel is set up in two buildings that serve for housing (see below, figure 200). Objects are numbered with 3.

The last settlement, where the expropriation of homes is expected, is the village of Uzem, which is located on the main road, only a few kilometers before the border crossing. The village is divided into two parts. One part is located on the right side under the road, while the other part is left above the road, scattered on several hills. The following figure presents the directly affected objects located on or along the alignment itself.

Figure 211 Location of the affected object. Location Uzem, lowland part (Source: Google Earth)

On the left side of the road, on local hills, scattered groups of houses divided into neighborhoods. In the nearest neighborhood, just above the lowland part of the village, several houses will be directly affected. The placement of the facilities on the alignment itself at the exit of the tunnel, shown in the following figure, indicates that when preparing the Elaborate for Expropriation, they should be taken into account.

Figure 212 Location of the affected object. Location Pashina watermill (Source: Google Earth)

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, long-term, with certainty of occurrence, irreversible, with high magnitude and high significance (impact can be mitigated and managed).

8.6.2.2 Construction phase

Impact 21: Impact on housing from vibration

Blasts, even those controlled, may be disturbing and often inflict damage on homes, which is not immediately evident. Part of the city of Kriva Palanka is located on top of a hill and underneath it a tunnel passes and the same part may not be immune to the aftershocks caused by controlled explosions for penetration and expansion of the tunnel. These tremors can cause some damage to the houses in the settlements.

Similarly, the closest objects to the alignment of the railway (construction site) will feel vibrations from the use of heavy machinery during construction activities. These machines will create vibrations that can damage existing houses and buildings. Such is the case with houses that are located in Kriva Palanka, and also Zhidilovo.

Also, the church in Zhidilovo is located above the railway line and may suffer damages during the mines (see figure 200, number 1).

In addition, during the construction phase maneuvering heavy machinery sometimes requires a wider space. Considering the existing configuration of the ground where the alignment of the railway is going, it is possible that once these machines enter into private ownership, thus causing material damage.

Additionally, the following picture shows a view from the location of the train station to the housing facilities (houses) that are located below the station. The vibration impact section is appropriately discussed in the vibrations section of this Study.

Figure 213 View from the location of the train station to the closest houses (Photo: Boris Stipcarov)

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, long-term, with the possibility of occurrence - probably, reversible, with low magnitude and minor significance (impact can be mitigated and managed).

8.7 Economy and livelihoods

8.7.1 Agriculture

8.7.1.1 Construction phase

Impact 22: Livestock disturbance due to noise in construction activities, explosions and / or displacement of livestock for grazing away from the alignment of the railway

Previously peaceful and tranquil environment will suddenly be a place with a great degree of noise and presence of workers, vehicles and other machinery. Movement of goods will be limited, as well as access to previously free pastures and resources. This applies especially to rural settlements Zhidilovo, Uzem and Krklja. Often a crossing of goods can be found across the existing road, which is near the alignment of the railway.

The owners of the goods will no longer be able to release it freely around the nearby hills or by the river. They will have to find other locations where they will carry the pashas. This can cause some economic impact because it will require resources allocated from local stock farmers.

Based on the set criteria, this impact can be defined as: negative, direct, local, short-term (it will be manifested only in the construction phase), with the possibility of occurrence-probably, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

Impact 23: Loss of agricultural land and property for railroad purposes

The alignment of the railway passes not only through forests and pastures, but also through active agricultural land, above all the gardens. Pillars of bridges in several places will be built on active agricultural land. Such is the case in the city of Kriva Palanka, as well as in T`lminci, Zhidilovo, and in two places in Uzem: along the road to the village of Kostur, as well as before the last tunnel that ends on the territory of the Republic of Bulgaria.

Although this agricultural land, which will be lost for the needs of the railway, is not a basic source of livelihood, it does support households that process them to make a small part of the income, or reduces the costs they allocate for food.

The following figures, as well as Figure 217 present two locations where the railway line will pass, and in doing so will be active agricultural lands used for garden production as well as storing of goods. The first one is in Zhidilovo, near the fishpond.

Figure 214 Active agricultural land in Zhidilovo (Source: Google Maps)

The second location is at the last tunnel, in front of the border with the Republic of Bulgaria, where a certain household uses the abandoned premises / objects for storing goods, and which freely moves in the surroundings. By subtracting this property, the household will lose some of the way in which the subsistence is realized.

Figure 215 View from the location of the train station to the closest houses (Source: Google Earth)

Figure 216 Objects that the agricultural household in Uzem uses (Photo: Boris Stipcarov)

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with the possibility of occurrence - probably, irreversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.7.2 Employment

8.7.2.1 Pre-construction phase

Impact 24: Increasing the expectations of the affected population in terms of employment

Realizing a new infrastructure project in the local self-government means that there are potential jobs for the local population. But not all unemployed people in that area can be employed. Unemployed people hope to finally get to the possibility of hiring some of the potential vacancies. In small and relatively traditional communities, conversations among residents about vacancies that come with the project can warm up and increase the level of expectations.

Based on the set criteria, this impact can be defined as: negative, indirect, local, short-term (it will be manifested only in the construction phase), with certainty of occurrence, reversible, with low magnitude and low significance (impact can be mitigated and managed).

Impact 25: Increasing employment

Railroad construction will increase the demand for labor in the area, where some of the unemployed can find temporary employment and support their household income.

Based on the set criteria, this impact can be defined as: positive, direct, local, medium-term (the impact will continue after the construction of the railway line), with certainty of occurrence, reversible, with medium magnitude and moderate significance (no measures are needed to mitigate the impact).

8.7.2.2 Operational phase

Impact 26: Deterioration of the economic situation of the residents in the municipality and possible migrations

The number of jobs available to local residents will be limited due to the specific working tasks and qualifications required for those tasks. The developer will definitely consider employment opportunities for local residents and hire some of them. But here lies the potential threat to the local community. If a certain part of the unemployed in the municipality find employment in the project, after its completion / putting into operation they will lose their jobs. Families will be left without income for a certain period of time. Also, by completing the project one can expect some residents of the rural communities to use the moment and leave the village and move elsewhere with better prospects for employment and income, primarily Kriva Palanka or Skopje.

Based on the set criteria, this impact can be defined as: negative, indirect, on the spot, permanent, with the possibility of occurrence - probably, irreversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.7.3 Business entities

8.7.3.1 Pre-construction phase

Impact 27: Loss of qualified personnel among local companies (increase in operating costs)

A new project in this area is an opportunity for some of the skilled workers in similar positions to change the company in search of better pay or better working conditions. This new opportunity is not well received by companies that employ such workers. Namely, if they lose skilled workers they will have to bear with themselves the consequences until they find new ones and train them to a certain level, so that the work process does not stop. This means increasing the operating costs of those companies that will lose skilled personnel for the construction of the railway.

Based on the set criteria, this impact can be defined as: negative, indirect, regional, long-term, with little possibility of occurrence - unlikely, reversible, with medium magnitude and low significance (impact can be mitigated and managed).

8.7.3.2 Construction phase

Impact 28: Economic loss to local businesses

This project is not expected to cause significant impact on the economic life of the Municipality. Only one economic entity can be directly affected by the construction of the railroad. It is a fish farm and a restaurant in the village Zhidilovo, located on the right side of the road, towards the Republic of Bulgaria. Business can feel certain influences because in its immediate vicinity the pillars of the bridge should be built, which on the left side of the hill goes through the road should proceed to the hill on the right side of the road and the river.

The figure shows the location of the fishpond and the restaurant (Number 4), its main facilities and the location of the bridge that needs to be built in the immediate vicinity.

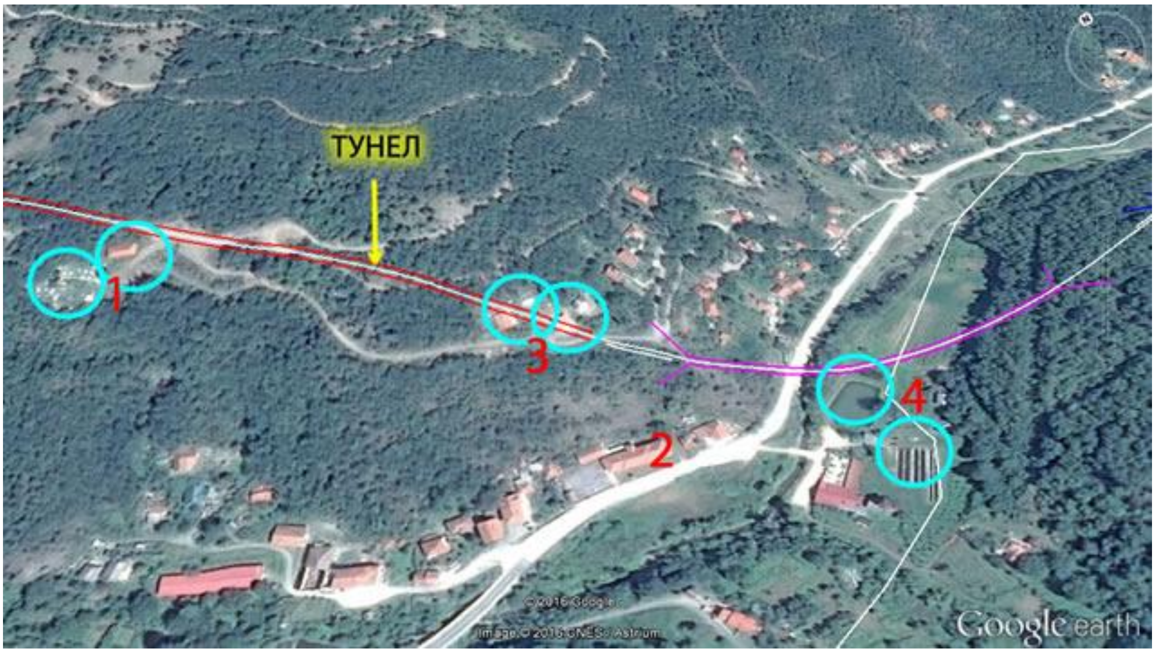


Figure 217 Placement of the railroad in relation to the cemetery in Zhidilovo (Source: Google Earth)

Based on the set criteria, this impact can be defined as: negative, indirect, regional, long-term, with little possibility of occurrence-unlikely, reversible, with medium magnitude and low significance (impact can be mitigated and managed).

Impact 29: Increased level of professional engagement for local companies

This is a positive impact, since construction works related to railroad construction will provide excellent opportunities for local companies to become suppliers of materials or services for the needs of the project. Local companies will find their own interest during the railroad construction. Some of the companies that become suppliers of the project will acquire a professional reference (recommendation) that will serve them for participation in domestic and international tenders. The experience gained in an international working environment in Macedonia can help companies that have worked on the project to increase the professional level of staff.

Based on the set criteria, this impact can be defined as: negative, direct, regional, long-term, with certainty of appearance, irreversible, with medium magnitude and moderate significance (no mitigation measures required).

Impact 30: The economic benefits of the project

This international traffic connection will contribute to the economy in the city of Kriva Palanka, as well as the surrounding settlements, to revive to a higher level, because the products that will leave the municipality will have a reduced price for transportation and transport of materials and goods will not depend only on the situation and The quality of the roads, but also the railroad.

The main benefit for the economy at the national and regional level with the implementation of the project will be the creation of new opportunities for stimulation and intensification of the economic activities and development of the region.

In this context, it is expected that a significant part of the capital investment funds will be spent on construction activities / services and the purchase and installation of the necessary equipment, which will be beneficial for the domestic companies through direct contact with them as subcontractors. On the other hand, the flow of labor will increase the demand for different types of services in the wider region, including accommodation, food, maintenance of vehicles, purchase of construction and other materials, fuel supply, etc., which means an increase in the overall economic activity of the region and indirectly leads to the creation of new jobs.

Increased revenue from local communities can be expected through:

1. New immediate employment during the construction phase and the operational phase of the complex
2. Development of the economy in the municipality of Kriva Palanka
3. Increased flow of capital in the municipal budget or possibility for increased investments in the municipality's infrastructure and other needs
4. Opportunities for developing additional services related to the project

The planned project will contribute to the diversification of the local economy, directly through new employment opportunities or indirectly, to a lower level, through the consumption of local goods and services. Depending on the scope of procurement that will be realized locally, other sectors of the local economy can also benefit. Local purchases of basic materials, products and services (food, delivery, transport, security, etc.) may result in the growth of local enterprises and the local economy.

Based on the set criteria, this impact can be defined as: positive, direct, national, long-term, with certainty of appearance, irreversible, with high magnitude and high significance (no mitigation measures required).

8.8 Material assets

The implementation of the project, ie the construction of the railway line Kriva Palanka-Border with the Republic of Bulgaria can cause negative impacts on material assets (agricultural land, built infrastructure-road, water supply, sewerage, electricity distribution, gas pipeline etc.) in the project area, which can be felt in the wider environment.

Although the project will cover small areas of agricultural land, however, what will be affected will have to undergo a conversion from agricultural to construction land, which means that in the future agricultural activities can not be carried out. In addition, materials from borrowing will be used for the construction of the railway line, and large quantities of waste will also be generated which should be removed at landfills. Providing locations for borrow pits and landfills means the involvement of new land surfaces and the conversion of agricultural land (farmland / non-cultivated) or land under forests in construction land. The impacts on land are covered in the sub-chapter **on Economy and livelihoods**.

Emissions of dust settled in the form of a sediment, possible unwanted leaks, and so on. may impair the quality of agricultural land along the alignment, which may result in reduced yields or impaired product quality, but these impacts are negligible.

Due to the construction activities related to the railway line, the existing road network will feel certain effects on several points. It is obvious that there will be increased frequency of vehicles on the local road network, less frequent stops and delays, sometimes traffic accidents, temporary change of road regime and the like. The impacts on local roads are described in the chapters **Housing, Communications and Communal Services, Community Safety and Health and** the chapter **Economy and livelihoods**.

8.8.1 Construction phase

Impact 31: Termination of access to communal and road infrastructure

The implementation of the Project can have negative impacts on the existing road, water supply, sewage, electro distribution and gas networks.

Impacts on material goods, translated into disruption of the communal good that the local population receives from the respective enterprises, is manifested as interruption of water supply, irrigation and sewerage network, then interruption in energy supply, interruption in gas supply, and temporary limited Access to a particular affected road.

The envisaged alignment of the line in several places intersects with the existing road, the gas network, the existing transmission line, and there is also the possibility of cutting the water supply and sewerage network (although the alignments of these are not known at this stage). During construction work, damage to these infrastructure networks may result, which may result in large financial costs and for the cause of the damage and the end user. Also, damage to infrastructure networks can cause incidents (floods, fires, etc.) that can cause negative impacts on the media on the environment, also endangering the health and safety of workers and the population. The risk of occurrence of these incidents is analyzed in more detail in the chapter Risk of accidents.

Although the main water supply infrastructure is located on the southern side of the city, water supply interruptions are possible during the construction phase. Same, there are interruptions in the supply of electricity to the local population.

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, short-term (it will be manifested only in the construction phase), with the possibility of occurrence - probably, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.9 Education

8.9.1 Construction phase

Impact 32: Disturbance from an interrupted process of education and learning

Explosions, accompanied by noise and vibration, may impair the educational process. This applies to both primary and secondary schools in Kriva Palanka, but also the primary school in Zhidilovo (Figure 217**, no 2**).

Blasts can only cause a temporary interruption of the educational process, but such frequent events can cause dissatisfaction because of the successive breaks in the educational process.

Based on the set criteria, this impact can be defined as: negative, direct, on the spot, short-term (it will be manifested only in the construction phase), with the possibility of occurrence - probably, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

8.10 Labor and working conditions

8.10.1 Construction phase

Impact 33: Stress caused by a noisy work environment

Engaged workers will be constantly exposed to noise from trucks, locomotives and machinery, which can cause a state of stress that can affect the satisfaction, concentration and efficiency of the worker himself.

In the workplace, the worker should not be exposed to a noise level greater than 85 dB more than 8 hours a day without hearing protection.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term (it will be manifested only in the construction phase), with the possibility of occurrence - probably, reversible, with medium magnitude and moderate significance (impact can be managed).

Impact 34: The influx of workers

Given the fact that in a certain period of time not only general but also skilled workers will be required to work on railway construction, the municipality will not be able to cover this need alone, so it will be necessary to bring workers with place of residence away from the project area.

These workers will have to stay temporarily, usually in the immediate vicinity of the construction site. For this purpose, the contractor will have to provide suitable premises that will be in accordance with all international and domestic standards and regulations.

This workforce will not be more numerous than the local population, but will use the existing social benefits and social infrastructure and thus will cause some pressure on local resources.

Based on the set criteria, this impact can be defined as: negative, direct, local, short-term (it will be manifested only in the construction phase), with the possibility of occurrence-probably, reversible, with low magnitude and low significance (impact can be mitigated and managed).

Impact 35: Incidents caused by easily flammable, corrosive and explosive materials

Project activities envision drilling / expanding tunnels. For that purpose, highly flammable materials, as well as explosives, will be used. Poor handling, as well as poor storage of these easily flammable, corrosive and explosive materials can cause material damage. And above all, it poses a threat to the safety of workers, the local population, and the environment.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with the possibility of occurrence - probably, irreversible, with low magnitude and low significance (impact can be mitigated and managed).

Impact 36: Stress caused by exhaust gases in the workplace

Construction workers, who will work in the project scope where machines and vehicles use diesel as a fuel, will be exposed to impacts from exhaust gases.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with the possibility of occurrence-probably, reversible, with low magnitude and minor significance (impact can be mitigated and managed).

Impact 37: Threatened health for workers due to work at a height

The alignment of the railway, at times, extends through steep parts of the terrain where viaducts, bridges, overpasses, underpasses and other buildings involving heights have to be built. In such a case, workers are exposed to heights that can easily become fatal.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with the possibility of occurrence-probably, reversible, with low magnitude and minor significance (impact can be mitigated and managed).

Impact 38: Endangered health of workers from rotating and mobile equipment

Injuries or deaths may occur due to jamming, rewinding, or undertaking by parts of the machinery, as well as unexpected movement of equipment or unusual movement during operations.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with little possibility of occurrence - unlikely, reversible, with low magnitude and low significance (impact can be mitigated and managed).

Impact 39: Endangered health of workers for driving industrial vehicles and traffic on a construction site

Physical hazards represent the potential for accident, injury or illness due to repetitive exposure to mechanical action or work activity. Individual exposure to physical hazards can result in a wide range of injuries, from minor and medical care, disabling, catastrophic, and / or fatal. Prolonged exposure over a long period of time can result in disabling with injury and consequence.

Poorly trained or inexperienced drivers of industrial vehicles have an increased risk of accident with other vehicles, pedestrians, and equipment. Industrial vehicles and delivery vehicles, as well as private vehicles on the construction site, also represent potential collision scenarios.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with little possibility of occurrence - unlikely, reversible, with low magnitude and negligible significance.

Impact 40: Diseases caused by electromagnetic radiation at the workplace

The magnitude of the electromagnetic radiation for the workers, which will be daily in contact with electromagnetic systems that drive the locomotive, can cause various diseases.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with the possibility of occurrence - probably, irreversible, low magnitude and negligible significance.

8.11 Cultural heritage, religion, values and habits

8.11.1 Construction phase

Impact 41: Potential destruction and loss of undiscovered archaeological sites

This area is full of archaeological sites. Besides the planned alignment there is no known archaeological site. But the project area has been inhabited since ancient times and during construction work it is sometimes possible to discover an unknown archaeological site. Uninformed employees can not identify and warn about a possible location of archaeological significance, which makes it possible to lose or destroy important undiscovered archaeological sites, including potentially valuable artifacts.

Based on the set criteria, this impact can be defined as: negative, direct, local, long-term, with little possibility of occurrence - unlikely, irreversible, with low magnitude and negligible significance.

Impact 42: Disturbance from explosions during religious ceremonies

Explosions can be very disturbing, especially if people perform religious rituals. For Christian believers, the funeral, baptism, glory and other religious holidays have a special significance and are often an important event.

Any disturbance during a period of religious holidays and practices for the local population may mean disrespect for their values and can easily be resisted by such practices.

Two locations are very close to the track line. The first location is in T`lminci. Namely, the alignment passes 50 meters under the cemetery in T`lminci. The following picture shows this situation.

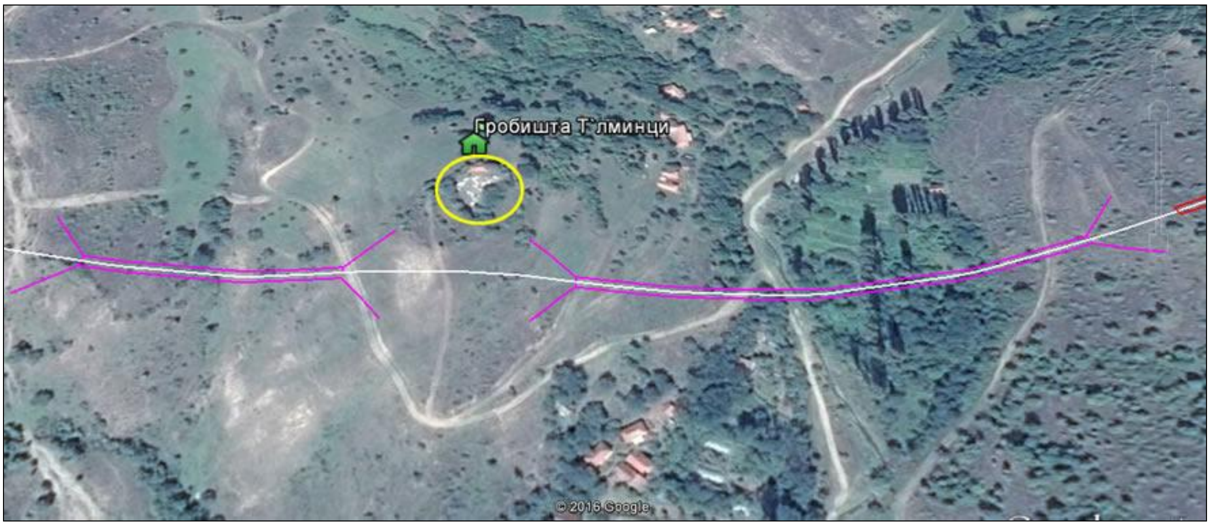


Figure 218 Placement of the railroad in relation to the cemeteries in T`lminci (Source: Google Earth)

The second location is in the village Zhidilovo, see the appropriate picture above. Namely, the alignment of the railway passes several tens of meters below the village cemetery. The railroad stops the road to the cemetery and the village church.

Based on the set criteria, this impact can be defined as: negative, direct, local, medium-term, with the possibility of reliable occurrence-reliable, reversible, with medium magnitude and moderate significance (impact can be mitigated and managed).

Table 93 The matrix of social impacts

Impact \ Condition	Nature of impact	Type of impact	Area	Duration	Probability to appear	Reversibility	Impact magnitude	Significance of impact	Mitigation measures
PRE-CONSTRUCTION PHASE									
System for managing the social environment									
Improper management of the implementation of the system for managing the social environment	Negative	Indirectly	Local	Short-term	Probably	Reversible	Low	Small	Yes
Delay in the implementation of the project due to the company's non-compliance with the requirements of the IFIs	Negative	Indirectly	Regional	Short-term	Probably	Irreversible	Moderate	Moderate	Yes
Delay in the realization of the project due to badly performed expropriation and dissatisfaction of the persons concerned	Negative	Indirectly	Regional	Short-term	Probably	Irreversible	Moderate	Moderate	Yes
Increased anxiety among the population due to the lack of communication with local populations and nearby property holders at the project area	Negative	Directly	Local	Short-term	Probably	Reversible	Moderate	Moderate	Yes
Problems related to the organization of the workforce	Negative	Indirectly	Local	Short-term	Probably	Reversible	Low	Small	Yes
Incomplete compliance with International Financial Institutions Standards (IFIs) with regard to workers and working conditions	Negative	Indirectly	Local	Short-term	Probably	Reversible	Low	Small	Yes
Housing, communications and communal services									
Expropriation of houses / homes	Negative	Immediate	On the spot	Long-term	Surely	Irreversible	High	Large	Yes
Economy and livelihoods									
Increasing the expectations of the affected population in terms of employment	Negative	Indirectly	Local	Short-term	Surely	Reversible	Low	Small	Yes

Impact \ Condition	Nature of impact	Type of impact	Area	Duration	Probability to appear	Reversibility	Impact magnitude	Significance of impact	Mitigation measures
Loss of qualified personnel from local companies (increase of operating costs)	Negative	Indirectly	Regionally	Long-term	Unlikely	Reversible	Moderate	Small	Yes
CONTRUCTION PHASE									
System for managing the social environment									
Reduced stakeholder engagement activities during construction	Negative	Directly	Local	Short-term	Probably	Reversible	Low	Small	Yes
Community safety and health									
Increased threat to the population and livestock due to the presence of a site	Negative	Immediate	On the spot	Short-term	Probably	Reversible	Low	Moderate	Yes
Occurrence of accidents from the transport of materials for and after the railroad	Negative	Immediate	Local	Long-term	Unlikely	Irreversible	High	Moderate	Yes
Problems related to workers' behavior towards the local environment	Negative	Indirectly	Local	Short-term	Probably	Reversible	Low	Small	Yes
Fear for personal health and safety due to the increased volume of traffic across settlements	Negative	Immediate	Local	Short-term	Surely	Reversible	Moderate	Moderate	Yes
Noise disturbance due to construction activities	Negative	Directly	On the spot	Short-term	Probably	Reversible	Moderate	Moderate	Yes
Adults in remote areas	Negative	Indirectly	On the spot	Short-term	Probably	Reversible	Low	Small	Yes
Housing, communications and communal services									
Disruption of everyday life caused by limited access to inhabited settlements, land and property	Negative	Directly	Local	Short-term	Surely	Reversible	Moderate	Moderate	Yes
Degradation of local roads due to construction transport related to the project	Negative	Directly	Local	Short-term	Surely	Reversible	Low	Small	Yes

Impact \ Condition	Nature of impact	Type of impact	Area	Duration	Probability to appear	Reversibility	Impact magnitude	Significance of impact	Mitigation measures
Impact on housing from vibration	Negative	Directly	On the spot	Long-term	Probably	Reversible	Low	Small	Yes
Material goods									
Interruption of access to communal and road infrastructure	Negative	Directly	On the spot	Short-term	Probably	Reversible	Low	Small	Yes
Economy and livelihoods									
Disturbance of livestock due to noise during construction activities, explosions and / or displacement of livestock for grazing away from the alignment of the railway	Negative	Directly	Local	Short-term	Probably	Reversible	Moderate	Moderate	Yes
Loss of agricultural land and property for the needs of the railway	Negative	Directly	Local	Long-term	Probably	Irreversible	Moderate	Moderate	Yes
Increase of employment	Positive	Directly	Local	Mid-term	Surely	Reversible	Moderate	Moderate	Yes
Economic loss to local businesses	Negative	Indirectly	Regional	Long-term	Unlikely	Reversible	Moderate	Small	Yes
Increased level of professional engagement for local companies	Positive	Directly	Regional	Long-term	Surely	Irreversible	Moderate	Moderate	No
Economic benefits of the project	Positive	Directly	National	Long-term	Surely	Irreversible	High	Large	No
Education									
Disturbance from a discontinued process of education and learning	Negative	Directly	Local	Short-term	Probably	Reversible	Low	Small	Yes
Work and working conditions									
Stress caused by a noisy work environment	Negative	Directly	Local	Long-term	Probably	Reversible	Moderate	Moderate	Yes
Influx of workers	Negative	Directly	Local	Short-term	Probably	Reversible	Low	Small	Yes
Incidents caused by easily flammable, corrosive	Negative	Directly	Local	Long-term	Probably	Irreversible	Low	Small	Yes

Impact \ Condition	Nature of impact	Type of impact	Area	Duration	Probability to appear	Reversibility	Impact magnitude	Significance of impact	Mitigation measures
and explosive materials									
Stress caused by exhaust gases in the workplace	Negative	Directly	Local	Long-term	Probably	Reversible	Low	Small	Yes
Endangered health for workers due to work at a height	Negative	Directly	Local	Long-term	Probably	Reversible	Low	Small	Yes
Endangered health of workers from rotating and mobile equipment	Negative	Directly	Local	Long-term	Unlikely	Reversible	Low	Negligible	Yes
Endangered health of workers for driving industrial vehicles and traffic on the construction site	Negative	Directly	Local	Long-term	Unlikely	Reversible	Low	Negligible	Yes
Cultural heritage, religion, values and habits									
Potential destruction and loss of undiscovered archaeological sites	Negative	Directly	Local	Long-term	Unlikely	Irreversible	Low	Negligible	Yes
Disturbance from explosions during religious ceremonies	Negative	Directly	Local	Long-term	Surely	Reversible	Moderate	Moderate	Yes
OPERATIONAL PHASE									
Demography									
Reducing migration	Positive	Indirectly	Local	Mid-term	Probably	Reversible	Moderate	Moderate	No
Community safety and health									
Possible incidents at the railway crossings	Negative	Directly	On the spot	Long-term	Probably	Irreversible	Low	Small	Yes
Possible incidents with illegal crossings over the railway	Negative	Indirectly	On the spot	Long-term	Probably	Irreversible	Low	Small	Yes
Disturbancedue to noise from rail traffic	Negative	Directly	On the spot	Long-term	Probably	Irreversible	Moderate	Moderate	Yes

Impact \ Condition	Nature of impact	Type of impact	Area	Duration	Probability to appear	Reversibility	Impact magnitude	Significance of impact	Mitigation measures
Economy and livelihoods									
Deterioration of the economic situation of the residents in the municipality and possible migrations	Negative	Indirectly	On the spot	Permanent	Probably	Irreversible	Moderate	Moderate	Yes
Work and working conditions									
Diseases caused by electromagnetic radiation at the workplace	Negative	Directly	Local	Long-term	Probably	Irreversible	Low	Small	Yes

8.12 Social impacts mitigation measures

SOCIAL IMPACTS	MITIGATION MEASURES
PRE-CONSTRUCTION	
Social aspects management system	
Improper management of the implementation of the social environment management system	Within the company ("Macedonian Railways-Infrastructure", MR-I), appoint an employee who will be responsible for managing and monitoring the implementation of mitigation measures, as well as monitoring the programs, and to regularly report the highest levels of the company and external stakeholders. The person must be familiar with the company's procedures, MFI standards / requirements, plans and programs to be achieved during the implementation of the Project. In order to achieve integrated management, it is not recommended to delegate managerial responsibilities from different segments of the System for social (and environmental) management to different employees. It is better to appoint, train and continually improve professionals who will be able to manage the responsibilities that come with funding from outside sources.
Residual impacts	**Residual impacts are not expected if all measures are implemented.**
Delay in the implementation of the project due to the company's non-compliance with the requirements of the IFIs	Procurement must be carefully planned and carried out in the sense that all possible options for engaging subcontractors must be examined before starting the tender procedure. The developer's staff must start early consultations with all potentially interested companies that can engage in construction work. The developer must either allocate staff or hire an experienced external associate who will prepare all necessary documents and procedures before the tender is announced
Residual impacts	Delays can always arise during the implementation of the project, although all procedures and recommendations have been implemented. In any case, this project is complex and requires the engagement of various professionals and companies that are not always in good condition for accepting the assignments, or ready for teamwork.
Delay in the realization of the project due to badly performed expropriation and dissatisfaction of the stakeholders	The most appropriate measure for mitigating the negative impacts of the process of expropriation of property (land, house and other property) is the implementation of good international practice in treating property acquisition / expropriation, which includes the preparation of the **Political Resettlement Framework** and the **Resettlement Action Plan** . In particular, it is necessary, along with the preparations for the construction phase of the project, to develop and implement a **Political Resettlement Framework**, from which an **Action Plan on Resettlement** will arise. The most important thing in this process is the proper information, communication and consultation of the persons that will be expropriated, as early as possible, until their final resettlement and the disappearance of the negative consequences of

	that resettlement. The use of these practices is in line with national legislation, but also more so in order to create a situation in the society (especially stakeholders) where the negative consequences of the implementation of the project will completely disappear or be marginalized.
Residual impacts	It is almost impossible to mitigate the negative impacts as a whole, because not all sides will always be satisfied. It is possible, due to the inertia and confidence of individuals in the developer, to underestimate the need for implementation of this measure, and then to create the situation before the occurrence of this negative impact. Or, some of the stakeholders have high aspirations and in every possible way insist on creating this imapct, in order to obtain greater financial and material benefits from the investor.
Increased anxiety among the population due to the lack of communication with local settlements and property owners near the project area	It is recommended that MR-I conduct a series of consultative activities with stakeholders, especially those who own land near or along the railway alignment. A grievance mechanism will be prepared and implemented and it will be publicly available in every affected settlement, at the headquarters of the Public Enterprise and the premises in the field, as well as in the premises of the municipality of Kriva Palanka. The developer must constantly and regularly maintain communication with the affected inhabitants of Kriva Palanka and other settlements: Uzem, T'Iminci and Zhidilovo, and especially with those who own land near the project, on the very alignment of the railway line or the facilities that will serve the project. But that communication must be systematized and translated into a Stakeholder Engagement Plan that will be developed according to the good international practice that promotes IFIs. Additionally, it is necessary for the contractor to organize an office, which will serve as the Information Office of the project. It will be a public location where all information and documents related to the project will be available to the public. The location of such an office is best to be as close as possible to the construction site.
Residual impacts	Residual impacts will remain, but with much lower intensity, because it is very difficult to impact the thoughts of people and their interests and desires.
Problems related to the organization of the workforce	The Contractor must prepare and implement an **Employment Plan** for the needs of the project, in cooperation with the local ESA office, where special attention will be given to engaging the local workforce. The plan will cover all aspects, from the analysis of the existing situation on the labor market at the local, regional and national level, to the organization and systematization of the required jobs for the project. It is preferable to include in the tender documentation a request to the contractors to submit a specification with a number of engaged workers by construction phase and their qualifications, and which are planned to be engaged if they participate in the construction of the project.

Residual impacts	Despite the implementation of all measures, residual impacts are possible.
Non-compliance with IFI standards regarding workers and working conditions	The developer must develop and implement a Occupational Health & Safety Management System. This management system will be compulsory for the Developer, including contractors and subcontractors. It will include aspects such as: identifying and using PPE, regular training and monitoring as well as ongoing security checks, as well as other measures. Part of the management system must be the **Occupational Health and Safety Plan** with an implemented grievance mechanism, in accordance with national laws, as well as with the requirements of the IFIs. The grievance mechanism for workers obliges the contractor to receive and appropriately resolve employee complaints in a fair and reasonable manner. The Occupational Health and Safety Plan will minimize, if not eliminate, all health and safety risks and the sources of those risks to workers. All contractors and subcontractors must comply with the requirements of the plan. The contractor will procure all resources, labor and materials from reliable sources of good reputation, where, along with the price, factors such as quality, reputation, performed projects and services are considered.
Residual impacts	Residual impacts are not expected if all measures are implemented.
Housing, communications and utilities	
Expropriation of houses / homes	The most appropriate measure for mitigating the negative impacts of the process of expropriation of homes and other property is the implementation of good international practice in the purchase of property (expropriation), which includes the preparation of the Political Resettlement Framework and the Resettlement Action Plan. In particular, along with the preparations for the construction phase of the project, a **Resettlement Policy Framework** needs to be developed, from which an **Action Plan on Resettlement** will arise. The most important thing in this process is the proper information, communication and consultation of the persons that will be expropriated, especially their homes, and as early as possible, at an early stage of the project. People who will lose their homes must be consulted from the very beginning and to find a solution according to the needs and possibilities. It is necessary to remain in contact with these persons until their final resettlement and the disappearance of the negative consequences of that resettlement. The use of these practices is in line with national legislation, but also more so in order to create a situation in the society (especially stakeholders) where the negative consequences of project implementation will completely disappear or be marginalized.
Residual impacts	It is almost impossible to mitigate the negative impacts as a whole, because not all sides will always be satisfied.
Economy and livelihood	

Increasing the expectations of the affected population in terms of employment	Prior to the commencement of the construction work, the Contractor must publish a good Employment Plan, which will be developed together with the regional unit of the Employment Agency of the Republic of Macedonia, where it will be determined that the project will create jobs, but only for qualified and for those who will pass the training and retraining process. It is not good to increase expectations in such a small social environment (the municipality and, in particular, the affected populated areas) due to the latent negative social consequences that such expectations carry with them. The contractor will hire unskilled labor, but also highly qualified profiles, because it is still a project with complex construction activities. In any case, some of the residents of the affected areas must be employed, and the contractor must provide training for all of them. The percentage of the local workforce in the project should be determined by the Investor, in cooperation with the local self-government and the regional unit of ESA.
Residual impacts	Despite the implementation of all measures, residual impacts are expected. The expectations of the local population can not be controlled from the outside.
Loss of qualified personnel from local companies (increase of operating costs)	Prior to the commencement of the construction work, the contractor must publish in public a good Employment Plan, developed together with the local office of the Employment Agency of the Republic of Macedonia. This plan must analyze the potential local labor market and find a solution with the least damage to all stakeholders. Labor market in Kriva Palanka is limited, as well as available qualified resources, especially after a period of strong migration.
Residual impacts	Despite the implementation of all measures, residual impacts are expected. The expectations of the local population can not be controlled from the outside.
CONSTRUCTION	
Social aspects management system	
Reduced stakeholder involvement in the construction phase	The developer must maintain an open communication channel with stakeholders and project stakeholders in the construction phase, since not all stakeholders are able or willing to fill out a complaint or grievance. The company must regularly hold semi-annual meetings with representatives of local community and other interested stakeholders. A strong emphasis must be placed on the presence of women at those meetings.
Residual impacts	Residual impacts are not expected if all measures are implemented.
Community health and safety	
Increased threat to the community and livestock due to the presence of a construction site	The contractor should develop and implement procedures for the protection of the health and safety of local communities, populations and their livestock. Procedures should include familiarization with the safety rules for workers and the construction site, and in order to prevent unauthorized access to the construction site, work camps, transport vehicles, construction machinery and warehouses. The Contractor will prepare and implement a **Construction Management Plan** in order to respond to the accidents and urgent cases in a manner appropriate to the construction

	risks. This plan will rely on the prior identification of the risks of major incidents, and will include the necessary measures to prevent major incidents, as well as mitigate their consequences for the local community. The contractor must create safe pedestrian and traffic corridors through the construction site, at the request of the local community and residents. The same corridors will be marked with visible signs, but also communicated with the representatives of local communities, as well as schools. The contractor must design and implement a **Safety Campaign for the population in the construction of infrastructure projects** that will include educational and informative activities for the population of the affected part of the city. Most of this campaign must be carried out before the start of construction activities, while the other part in the construction phase. The campaign must consist of a series of lectures intended for primary and secondary school students in Kriva Palanka, the risks to population safety when there are construction activities for the construction of infrastructure projects, as well as the risks to the population in the operational phase of the project. The campaign must be supported by media, with information, publication of manuals, leaflets and recommendations in printed form available for the local affected population, but also in electronic form on the website of the municipality, as well as other institutions of local character, as well as on the site of the Investor. Additionally, those parts where there are paths for the movement of domestic animals will have to have a special protection regime in order not to cause loss of goods. Locations where animals can be expected can be found around the villages Zhidilovo, T'lminci and Uzem.
Residual impacts	Although all measures are implemented, there will still be "interested" parties that will try to find a way to satisfy their own curiosity and find themselves at a construction site at some point.
Emergencies due to of transportation of materials for and along the railway	The Contractor, in cooperation with the developer, and in particular the competent services, should prepare an Emergency Preparedness Plan, covering all possible incidents related to the railway during construction and operation, as well as the possible measures for rapid reaction and mitigation of the harmful consequences. Material damages must be compensated in full, at market prices of the materials and services for their placement in their original condition.
Residual impacts	Despite the implementation of all measures, residual impacts are expected, but it is early to talk about something that has not happened yet
Problems related to workers' behavior towards the local environment	In terms of labor rights, all workers (including contractors and subcontractors) will have contracts with clearly expressed rights and conditions for their employment, and their legal rights. Contracts will be explicitly explained to all workers when necessary to ensure that workers understand their rights. Contracts must be concluded before the commencement of the working activities. All workers (including contractors and subcontractors) will be able to join trade unions of their choice and have the right to collective negotiations.

	All employees, even those of subcontractors, must sign a Code of Conduct, which should be accessible and visible, and each worker must understand the weight of the document and the consequences it brings if it violates it.
Residual impacts	Despite the implementation of all measures, residual impacts are possible.
Fear for personal health and safety due to the increased volume of traffic across settlements	Preparation and full implementation of a **Temporary Traffic Management Plan** in the settlements, actively communicated with the stakeholders from the affected settlements and the local public. All critical points that must be covered by the plan must have the appropriate traffic signalization during the construction phase and the speed limit that will correspond to the newly occurred situation. The notification of the existence of the plan must be communicated in a timely manner with the local communities, and publicly displayed in the municipality and the premises of the information office of the project.
Residual impacts	Despite the implementation of all measures, residual impacts are possible
Noise disturbance due to construction activities	The Contractor, in coordination with the Investor and the local self-government, should hold several meetings with the local population, where all the negative consequences of the project will be explained, in particular, the noise, the frequency of vehicles and workers, as well as the safety of the population during the upcoming period of construction activities in the immediate vicinity of their homes. It is desirable that these meetings be held prior to the beginning of the construction activities. Citizens have the right to know what will happen in the immediate vicinity of their homes and properties. The contractor should avoid construction activities in times of major religious holidays, non-working days, as well as activities that create increased noise and are not suitable for the night hours, that is, after 19 h.
Residual impacts	Despite the implementation of all measures, residual impacts are possible
Adults in remote areas	During the construction phase it is necessary to provide non-financial assistance to the Inter-municipal Center for Social Work Kriva Palanka (IMCSWKP) for visiting old and vulnerable individuals / groups in the affected area. This non-financial assistance will encompass the provision of driver, vehicle and fuel in order IMCSWKP to visit the socially vulnerable individuals living in remote settlements, located north of the planned line, once a week. Preparation of an Action Plan for Social Support during the construction phase, which will regulate the relations and social support that the contractor should deliver to the IMCSWKP described above.
Residual impacts	Residual impacts are not expected if all measures are implemented
Housing, communications and utilities	

Disruption of everyday life caused by limited access to inhabited settlements, land and property	Public availability of time frames for construction activities, especially for each settlement. Engaging an appropriate % of the workforce for this project from the entire project area, with a special advantage given to the applicants from the rural populated areas of the project area.
Residual impacts	Residual impacts are not expected if all measures are implemented
Degradation of local roads due to construction transport related to the project	Upon completion of the construction activities, the Contractor must repair the damaged local roads used for the transport of goods and people.
Residual impacts	Residual impacts are not expected if all measures are implemented
Material assets	
Interruption of access to communal and road infrastructure	The Contractor is expected to undertake all the necessary activities to provide information on the location of the infrastructure along the alignment. But it is likely that, with the exception of the gas and power grids whose location is known, there may be unregistered water supply from private sources and wells that are not registered in the respective utility companies. It is recommended to provide all opinions and consents from the competent institutions for the material assets, facilities, networks and infrastructures that present in the project area, or they are planned to be build and noted in the planning and strategic documents of the Republic of Macedonia, the Region or the Municipality (some of them are provided and Attached in Annex 2). In the design phase, as well as in the construction work, the procedure should be handled in accordance with the recommendations and opinions of the competent institutions. In case of interruption of access to communal infrastructure, the contractor is obliged to service the interruption as soon as possible or to provide an alternative approach. The Contractor will compensate for all damages incurred.
Residual impacts	Residual impacts are not expected if all measures are implemented
Vibration impacts on houses	In order to protect the project against unforeseen risks, as well as the inhabitants of the settlements from possible negative consequences related to damage to houses, it is desirable for the contractor to record the current state of all houses that are located along the alignment in the width of 100m. The condition of all houses should be checked and recorded. If some of the houses later (during the operation of the railway) report damage due to blasting, there will already be a record of the condition of the house before the commencement of the construction of the railway. All damages caused must be compensated in full, at market price.
Residual impacts	Despite the implementation of all the measures, residual impacts are possible. Sometimes vibrations damage the building gradually, and this is not always visible.
Degradation of local roads due to construction transport related to the project	Upon completion of the construction activities, the Contractor must repair the damaged local roads used for the transport of goods and people.

Residual impacts	Residual impacts are not expected if all measures are implemented
Economy and livelihoods	
Disturbance of livestock due to construction noise, blasting and / or displacement of grazing livestock away from the alignment of the railway	Mitigation measures should include consultation / meeting with the owners of livestock grazing on the local hills and by the river, where they will be timely informed about the time frame of the construction activities per location, but also the grievance mechanism, and the location where the latest information about the project will be published and which will concern them.
Residual impacts	Despite the application of all mitigation measures, residual impacts can still be expected
Increase of employment	NONE
Residual impacs	NONE
Loss of agricultural land and property for railway purposes	Mitigation measures should include consultation / meeting with the owners of the livestock and the agricultural land to be confiscated. If it is assessed that households will lose some of their livelihood, for the purpose of subtracting agricultural property, they must be compensated through the Resettlement Action Plan.
Residual impacts	Residual impacts are not expected if all measures are implemented
Economic loss to local businesses	At the very beginning of the construction work, the contractor must meet with the owners of the fishpond where the construction solutions will be presented, and the minimization of the negative impacts of the project on the fishpond and the restaurant will be discussed. This case, like other similar cases with economic losses due to the project, not seen in this phase of the project, must be covered in the Resettlement Policy Framework and the Resettlement Action Plan. In the event of causing a halt to the work of the fishpond or the restaurant or other economic losses, the owners of the fish farm should be compensated at market prices.
Residual impacts	Despite the application of all mitigation measures, residual impacts can still be expected
Increased level of professional engagement for local companies	NONE
Residual impacts	NONE
Economic benefits of the project	NONE
Residual impacts	NONE
Education	

Disturbance from an interrupted process of education and learning	A communication and information channel must be established between the contractor and the local authorities and the affected communities, at the very beginning of the construction phase. It should be maintained until the very completion of the construction activities. The local population from the town and the populated areas where the explosions will take place must be noticed about the timeframe of the planned blasting on a weekly basis.
Residual impacts	Despite the implementation of all measures, residual impacts are expected.
Labor and working conditions	
Stress caused by a noisy work environment	Compliance with local labor legislation and EU directives on Occupational safety and health, as well as the use of personal protective equipment 89/654 / EEC, 89/656 / EEC, 89/686 / EEC and 2009/104 / EC. It is necessary to use personal protective equipment. The Contractor must create a Occupational Health and Safety Plan with an implemented grievance mechanism for employees.
Residual impacts	Residual impacts are not expected if all measures are implemented
Influx of workers	Creation of a Worker Accomodation Plan that will be in line with the standards of good international practice translated through the experience and standards of IFIs. If there is a need to organize a camp for workers, it must not be near to any of the rural settlements. Every contracted worker from the Contractor must sign a Code of Conduct for Workers, which will include not only declarations and measures related to the labor and material process, but also respect for the local population, community and their property. The Code of Conduct for Workers must be publicly available together with the Grievance Complaints Procedure.
Residual impacts	Residual impacts are not expected if all measures are implemented
Incidents caused by easily flammable, corrosive and explosive materials	Provide special training for workers for handling flammable materials and protection and fire prevention. Store flammable materials away from their initiating sources and oxidizing materials. Storage must be in rooms with natural air or passive ventilation. The area where the materials are stored should be separated and specifically marked for potentially flammable materials (no smoking, using mobile phones or other sparkling devices).
Residual impacts	Residual impacts are not expected if all measures are implemented.
Stress caused by exhaust gases in the workplace	The Contractor must create a Occupational Health and Safety Plan with an implemented grievance mechanism for employees.
Residual impacts	Residual impacts are not expected if all measures are implemented.

Threatened health of workers due to work at a height	Mitigation measures must include appropriate training on the use, servicing and integrity of PPE (Personal Protective Equipment). Appropriate use of scales and scaffolds must be left to trained employees. Use of anti-fall devices, including a safety belt and rope movement limiter, to prevent access to potential points at risk of collapse, or anti-fall protection devices that are fully fastened to the body used in conjunction with shock absorption wires or devices for self-pulling and blocking of an inert fall, attached to a fixed stopping point or horizontal "safety lines". Prevention from falling and implementing protective measures is required when the worker is exposed to danger of falling over two meters in a working machine, in water or other liquids, in dangerous substances or through an opening in the working surface. Must comply with local labor legislation and EU directives on Occupational safety and health, as well as the use of personal protective equipment 89/654 / EEC, 89/656 / EEC, 89/686 / EEC and 2009/104 / EC
Residual impacts	Residual impacts are not expected if all measures are implemented.
Threatened health of workers from rotating and mobile equipment	Use of specially designed machines that eliminate the danger of a trap, as well as ensuring that the limbs are away from danger of injury under normal operating conditions. When a machine or equipment has an exposed movable part or spitz that may endanger the safety of each worker, the machinery or equipment shall be fitted with, and protected from a bumper or other device which prevents access to the movable part or the exposed sharp part. Bumpers should be manufactured and installed in accordance with the appropriate safety standards for machines.
Residual impacts	Residual impacts are not expected if all measures are implemented.
Threatened health of workers due to the driving of industrial vehicles and traffic to the construction site	Training and licensing of industrial vehicle operators for the safe operation of specialized vehicles such as forklifts, including safe reloading and loading, load limits. Mobile equipment with limited rear visibility must be equipped with a sound alarm. It is important to establish a crossing, speed limit on-site, vehicle inspection requirements, operating rules and procedures (for example, banning for forklift trucks in a downward position), and controlling patterns or directions of traffic. Compliance with local labor legislation and EU directives on occupational health and safety.
Residual impacts	Residual impacts are not expected if all measures are implemented.
Cultural heritage, religion, values and habits	
Potential destruction and loss of undiscovered archaeological sites	In accordance with the Macedonian Law on Protection of the Cultural Heritage, in case of unexpected discovery of archaeological sites, the Contractor is obliged to immediately inform the Investor (MR-I) and the Ministry of Culture and to follow their instructions. Construction work will be temporarily suspended while the competent authorities decide

	whether any research is needed or all protection measures should be applied. The contractor should follow the instructions given by the authorities responsible for the protection of cultural heritage. The contractor must keep the discovered objects in place and in the state in which they are detected. Workers should undergo basic training on the procedure for a random archaeological site.
Residual impacts	Residual impacts are not expected if all measures are implemented.
Anxiety due to blasting during religious ceremonies	In order to protect the inhabitants from the affected settlements from the possible negative consequences of interrupting religious practices, especially the burial of the dead and thus creating a dispute between the local community and the contractor, it must prepare a weekly timetable for activities that will generate strong noise and place it in public locations in settlements. The same can be regularly reported to such an event and local media, as well as the municipality, which would easily distribute this information. Sunday must also be a day without explosions, because the majority of inhabitants in other affected settlements are Orthodox Christians.
Residual impacts	Residual impacts are not expected if all measures are implemented.
OPERATION	
Demographics	
Reduction of migration	NONE
Residual impacts	NONE
Community health and safety	
Possible incidents at the railway crossing points	The developer must implement a regular practice of raising local awareness about the negative aspects of disregarding the signalization of the railway crossings. Local residents must be remembered, especially the youth, about the possible consequences of disregarding the security infrastructure and signaling along the railway.
Residual impacts	Despite the implementation of mitigation measures, there will be residual impacts. Attempts to illegally cross with a vehicle through a railway crossing will not disappear. Some people rely on their own feelings when it comes to personal safety and often do not obey the rules prescribed by the railway operator.
Possible incidents with crossings across the railway at illegal crossing points	The developer must implement a regular practice of raising local awareness about the negative aspects of crossing the railway line at illegal pedestrian crossings. Local residents must remember, especially the youth, about the possible consequences of disregarding the rules for safe passage through the railroad, that is, the crossing of the railway at illegal pedestrian crossings.

Residual impacts	Despite the implementation of mitigation measures, there will be residual impacts. Attempts to illegally cross the railway track will not disappear. Some people rely on their own feelings when it comes to personal safety and often do not obey the rules prescribed by the railway operator.
Anxiety due to noise from rail traffic	Specifically for this project, mitigation measures are proposed in the "Noise" section.
Residual impacts	Residual impacts are also possible after the implementation of mitigation measures. Sometimes, to some extent, the proximity of the railway may initiate the relocation of more sensitive persons / households in the more quiet parts of the town or in another settlement, i.e. a kind of process of internal migration. Such induced migrations in reality depend not only on the proximity of the railway line, but also on economic and other factors.
Economy and livelihoods	
Deterioration of the economic situation of the residents in the municipality and possible migrations	The contractor must, in cooperation with the local office of the Employment Agency of the Republic of Macedonia and other competent state institutions, before the very end of the project, prepare a Plan for renewal of the livelihoods (PRL) for the persons employed in the project who have lost their jobs after Completion of the construction phase of the project. The plan must include measures and programs that will help the person engaged in the construction phase of the project, easier to overcome the period after completion of the project and the state of loss of income in the household on this basis. Such measures may be, for example, assistance in self-employment, retraining, access to finance for opening a business, etc.
Residual impacts	Residual impacts are possible.
Labor and working conditions	
Diseases caused by electromagnetic radiation at the workplace	Regular health control of staff exposed to this type of radiation.
Residual impacts	Residual impacts are not expected if all measures are implemented.

9 ENVIRONMENTAL AND SOCIAL CUMULATIVE IMPACTS AND MITIGATION MEASURES

Changes in the environment and society, caused by the envisaged activities for the implementation of the railway construction project, combined with other activities from the past, present or future activities, similar to the activities envisaged in the project area, are assessed as cumulative impacts.

In general, cumulative effects relate to influences that are additive or interactive (synergistic) in nature and are the result of multiple activities at a given time, including the impacts caused by the project activity.

From the submitted documentation for the Corridor VIII section (Kriva Palanka-Border with the Republic of Bulgaria) and the collected data and information it can be concluded that in the immediate vicinity of the project area, where the alignment of the envisaged railway line is located, activities for implementation of the Infrastructure projects, and there are also facilities that have already been built and their presence or prolonged effects from the time of their construction contribute to the emergence of cumulative impacts.

In the immediate vicinity of the project area is planned: A) construction of the express road Rankovce-Kriva Palanka; B) reconstruction of the existing main road Kriva Palanka-Deve Bair; C) a new motorway to the Republic of Bulgaria (if built in the future). [72]

From the major infrastructure facilities that are nearby or interfere with the Project Corridor, the 110 kV transmission line connection with the Republic of Bulgaria and the gas pipeline network has been built.

The alignments of the transmission line, the gas pipeline network, the highway, the expressway, the existing road leading to the border to the Republic of Bulgaria, as well as the corridor of the line, cross into certain points, detailed in Chapter 6.11-Material goods.

The activities of rehabilitation and reconstruction of the existing road to the border crossing, as well as the construction of the expressway are assumed to start before the implementation of the construction works for the construction of the railway line. However, since it is about the implementation of projects related to construction activities that will last every 24 months at least (there is a risk of overlapping of activities), the sum of the impacts on the environment and the social environment will have greater significance than the similar impacts considered Individually.

If all projects are active at the same time, the intensity of the cumulative impacts will be significantly higher, and difficulties can arise in the implementation of the measures for their reduction or avoidance. This is unlikely, as the pace of realization of the projected projects does not always follow the envisaged course, so there is a high probability of deferring the duration of each of them, which will greatly reduce the anticipated cumulative impacts.

9.1 Cummulative impacts on the environment

Considered from the aspect of environmental impacts, the implementation of the Project will cause positive cumulative impacts in terms of reducing greenhouse gas emissions, since much of the road transport for human and cargo transportation, which is one of the more significant sources of greenhouse gases Contributing to climate change, will be replaced by rail transport. Based on the calculations and analyzes, the construction of the railway line is expected to contribute to the reduction of CO2 emissions at the national level by 27 (kt) by 2030 or the cumulative CO2 emissions will be reduced by 229 kt.

In addition to the positive cumulative impacts, the construction and operation of the railway line will cause negative cumulative impacts on the media and environmental areas.

Below is an overview of possible negative cumulative impacts on the media and areas on the environment, as well as measures to reduce or avoid them.

[72] The motorway is a planned investment, but there is no confirmation that will be implemented for sure.

- **Geology and soils**

Railway construction can cause cumulative impacts on geology and soils in the project area. The alignment of the envisaged expressway, the existing main road, as well as the alignment of the future highway extends within the narrow range of the railway. The alignment of the constructed gas pipeline according to the attached maps is intersected with the alignment of the railway line at the mouth of Kiselichka in Kriva Reka. This point should be singled out as particularly sensitive in relation to the cumulative effects on the soil, because at that point the alignment of the railway crosses with the alignment of the planned motorway[73], as well as with the alignment of the existing road on which the reconstruction is planned. In addition, the terrain on this stretch is quite steep and is close to both water bodies (Kiselicka and Kriva Reka), so an increased impact is also expected on the water resources that can further affect the soils.

Construction of the railway line is expected to cause other cumulative impacts on geology and soils, with significance and intensity, as described:

- ✓ The destruction of the surface soil layer, caused by excavation, which will have a local character, so that the activities for the construction of the expressway, the reconstruction of the existing motorway and the construction of the future highway, which would take place near the railway line alignment, can significantly affect the increased destruction of the surface soil layer from the anticipated, ie small cumulative impacts are expected.
- ✓ The proximity of the alignments of the facilities (expressway, motorway and rail), due to the increased intensity of the construction works (excavation, transport, etc.), can greatly increase the risk of erosion, especially at the locations where the roads are located very close to the inclined terrains. The sections 66 + 600-66 + 900, 67 + 400-67 + 700, the section from Kriva Palanka to the inflow of the Kiselicka River, where the alignments of the road and the line are moving along the inclined terrain, can be singled out as critical points. The same goes for the part of the alignment on the slope above the Kriva river from 77 + 950 where the motorway for the second time interferes with the alignment all the way up to Zidilovo 79 + 650 where they re-interfere.
- ✓ The increased volume of construction activities for the construction of the railway and the express road as well as the future motorway and the reconstruction of the highway will certainly increase the volume of heavy construction mechanization, as well as the need for wider access roads, locations for dumping of materials and inert waste and camps. All this will lead to increased intensity (cumulative effect) of compaction of the surface soil layer. In addition, the need for excavation will lead to an increased volume of manipulation (transport, landfill, storage, application) on the soil, which increases the risk of soil compaction and destruction of its structure. This impact can be expected along the entire length of the alignment. The increased manipulation and concentration of dangerous substances in the narrow range, their transport and storage, will increase the risk of soil contamination. Also with the increased volume of transport and movement of the construction mechanization, the influence of contamination of the soil with motor oils, gasoline and other chemical substances is increased.
- ✓ Increased extent of soil manipulation increases the risk of contamination of "healthy" suitable soil with contaminated soil. This type of contamination may occur during manipulation (excavation, loading / unloading and transport) as well as when storing the soil.

To this, it should be added that the already built gas network has contributed to certain disturbances of soil conditions.

- **Hydrology, surface and groundwater**

Construction of the railway can cause cumulative impacts on hydrology, surface and groundwater. Along the alignments of the railway, the expressway, as well as the alignment of the existing national road and the future highway there are many permanent or temporary rivers and streams. The

[73] The motorway is a planned investment, but there is no confirmation that will be implemented for sure.

performance of the construction works on infrastructure projects (railways and roads) can cause negative cumulative impacts of Kriva Reka, Gaberska Reka, Gradechka Reka, Rangel, Domachki Dol, Zhidilovski Dol, Kiselicka Reka, Arbanashki Dol, Krkljanska Reka and others, if the construction activities are performed at the same time and in the immediate vicinity of the rivers.

Cumulative impacts can be caused as a result of construction work near the rivers, river beds and so on, which will contribute to increasing the sediment in the rivers, changes in the flow, etc. Also, drainage at construction sites, pumping of groundwater, incidental leaks, the increased risk of erosion may cause negative cumulative impacts on the waters in the project area (surface and groundwater).

The existence and functioning of the Toranica mine causes significant negative impacts on the water quality in Kriva Reka. The construction of the railway at Kostur and Uzem can cause cumulative impacts on the water quality in Kriva Reka in case of unwanted leaks, inadequate storage of possibly contaminated soil, etc.

- **Ambient air and climate change**

During the construction of the railway, increased emissions from dust and exhaust gases in the air will be generated. If the construction activities for the expressway and the motorway are carried out at the same time and in close proximity to the railway construction sites, as well as the reconstruction of the existing national road, a cumulative effect on the ambient air from these sources can be felt. The generated greenhouse gases from equipment and mechanization and removal of vegetation in the construction phase will contribute to global climate change and microclimate changes in the area.

The existing national road is a significant source of emissions in the air, as well as life activities in the settlements Tlminci, Kriva Palanka, Zhidilovo and Uzem, especially in Kriva Palanka, so that the generated emissions in the air as a result of the construction of the railway line will cause cumulative impacts on ambient air.

In the operational phase of the railway line, negligible cumulative impacts are expected on the ambient air. As mentioned earlier, the operation of the railway will contribute to reducing the emissions from road traffic, since much of the traffic that should take place along the roads will take place along the railway line.

- **Noise**

During the construction of the railway, an increased level of noise will be generated. If construction work for the expressway and the motorway, as well as reconstruction of the existing road, are carried out at the same time and in the immediate vicinity of the railway construction sites, one can feel the cumulative impact of the noise from these sources. This can only happen if the difference in the noise intensity of both sources in a given receptor is less than 10 dB. Considering the lengths of the alignments, it is unlikely that at the same time, close-up works will be carried out.

At a variable distance, along the railway Kriva Palanka-Border with the Republic of Bulgaria, the main road to the Republic of Bulgaria extends. The alignments of the railway and the road cross four times, three of which are with a bridge, and one crossing is with a tunnel beneath the road.

The distances between the alignments and the height differences are usually large enough to neglect the cumulative effects of noise. However, on certain sections, cumulative impacts are possible, ie:

- From the beginning of the bridge no. 16 (chainage 69 + 965,189) to the entrance to tunnel no. 8 (chainage 71 + 793.14);
- From the tunnel outlet no.8 (chainage 72 + 789.87) to the entrance to the tunnel no. 9 (chainage 73 + 824.63);
- From the tunnel outlet no. 16 at Zhidilovo (chainage 79 + 720.00) to the exit of bridge no. 37 (chainage 80 + 068.737);
- Between the chainages 82 + 260 and 82 + 340 in the vicinity of Uzem. In this case, there is only a small local road in the vicinity, with a completely unknown frequency of vehicle movements.

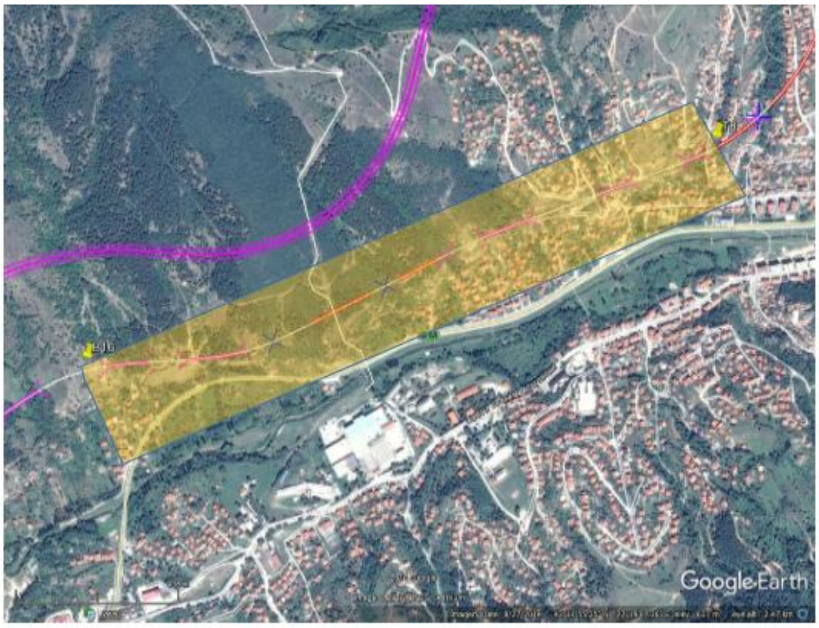


Figure 219 Area in Kriva Palanka where cumulative noise impact is possible from the future railway and the road towards the border with Bulgaria

Figure 220 Area in Kriva Palanka where cumulative noise impact is possible from the future railway and the road towards the border with Bulgaria

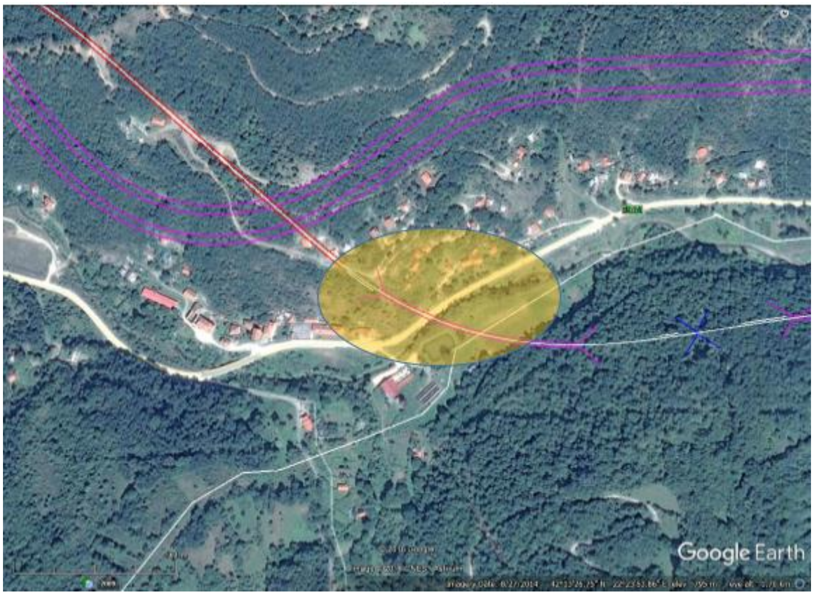


Figure 221 Area in Zhidilovo where cumulative noise impact is possible from the future railway and the road towards the border with Bulgaria

- **Vibrations**

During the construction of the railway, vibrations from construction activities and from the movement of vehicles and mechanization will be generated. If construction work for the expressway and the motorway, as well as reconstruction of the existing road, are carried out at the same time and in the immediate vicinity of the railway construction sites, a cumulative effect of the vibrations from these sources can be felt. Considering the length of the alignment, it is unlikely that at the same time and at a near distance, construction works will be performed.

Regarding the cumulative impacts in the operational phase, it can be said that there is a possibility of cumulative impacts from vibrations caused by railway traffic and road traffic, but without detailed examinations, their occurrence and intensity can not be reliably confirmed.

- **Biodiversity**

The concentration of multiple linear infrastructure projects will inevitably lead to significant damage to the landscape and biodiversity. The terrain rich in gorges through which Corridor VIII passes dictates the concentration of linear infrastructure objects on a relatively small area. Thus, the negative impact on the landscape and biodiversity will increase multiple times, although the individual impact on each facility separately does not necessarily have to be significant (for example, most of the impacts on habitats, the flora that will be caused by the construction of the railway are assessed as impacts with small to moderate significance).

- ***Impacts on visual characteristics of the landscape***

The cumulative impacts caused by the construction of the railway line, as well as the construction of the expressway and the highway will contribute to increasing the significance of the impacts on the visual characteristics of the landscape (as a result of the increased scope and magnitude of the impacts).

- ***Impacts on the functional characteristics of the landscape and biocorridors***

The construction of the railway line and other planned infrastructure facilities will contribute to an increased negative impact on the functionality of the landscape in terms of migration of species through biocoridors identified in MAK-NEN. However, with this level of data for the highway / expressway project, the level of increased impacts can not be more accurately and correctly determined. This depends above all on the number and size of bridges and viaducts on the motorway, as well as the possible tunnels. In any case, it can be assumed that the intensity / magnitude of the impacts (according to the applied methodology) will increase, and therefore the significance of the impacts will also increase.

- ***Impacts on habitats***

Regarding the cumulative impacts on habitats, it can be concluded that the degree of impact from the construction of the railway, motorway and other infrastructure facilities along the alignment of the railway line will be different. For example, no cumulative impact is expected on the beech forests, because, according to the preliminary highway alignments, additional infrastructure facilities pass along south-oriented slopes, where there aren't beech forests. Also, according to the position of the highway alignment, no increased impact is expected on wet and moderately wet meadows. The effects on the riparian forests and the willow and poplar belts will be increased. It should be noted that impacts with "high significance" are expected even in the conditions of construction only on the railway that is subject to evaluation of this study. The same applies to the gravel and sandy banks of rivers and streams, as well as rivers and streams as habitats.

- ***Impacts on flora***

Increased impacts on the flora are expected due to the cumulative effect caused by the construction of the highway / expressway to the Bulgarian border. Given the poor conservation significance of the plant species from the region being assessed, the increased impact is only due to the increased scope of the impacts - from local to regional.

- ***Impacts on fauna***

The cumulative impacts on the fauna from the construction and operation of the railway should be considered in relation to the existing and planned infrastructure facilities. The railway will cause a certain impact on the fragmentation of habitats and the mobility of animal organisms, but this impact is generally low in intensity.

Construction of the railway and the planned highway: The construction of the planned highway can dramatically increase the fragmentation and impede the movement of animal organisms, but also increase the mortality of wild animals from collisions, harassment, and so on. Potential places with a higher cumulative effect are those where the railway line and the planned highway are located in the immediate vicinity, especially the section between Kriva Palanka-Zhidilovo, about 7 km long.

Figure 222 Part of the alignment (Kriva Palanka-Zhidilovo) where increased level of cumulative impacts from the construction of the railway and the motorway are possible

Construction of the railway and the expressway: The cumulative effects of the construction of the railway and the construction of the expressway can have a significant effect, which will be lower in relation to the construction of the highway. The main difference is in laying a fence on the highway that will reduce the possibility of movement of animal organisms, and on the other hand will reduce the mortality of animals from collisions. According to the plans, a new section on the Rankovce-Kriva Palanka expressway is expected to be built, whose alignment runs parallel with the alignment of the railway from the village of Dlabochica to Kriva Palanka. The construction of the new section of the expressway from the village of Dlabochica to Kriva Palanka will cause a significant impact on the fauna, especially due to the fragmentation of the landscape.

Construction of the railway and reconstruction of the existing national road: The extension of the existing road from Kriva Palanka to the Deve Bair border crossing will have a significant cumulative impact which is to a very small extent due to the railway. And in this case, the point of Kiselicka River's inflow in Kriva Reka should be especially considered. The extension of the existing road will have a very strong impact on Kriva Reka, but the construction and operation of the railway will contribute little to the cumulative impact.

Constructed gas pipeline and railway construction: The constructed gas pipeline undoubtedly caused certain impacts on fauna, especially in the construction phase. The alignment of the pipeline interferes with the alignment of the railway at several points, and is especially significant at the inflow of Kiselicka in the Kriva Reka. Higher cumulative effects on fauna can be expected at this location, bearing in mind that the railway also crosses with the alignment of the planned highway. This can cause potentially cumulative effects along with the functioning of the electrified line, especially due to the increased possibility of electrocution of the birds. However, the proposed design of the railway will eliminate such impacts.

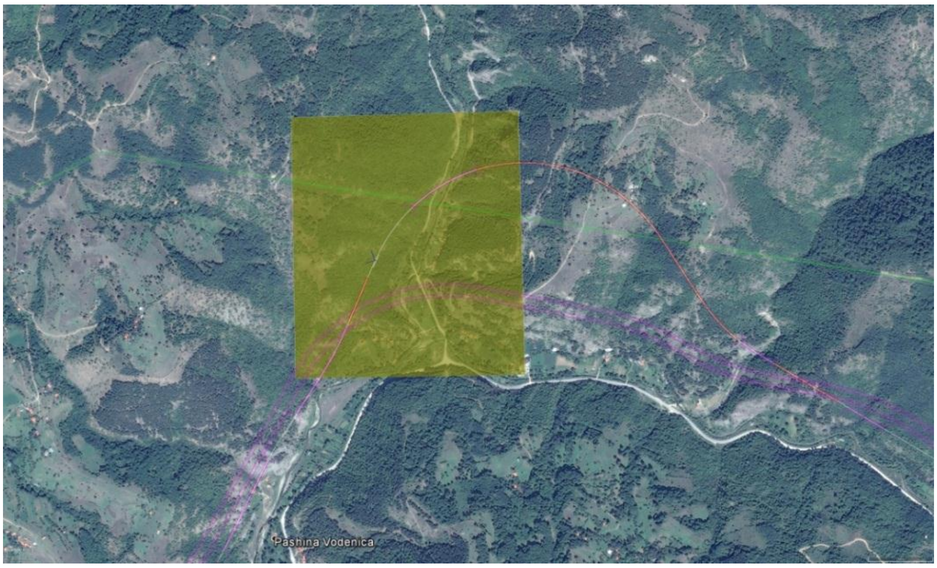


Figure 223 Interference of the railway (red-whitish line), the overhead power line (green line) and the motorway (purple line) at the inflow of Kiselichka River into Kriva River

Operation of the Toranica mine and construction of the railway line: The existence and functioning of the Toranica mine is a serious pressure on Kriva Reka in terms of water quality and impacts on biodiversity.

The construction and operation of the railway will not significantly increase the impact on river ecosystems.

- **Protected areas**

Cumulative impacts on protected areas from the construction and operation of the railway can be considered through two aspects: impacts on natural characteristics and impacts on the governing bodies.

The first aspect is covered through impacts on the most important components of biodiversity and nature, but also cultural and social aspects. Basically, the cumulative impacts of the construction of the railway line, the highway, the constructed transmission line, as well as the existing infrastructure facilities (mines, small hydropower plants) will contribute to the reduction of the value of the proposed protection areas as well as the areas of international importance. This is especially true for the area of Osogovo Mountains (proposed area for protection, Emerald sites, significant plant areas). The analyzed railway line, in relation to the other implemented and planned infrastructure projects, is the facility with the lowest impact on this area.

Given that currently no governing body has been designated for any of these areas, cumulative impacts on administrative capacities and economic implications on the management of the areas can not be assessed. It can be assumed that the operation of the railway will have negative, but also certain positive effects on the management of the areas. Negative impacts are expressed through reduced availability of areas and difficulties in integrated management of the entire area. This situation will be intensified by the construction of other infrastructure facilities and the participation of other stakeholders (public enterprises and concessionaires). The possibility of compensation and financial compensation, together with the increased availability of tourist areas, represent the positive impacts.

- **Forestry**

Considering that in the vicinity of the project area the construction of the expressway, the future highway, the reconstruction of the existing national road is planned, and also there is already a built gas network and a transmission line, from here it can be concluded that the construction of the railway line with the accompanying infrastructure, landfills, material borrowing, etc. will cause cumulative impacts on forestry. The overall impacts will extend to the additional forest surfaces, which will result in loss of a larger productive forest area, and consequently additional loss of wood mass, natural regeneration, growth, etc. Such cumulative impacts will additionally influence the concept of forest management, which will require appropriate changes in the design documents, and of course they will also have a cumulative contribution to climate change.

9.2 Cumulative impacts on the society

The construction of the international traffic lane, Kriva Palanka-Border Railway Republic of Bulgaria, together with the construction and reconstruction of the envisaged roads will contribute to positive cumulative impacts in the region, as a result of the increased opportunities for temporary employment of the local population, development of local businesses, migration, etc. Also, the operation of the railroads and roads will contribute to improving the transport services and their quality (fast and efficient transport of people and goods), which will significantly contribute to the revival of the region, the development of the economy, reduction of the intensity of the village-town and city-capital city migration, etc.

The construction of the railway and other infrastructure projects will contribute to increasing the noise and vibration intensities, the amount of generated dust and exhaust, the impacts on the health and safety of the community, road safety, the presence of workers in the area of the project, and more. This is expected especially in and near the settlements: T'lminci, Kriva Palanka, Zhidilovo and Uzem.

The following table provides an overview of social domains where social cumulative impacts are expected.

- **Economy**
- ✓ **Manpower and business - In the construction phase** - The cumulative impact on the construction workforce from the envisaged projects is expected in the period after 2018, when it is assumed that rehabilitation of the existing national road to Deve Bair and the Rankovce - Kriva Palanka expressway will commence. A significant number of local workforce will be engaged in the implementation of these projects, which can lead to the extraction of skilled labor from existing local businesses and pose additional stress for companies offering low-paying jobs.

  If other projects are planned in the meantime, regardless of these three, it could strengthen this impact, and then a small portion of the workers will have to be borrowed outside the project area, in the form of a wave working on a daily basis As long as the construction phase of this project takes place.

The potential loss of employees at the expense of these projects may limit some local enterprises to conclude new business contracts. Increased production costs due to increased wages, rental of property and increased transport costs can reduce the profit margin of some businesses locally.

This has a significant impact on local economies that even without these impacts barely manage to cope with the existing business principles and working conditions. Even with the implementation of appropriate management measures, the likelihood of negative cumulative impacts on local business is almost certain.

In the **operational phase**, the negative cumulative effect is the state of the completed projects where the demand for labor will significantly decrease, and this puts a lower price for engaging the local workforce. Likewise, the demand for labor will decrease, which can trigger migration considerations on a part of the population.

- ✓ **Production and service sector** - Part of the equipment and vehicles to be used during the construction activities will be procured / borrowed from the region, which can have a positive impact on the local economy. The local economy will also benefit from the use of restaurants, hotels and other catering services. However, the project may have an effect on price inflation, which will benefit only some members of the community, but it may adversely affect others at the local level. Resources will become more expensive, which can compromise production companies that use local resources. This is a significant impact on local companies, but negative for the local population, primarily due to the increase in the prices of products.
- ✓ **Business** - If all projects listed in the cumulative impact assessment are commencing with their implementation, they will create an increased opportunity for businesses to increase sales revenue, as well as overall sustainability through the procurement of goods and services. Existing businesses will expand and new businesses will move to the region, at least temporarily to provide services for projects under construction. The local employment rate will surely increase. These are potential cumulative benefits.

- **Social and healthcare institutions**

- ✓ In the construction phase, it is likely that local healthcare institutions will feel an increased demand for services, which will increase the costs of operation of the healthcare institution. The current medical services are provided for a normal, everyday, operating mode of the medical center in Kriva Palanka. But with the increase in the number of workers in the project area, especially in construction where there are higher workplace risks, such as injuries and infectious diseases, local healthcare institutions are expected to have significantly increased workload, which will require funding that they they do not have. Measures are needed to mitigate the possible impacts.

9.3 Measures for mitigating the cumulative impacts on the environment and society

- **Measures for mitigating the cumulative impacts on the environment**

In order to reduce the cumulative impacts on the media and the areas of the environment, it is recommended to apply the following measures:

Table 94 Measures for mitigating the cumulative impacts on the environment

Cumulative impacts	Measure/Mitigation	Timeframe	Responsibility
Geology and soils	Use of the same access roads, landfills, camps, dumping grounds and other construction facilities, which would reduce the impact on soils and geology.	Construction phase	Contractor
Hydrology, surface- and groundwater	During construction work, coordination of projects (roads and railways) is recommended in order to avoid concurrent construction works at close distances to the rivers and streams in the project area. If the construction work is carried out	Construction phase	Contractor

	simultaneously, take into account the maintenance of the biological minimum in the rivers and strict control of the measures for avoiding possible water pollution.		
Ambient air and climate change	In the construction work, coordination of the projects (roads and railways) is recommended in order to avoid simultaneous construction work; Use of the same access roads, landfills, camps, landfills and other construction facilities, in order to avoid unnecessary removal of vegetation; If construction works are carried out simultaneously, apply all available measures to reduce air emissions and strict control of all sources of emissions.	Construction phase	Contractor
Noise	During the elaboration of Detailed Designs, the sections should be taken into account, where there is a possibility of cumulative impacts, in the construction and operational phase. During construction work, coordination of projects (roads and railways) is recommended in order to avoid concurrent construction works at close distances at locations where sensitive receptors are present, When preparing Detailed Designs for roads, account should be taken of the calculated levels of noise from the railways and, if necessary, to design sound barriers between the road and the receptors.	Construction and operational phase	Contractor and PE “MR-I”
Vibrations	In the detailed assessment of the vibrations in the pre-construction phase, take into account the envisaged construction of the express road, the highway, the reconstruction of the existing road and, if there is a possibility for cumulative impacts, to anticipate appropriate measures that will be applied in the construction and operational phase.	Construction and operational phase	Contractor and PE “MR-I”
Landscape (visual characteristics of the landscape)	The measures for landscaping of the excavations and embankments along the railway line should be fully implemented and replicated in the context of the other linear infrastructure projects envisaged in this corridor. In this way, the change in the visual characteristics of the landscape can be mitigated by introducing a new object in the landscape, but can not be eliminated.	Construction and operational phase	Contractor and PE “MR-I”
Landscape (functional characteristics of the landscape)	Taking additional measures to ensure the "flow" of the biocorridors, ie providing additional culverts along the highway, which will be based on detailed assessments and analyzes.	Construction phase	Contractor
Biodiversity - habitats	No additional measures are planned to eliminate the cumulative effects on the habitats (in the case of river and riparian habitats only), except for the consistent application of the measures envisaged in the railway construction. The same measures should apply in the event of the construction of the motorway.	Construction phase	Contractor

Biodiversity - flora	No additional measures are foreseen to eliminate the additional effects on the flora, except for the consistent application of the foreseen measures for the construction of the railway line. The same measures should apply in the event of the construction of the motorway.	Construction phase	Contractor
Biodiversity - fauna	*Construction of the railway and the planned highway* Careful planning and undertaking of serious measures for mitigating the impacts from the construction of the future highway, especially the area of the identified biocorridors from MAKNEN (Macedonian national ecological network).	Construction phase	Contractor
Biodivesrity - fauna	*Construction of the railway and the expressway* The envisaged measures for the construction and operation of the railway at this moment are sufficient to minimize the expected impacts, but in the planning of this section of the expressway, particular attention will need to be paid to enable the movement of animals even during the functioning of the expressway .	Construction and operational phase	Contractor and PE “MR-I”
Biodiversity – fauna	*Construction of the railway and reconstruction of the existing national road* It is necessary to anticipate effective mitigation measures, as well as strengthened monitoring.	Construction phase	Contractor
Protected areas	The proposed measures are sufficient to mitigate most of the impacts. However, care should be taken in planning the borrow pits and landfills, ie such areas should be outside the boundaries of the aforementioned areas (Osogovo Mountains, German-Kozjak and Kiselicka River Gorge).	Pre-construction and construction phase	Contractor
Forestry	Use of the same access roads, landfills, campsites, landfills and other construction facilities, Change of designing documents for forestry management, in accordance with the newly created changes.	Construction and operational phase	Contractor and PE “MR-I”

Mitigation measures that relate to cumulative social impacts have been identified and are presented in the table below.

Table 95 Measures for mitigating the cumulative impacts on society

Cumulative impact	Measure/Mitigation	Timeframe	Responsibility
Economy - Business	Companies should be timely informed about possible impacts and opportunities for economic activity in the surrounding areas and for the expected periods of impacts, enabling them to plan and prepare. Specific programs need to be set up to enable local businesses to benefit from procurement opportunities and more.	Construction phase	Contractor
Economy - workforce	Information on the workforce, the proposed schedule and the conditions for placement in the project area are unknown. Indicatively stated starting dates in	Construction phase	Contractor

	public information may differ from the exact dates of the project. Labor projections can be postponed substantially by changing the peak moment of need of the workforce. Of great importance for all projects is to enable collaboration and communication at a higher level and to establish coordination of their activities in order to avoid any obstacles in their mutual work.		
Economy - employment	Local residents should be given preference for employment, especially in the Project, and avoid losing funds in the local community. The Contractor will offer adequate education and professional upgrading of the low qualified personnel. Cooperation with ESA in the pre-construction phase in order to ensure in a timely manner qualified personnel. Contact the local ESA office in order to provide additional training for the workforce.	Construction phase	Contractor
Social services	In order to reduce the potential impact on the local health service during the construction phase, the contractor should hire his own medical staff who will be available for the time of work. It is also expected that the contractor will communicate with the local health organizations, especially with the medical institutions, and cooperate and coordinate.	Construction phase	Contractor

10 TRANSBOUNDARY IMPACTS

As a result of the construction of the border tunnel no.22 (with a total length of 2.383 m, of which 1,193.70 m belong to the territory of the Republic of Bulgaria, chainage km 87 + 280,00 to km 89 + 560,00) connecting the Republic of Macedonia with the Republic of Bulgaria, and the performance of construction works near the border with the Republic of Bulgaria, environmental impact assessments have taken into account and analyzed for possible environmental impacts that may be caused in the construction and operation phase which can cause transboundary effects.

Construction activities, close to the border, include the construction of a border tunnel with all accompanying elements.

It is envisaged that all raw materials and auxiliary materials will be stored on the Macedonian side. The excavated land, stone and other materials will be disposed on defined landfills on the Macedonian side and all other accompanying activities will take place exclusively on the same site, ie in certain locations in front of the tunnel or in the tunnel itself[74].

Given the baseline of the location (absence of sensitive receptors), and the type of activities to be performed, it can be concluded that the construction of the railway under normal operating conditions is not expected to cause impacts on the environmental media and environmental areas that would cause a transboundary effect, or if, for example, impacts on ambient air quality or impacts caused by increased noise levels do occur, they are likely to be negligible. Both in the construction and in the operational phase, under normal operating conditions, no transboundary impacts are expected on the environmental media and environmental areas.

It is also of particular importance to point out that the performance of the construction and operational activities of the railway line is not expected to cause negative transboundary impacts on protected and internationally recognized areas (detailed in Chapter 7.9.10).

As a result of the construction and operation of the railway, under normal conditions, negative transboundary impacts on the social aspects are not expected, but on the contrary, with the operation of the railroad, the improvement of the transport infrastructure and the connection with the Republic of Bulgaria, the improvement of the transport of people and goods, will have a positive impact and significant contribution to the economic development of both countries.

The transboundary environmental and social impacts and their assessment are shown in the table below.

Table 96 Overview of transboundary impacts

Environmental media and factors	**Assessment of transboundary impacts**	**Mitigation measures**
Geology and geomorphology	No significant impacts are expected, due to the terrain characteristics.	Adhering to the proposed tunneling methodology
Soils	No significant impacts are expected, due to the fact that construction activities, landfilling, storage of materials will be performed at Macedonian territory.	No measures are proposed
Surface water	No significant impacts are expected, due to the fact that there are no shared watershed areas at the border line between the two countries	No measures are proposed
Groundwater	No significant impacts are expected, due to the identified low permeability of the soil and rocks, and the depth of the groundwater table (more than 100 m).	Adhering to the proposed tunneling methodology, monitoring of the groundwater table and quality using the installed piezometers on the

[74] On the base of the prepared Waste management programme by the future Contractor and in close communication with the Municipality of Kriva Palanka.

		Bulgarian and Macedonian side.
Air quality	No significant impacts are expected.	No measures are proposed
Noise	No significant impacts are expected, due to the distance of settlements and protected areas.	No measures are proposed
Vibrations	No significant impacts are expected, due to the distance of settlements and protected areas.	No measures are proposed
Climate change	No significant impacts are expected.	No measures are proposed
Visual fetures of landscape	No significant impacts are expected, due to the fact that most of the tunnel is already constructed and there are no nearby receptors.	No measures are proposed
Functional characteristics of landscape	No significant impacts are expected, due to the fact that most of the tunnel is already constructed and the tunnels are preffered option regarding the functional aspects of the landscape.	No measures are proposed
Habitats	No significant impacts are expected, due to the fact that most of the tunnel is already constructed and the tunnels are preffered option regarding the protection of the existing habitats in the area.	No measures are proposed
Plant species	No significant impacts are expected.	No measures are proposed
Animal species	No significant impacts are expected.	No measures are proposed
Diatoms and macroinvertebrates	No significant impacts are expected.	No measures are proposed
Protected areas	No significant impacts are expected, due to the fact that the tunnel alignment does not interfere with protected areas, and the distance between the border tunnel and NATURA 2000 sites on the neighbouring country (Republic of Bulgaria): ✓ approx. 1, 90 km from the “Osogovska Planina” site (site code: BG0002079); and ✓ approx. 1,50 km from “Karshalevo” (site code: BG0000294)	No measures are proposed
Forestry	No significant impacts are expected, due to the fact that no deforestation is envisaged during the construction of the border tunnel and operation of the railway	No measures are proposed
Waste	No significant impacts are expected, due to the fact that the waste generated by the construction activities will be deposited on identified locations[75], far away from the border	No measures are proposed
Social aspects	**Assessment of transboundary impacts**	**Mitigation measures**
Transport of goods and passengers	Positive impacts, improved trade, economy, communication and new opportunities (business, tourism etc.)	No measures are proposed
Economy and livelihoods	Positive impacts, improved trade, economy, communication and new opportunities (business, tourism etc.)	No measures are proposed

[75] Some of the locations are already identified, but will be approved by the future Contractor for construction of the railway.

11 RISK FROM ACCIDENTS

This chapter aims to indicate the potential risks of accidents, during the construction and operational phase, the potential effect on the environment caused by them, as well as mitigation measures.

Even in the best planning, design, application of good construction and operational practice and the application of preventive measures, there is a potential for incidents (accidents) that may occur during the implementation of each phase of the Project.

The risk of accidents or incidental situations may arise as a result of:

- technical defect of the equipment for work (construction equipment and railway equipment);
- improper handling of raw materials and auxiliary materials, waste, etc.;
- human error and
- natural phenomena (earthquakes, floods, etc.).

11.1 Risk of accidents during the construction phase

Considering that this is a construction of a linear structure-railway, the most important safety aspects are in correlation with the construction and arrangement of the construction site, handling and storage of raw materials, auxiliary materials, waste, the way of use of the equipment, mechanization, transportation, etc. And they depend on the application and compliance with the legal obligations and the envisaged technical security measures for this type of activity.

Incidental occurrences of a fire or explosion at locations near the border with the Republic of Bulgaria, if they are not timely controlled and prevented from spreading, can cause negative transboundary impacts on the affected receptors.

11.1.1 Risk of incidental leakage of hazardous materials

Hazardous materials are substances and mixtures which, due to their physical and chemical properties, can cause damage to the environment and human health and safety during construction work, in case of leakage, fire, explosion, etc.

During the construction of the railway, the following chemicals and hazardous substances will be used: fuels, fats, oils, explosives, etc. Also, as a result of the construction activities, different types of waste will be created (hazardous and non-hazardous) such as: excavated land, contaminated soil (contaminated land from unwanted leakages or contaminated land that can be found during excavation), waste from removed vegetation, packaging waste, inert waste, ie waste from building and demolition, etc. Inadequate storage and treatment of waste, especially hazardous waste, can cause leakage and pollution of the environmental media.

Incidental leakage of hazardous materials may occur as a result of:

- inadequately arranged storage areas for hazardous substances;
- the absence of tanks or other protective containers for the collection of possible leakage of hazardous substances;
- Impairment / damage to the storage reservoirs for hazardous substances;
- collision of vehicles;
- spillage during maintenance or refueling;
- Inadequate waste management, etc.

Preventive measures and mitigation measures

- Preparation and full implementation of the Hazardous Materials Management Plan and leakage control;
- A warehouse or storage tank for flammable liquids and gases, refueling station, fuel supply station can be built or placed at a site for which the Ministry of the Interior affairs will give prior consent.
- Construction of a secondary system (tanks) for collection of leachate around storage tanks;
- Training workers about possible hazards and harmful effects of chemicals / hazardous substances;

- Preparation of a plan for evacuation and rescue in case of fire, explosion;
- Possession of appropriate equipment in case of fire, explosion, leakage.

11.1.2 Risk of fire / explosion

Fire and explosion during the construction phase may occur as a result of the following factors:

- Inadequately stored and / or scattered construction material that is highly flammable;
- improper use and storage of hazardous materials;
- use of hazardous materials (use of explosives, flammable liquids, liquefied gas and dissolved pressurized gases);
- work in close proximity to existing underground installations, such as electricity supply installations, pipeline, water and sewage networks, and others;
- Inadequate insulation, protection and / or overload of electrical installations;
- negligence when choosing a site for grinding and welding, where sparks appear;
- smoking and reckless removal of shots;
- deliberate firing;
- movement and stay at a site for uninvited persons that could cause a fire and
- lack of a fire protection system and / or inadequate maintenance of the system.

In addition to the aforementioned factors for the occurrence of a fire / explosion, there is also a high risk of explosion at the points where the railway is cut by the pipeline. In fact, the use of construction mechanization can lead to damage to the pipeline, and hence gas leakage and explosion can occur.

Preventive measures and mitigation measures

- Preparation of an Fire, Explosions and Hazardous Materials Management Plan in the construction phase;
- Preparation and application of a notification procedure in case of a state of emergency – fire during the execution of construction works;
- Preparation and application of emergency evacuation procedures, including type of evacuation during incidental situations during the construction phase;
- Training of workers involved in construction activities for fire protection, explosions and hazardous materials;
- Setting up adequate equipment for fire extinguishing at the construction site and training of the workers (and supervision) for handling it;
- Determining the location of all underground installations (electricity, water, gas and sewage networks and others) in the preconstructive phase and their drawing on a map (which will be available in a prominent place on the construction site);
- Designation of the gas pipeline with signs of occupational health&safety;
- Familiarization of all workers, for the exact location of the gas pipeline;
- Mechanical excavations by mechanization and storage of building materials and tools must not be carried out near a gas pipeline, that is, within the range of 15 meters from the gas pipeline;
- All activities must take place in the presence of supervision.

11.2 Risk of accidents during the operational phase

The most important security issues in the operation of the railway are the departure of the train from rails, collision, overturning of compositions, fires and explosions (including sabotage / terrorism), falling from trains, collision of the train with vehicles from road traffic and people at the crossings, etc.

Incidental occurrences of a fire or explosion at locations near the border with the Republic of Bulgaria, if they are not timely controlled and prevented from spreading, can cause negative transboundary impacts on the affected receptors.

- **General operational safety of the railway**

The most significant security problem that potentially affects the crew and passengers is the threat of serious injury or potential loss of life due to collisions with other trains or passenger vehicles, as well as the possibility of an accident related to these situations or other operational reasons.

Recommended actions for managing risky activities include the implementation of railway operational safety procedures aimed at reducing the likelihood of collision, such as the European Train Control System, proposed in the Feasibility Study.

In order to meet the requirements of the system, it is necessary:

- proper operation of the station and the intersections of the railway line;
- the "infill" function is necessary to be implemented through the balise[76] groups;
- These balise groups will be installed 400 m in front of the incoming signals (between warning signals and input signals) and between the input and output signals of the stations;
- defining the technical operation of the proposed equipment;
- the operation of one track and multi-track sections, which would allow two-way traffic;
- the proper functioning of the section, does not depend on the type of: ballast, sleepers and rails;
- operation with several levels of adhesion, between the wheel set and the rail and
- implementation of all operating modes during the train stop (depending on the type of train).

Carrying out regular inspections and maintenance of the railway line and facilities will ensure the monitoring of stability and integrity in accordance with national and international safety standards for railways. It is also recommended to prepare and implement a Security Program, which is equivalent to internationally recognized safety programs for railways.

- **Security of crossings**

Crossings across the railway pose a high risk of rail accidents. On railways with sparse traffic, a flagman can be used to stop all road traffic at the crossroads until the train arrives. Also, automatic warning with lights and bells, as well as ramps, are used more often. Crossings that do not have a ramp represent the greatest potential danger. Recommendations to prevent, minimize and control risks associated with railway crossings include the installation of automatic ramps at all points where crossings are planned.

- **Pedestrian safety**

The railway line self-willed crossers may be exposed to the risk of train movement. Measures to minimize or prevent the crossing of the railway by people include:

- Set clear and prominent warning signs;
- Fencing or other barriers to the place where the train station ends to prevent access to trains of unauthorized persons;
- Education, especially for young people in terms of the dangers of self-willed crossing;
- Use of pedestrian bridges near the crossing point;
- Use video surveillance to monitor the train stations and other areas where a train often passes and alarm system to detect wild switches.

- **Transport of hazardous materials**

Hazardous materials are often transported by rail in a packed and unpackaged form, which poses a potential risk of release / leakage in the environment in case of accidents and other causes[77]. Examples include leakage from the safety valves of wagon tanks and other containers for hazardous

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[76] Balise is a designation (marker) set between the rails, which is part of the European Train Control System

[77] Although dangerous materials are transported by different types of railway wagons (covered wagons, wagon boxes, intermodal wagons, etc.), wagon tanks do most of the transport of such materials.

materials. In intermodal containers, leakage and seepage may occur as a result of inadequate packaging and excessive load during transport. Additionally, there is a possibility of leaking diesel during the fuel supply of trains.

Measures to prevent, reduce and control the leakage of hazardous materials during rail transport include the following:

- Implementation of a system for proper checking, acceptance and transport of hazardous materials. Since these materials can be transferred from third parties, the checking and acceptance process should be in accordance with the international and national standards for the packaging, marking and labeling of containers, as well as the necessary certificates.
- The use of wagon tanks that meet national and international standards appropriate for the loading of hazardous materials;
- Preparation of the Hazardous Materials and Leakage Control Management Plan and emergency preparedness plans based on the analysis in case of accidents;
- Preventive and control measures include:
  - Proper planning of the time of transport of hazardous materials in order to minimize the risk to the community (for example, limiting the transport of hazardous materials to some routes);
  - Construction of protective barriers and other technical measures (drainage) at sensitive locations (near water resources, settlements, etc.);
  - Implementation of emergency notification systems and evacuation procedures;
- Implementation of the Hazardous Materials and Leakage Control Management Plan, including the provisions for the safety of persons, the prevention of unauthorized access and measures to reduce risks during the storage and transport of hazardous materials;
- Using a standardized system for charging a fuel locomotive, including automatic shutdown systems.

- **Fires and explosions**

Fires and explosions can occur as a result of the departure of the wagon tanks from the rails and the leakage / dispersion of explosive and / or flammable materials.

Fires can also occur as a result of inadequate maintenance of the vegetation. If there is no regular control of the vegetation of the railway itself and its protective belt, with only a small amount of fuel and high ambient temperatures, accompanied by other climatic conditions (strong winds), a large forest fire can occur that is a threat for the railway traffic, transport of people and freight.

Measures for preventing and controlling the risk of fires and explosions include:

- Implementation of the solutions for emergency exits and evacuation routes (proposed in the project documentation) and their regular maintenance;
- Assessment of susceptibility to natural disasters and other accidents and preparation of Natural Disaster and Other Accidents Protection and Rescue Plan.
- Monitoring the vegetation along the railway line;
- Timely cleaning, as well as other activities to maintain vegetation to avoid the risk of fires during seasons when the risk is high (summer and early autumn);
- Planting and managing fire-resistant tree species within, and in the immediate vicinity of the railway.

In accordance with the EU Regulation No. 1303/2014, for the technical specifications for interoperability relating to "safety in the railway tunnels" of the railway system in the European Union (TSI), an assessment has been made of the places where firefighting equipment is required. In the following locations, ie tunnels, fire equipment should be installed as follows:

- entrance of the tunnel T01;
- the exit of the tunnel T04;
- entrance of the tunnel T07;

- on the exit of the tunnel T08;
- the entrance to the tunnel T09;
- the exit of tunnel T12;
- the entrance and exit of tunnel T13;
- the entrance to the tunnel T14;
- on the exit of the tunnel T16;
- the entrance and exit of the tunnel T19;
- the entrance and exit of the tunnel T20;
- the exit of the tunnel T21;
- on the entrance and exit of the tunnel Deve Bair.

11.3 Risk of natural disasters (earthquakes, floods, etc.) during the construction and operational phase

➢ **Earthquakes**

An earthquake or tremor is a natural phenomenon, which is the result of the shift of tectonic plates, the movement of the earth's crust, thereby releasing great energy leading to earthquake.

The strength of the tremor depends on several factors, such as the amount of released energy, the depth of the hypocentre, the distance from the epicenter and the composition of the earth's crust. The earthquake is manifested by tremor or dislocation of the ground.

The project area belongs to a seismological zone with a maximum earthquake intensity of 8 ° per MCS scale.

In the event of an earthquake, during the construction and operational phase, damage to the construction site, damage to the railway, human casualties, etc. can occur.

Measures to protect against earthquakes

- Preparing a plan for evacuation and rescue in the event of an emergency;
- Training of employees and preparation of guidelines in case of an earthquake.

➢ ***Floods***

A flood is a natural phenomenon, which occurs due to the high water level in the rivers and lakes, due to which the water pours from the riverbeds and floods the surrounding area.

The reasons leading to high water levels in the rivers and lakes are mostly melting snow, heavy rainfall or some great storm, damaging the dam, riverbed, etc.

The construction of the new railway line Kriva Palanka-Border with the Republic of Bulgaria, as part of Corridor VIII, is located in the catchment area of Kriva Reka.

As is reported in the section on floods and other meteorological phenomena, in the last 60 years, frequent occurrences of flood waves that were formed along the course of the Kriva Reka and its larger tributaries have been observed.

The larger right tributaries of the Kriva Reka such as the Toranica River, the Kiselicka River and the Vetunica River (larger tributaries that can endanger the railway line), as well as the river Krklja, and the Durachka Reka, which although they are left tributaries and are not crossed by the alignment of the railway, can indirectly contribute to endangering the objects of the same. In addition to these larger rivers that are tributaries of the Kriva Reka, on the right side there are another 5 smaller rivers with a catchment area of 3-20 km^2, which can cause catastrophic large waters, ie the so-called. "Flash floods", which appeared very often on our territory, earlier and in recent years, and had a devastating character.

The catchment areas of these rivers have much sparser vegetation, unlike left tributaries, and the soil is usually loessivized, which in times of intense rainfall is eroded (the upper layer of soil) and together with the flood wave, in the form of mud, moves very fast and fills all passes, including culverts, if they are not adequately dimensioned. In such conditions, climatic (erosive processes) along river valleys or dry-beds may occur.

In addition, the railway line, with its facilities, can be endangered even in times of crisp, cold and snow-covered winters, with large snowdrifts and strong winds. The most endangered point in this section may be the area Ba.S01 at the village of Uzem and the point Ba.B43 where the line turns for 360°. The danger can be from flood waves, blows from winds and snow drifts.

During construction of the railway line as well as during the operation of the railway, in the event of a flood, human casualties as well as damage to: construction site(s), construction mechanization, bridges, viaducts, passages, railway alignment, etc. can occur.

Measures for flood protection

Mitigation measures in the event of a flood are the following:

- Take measures that are given in the section Hydrology and surface waters;
- Regulation and regular cleaning of the beds, especially: Kriva Reka, Toranica River, Kiselichka River and Vetunichka River;
- Preparing a plan for evacuation and rescue during the construction phase;
- Training all employees for evacuation and rescue.

➢ ***Landslide***

Landslide is a geological phenomenon that includes a wide range of terrain movements such as rockfalls and landslides.

Landslides may occur at the banks of the watercourses. Although the action of gravity is the main driving force for the landslide to occur, there are other factors that influence the stability of the slopes, ie erosion, and thus landslide (topography, climate, hydrography, soils, etc.).

More than 85% of the terrain of the future railway line belongs to hilly and mountainous areas. In line with the analysis of possible impacts (presented in the environmental baseline on geology), there is potential for the development of linear erosion.

In addition, in line with the assessment of climate change impacts on the future line, intensive rain-initiated spraying erosion and fluvial erosion may occur.

Soils in the project area are characterized as medium to highly susceptible to erosion processes.

The Martin-Dol area is identified as one of the most vulnerable basins in the Municipality, which endangers the alignment of the railway.

In the event of landslides, during the construction and operational phase, the following can occur:

- damage to the construction site;
- damage to construction mechanization;
- Damage to the alignment of the railway line, etc.

Landslide protection measures

- Before commencement of the construction phase, it is necessary to prepare a Soil Management and Erosion and Sedimentation Protection Plan, which will include: determining the critical points where landslides may occur during the construction and operation phase, the most effective methods for protection from erosion, the most appropriate measures for drainage, the most effective methods for retention of deposits, etc.
- During the construction phase, prepare a Plan for Evacuation and Rescue in the event of an emergency situation, which will be familiarized to all employees.

➢ **Hazard risk**

The tailings of the Toranica mine, located just 1 km upstream from the foreseen bridge at 84 + 100, could pose a threat to the railway and accompanying facilities in case of a major accident during the construction and the operational phase. The possible hazard at the tailings (resulting from various reasons) can not only jeopardize the railway and associated facilities, but can also jeopardize the safety of workers and passengers.

Hazard protection measures

When drafting the project documentation, take into account the proximity of the tailings to the alignment of the railway and to anticipate appropriate measures for protection from a possible major accident, both in the construction and in the operational phase.

Risk analysis

This chapter presents the methodology for risk[78] analysis as well as the results of the identified hazards and environmental hazards, ie the assessed risks during the construction and operational phase of the railway.

For the risk analysis, ie for identifying the hazards, determining the level of risk, the qualitative PHA method has been applied. This method provides a disciplined analysis of all adverse events that can be characterized as potential hazards or accidents. The level of risk is determined by each identified hazard / nuisance, taking into account the probability of occurrence of the risk (Annex 21, Table 170) and as well as categorization of the severity of the consequences on the environment (Annex 21, Table 171).

After determining the probability of occurrence of risk and potential hazards, the level of risk is determined using the matrix (Annex 21, Table 172).

Emergency Management Guidelines and Action Plan contents

For each phase of the Project it is necessary to appoint a person for control, who will develop an emergency management plan for emergencies that may occur during the operation.

Emergency planning must be based on the following components:

- Assessing what constitutes an "emergency" for the specific operation / work; it refers to the dangers listed in the risk assessment in Table 173, Table 174, Table 175 and an on-site incident plan for dealing with incidents;
- Communication, responsibility for emergency evacuation, establishment of a control center;
- Set up emergency procedures, including upgrading and revision of the plan, and
- Testing the emergency plan scenario.

The preparation of the Emergency Action Plan is in order to adequately and timely organize the employer and the employees for emergency situations during the operation. In fact, it is necessary to prepare an action plan for all phases: construction and operation of the railway line:

The elements of the plan are:

- Procedures for emergency evacuations;
- Procedure for workers trained for evacuation and rescue;
- Procedures for taking care of all employees after the evacuation;
- Procedures for trained first-aid workers.
- Procedures for the manner of fire notification and other emergencies;
- Data for workers who can be contacted for additional information within the plan.

[78] Risk is the likelihood of occurrence of a certain environmental effect, at a certain time period or during specific circumstances

12 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN & MONITORING PROGRAM

12.1 Environmental and Social Management Plan – ESMP

12.1.1 Purpose for development, objectives and scope of the ESMP

Although the development of an Environmental and Social Management Plan is not a requirement of the national legislation nor the EIA Directive, however, it is a separate part of this Study, which is tasked with identifying, analyzing and assessing the possible impacts resulting from the construction of the third section (Kriva Palanka-Border with Bulgaria) from the railway line Kumanovo-Border with Bulgaria, as part of Corridor VIII. The Environmental and Social Management Plan (ESMP) tackles the measures for protection from possible impacts identified in Chapter 7 of the EIA study and provides unbiased obligations, responsibilities and competencies for their implementation with a certain timetable.

The plan provides a description of the proposed measures to be implemented in order to achieve a sustainable and acceptable level of environmental and social impact identified in the ESIA Study and at the same time is a simple tool that can help the requirements to be met and harmonized with the national regulations and regulations of the European Union.

12.1.2 Objectives of the Environmental and Social Management Plan

- Provide practical and achievable actions for environmental and social management, which will be in line with national and EU requirements;
- Providing sufficient resources in the Project budget so that the scope of activities associated with the ESMP is consistent with the significance of the Project's impacts;
- Provide comprehensive monitoring and control over possible negative impacts, during the construction and operational phase;
- A guarantee that the competent authorities will be committed to the future implementation of mitigation measures in accordance with the defined timetable and their monitoring;
- Providing relevant and timely information to the public regarding the phases of the Project;
- Providing feedback for continuous application and improvement of environmental performance;
- To give an answer / solution to the changes that occurred during the implementation of the project that were not taken into account in the EIA Study;
- Respond / give a solution to unforeseen events.

12.1.3 Possible impacts from the implementation of the project and mitigation measures

The impacts expected to occur from the implementation of the project activities and the measures for their mitigation are elaborated in Chapter 7 of the EIA Study in the construction phase and the operational phase (the decommissioning / ie the post-operative phase is not described because the expected impacts are almost identical to those characteristic for the construction phase **and because of the fact that such types of infrastructure projects have a long life cycle**).

12.1.4 Environmental, Social and Human Health Management Plans/Programs

The Environmental and Social Management Plan (ESMP) will be composed of specific / targeted plans and programs that will address the management of specific media, areas and aspects of the environment and the society. The plans will refer to each phase of the project cycle (mainly construction and operational phase) and will contain actions and programs for their implementation, related to the requirements of the respective regulatory framework.

Each plan, as a basis, will have the following content: A) objectives of the plan; B) management actions; C) responsibilities in carrying out activities; D) monitoring over the implementation of the activities; E) reporting; F) criteria, objectives to be achieved and monitoring indicators; G) timeframe for implementation.

Each plan will propose a way of control and communication, as well as topics for employee training. Part of each plan / program will be checklists for the purpose of keeping records / monitoring the compliance of the measures and activities of the plans and their implementation with the legal requirements and requirements defined in each plan / program.

Informing about the level of implementation of each particular plan / program will be through regular reports. The form of the reports will be proposed by appropriate experts (and will be defined in each plan).

In the *construction phase*, the EMSP will be implemented by the Contractor in cooperation with PERI and MTC. For this purpose, it will implement an environmental and social management system, and prepare Environmental Management Plan composed of the following planning / programming documents:

- Construction Site Organization Plan,
- Dust Management Plan,
- Blasting Management Plan,
- Traffic Management Plan,
- Noise Management Plan,
- Waste Management Program,
- Soil Management Plan and Erosion and Sedimentation Protection Plan,
- Biological Diversity Management Plan (Plant and Animal Species),
- Plan for management and removal of forest vegetation,
- Plan for water management and river crossing,
- Plan for flood management, especially for protection against "flash floods",
- Hazardous Substances Management Plan and Leakage Control,
- Plan for protection and rescue from natural disasters and other accidents,
- Plan for emergency evacuation and rescue (fire, explosion, discharge of hazardous substances),
- Occupational safety and health plan for temporary and mobile construction sites with implemented grievance mechanism for workers, as well as a statement of safety with risk assessment for site workplaces,
- Political Resettlement Framework (PRF) and Resettlement Action Plan,
- Stakeholder Engagement Plan,
- Employment plan for the needs of the project,
- Action plan for social support during construction,
- Plan for worker accommodation.

In the *operational phase*, EMSP will be implemented by PERI, with all its structural units, in cooperation with MTC and the Government of the Republic of Macedonia. For these needs, PERI will implement a system for environmental management and social aspects, and prepare an Environmental Management Plan composed of the following planning / program documents:

- Soil management plan and protection against erosion and sedimentation,
- Plan for remediation of contaminated soils or replacement of contaminated soil material with new and its storage in special landfills (if required),
- Plan for management and removal of forest vegetation,
- Plan for protection from weeds and ruderal vegetation,
- Waste Management Program if the requirements of Article 21 of the Law on Waste Management are fulfilled,
- Hazardous substances Management Plan and Leakage Control,
- Assessment of the threat of natural disasters and other accidents with the Plan for protection and rescue from natural disasters and other accidents,
- Plan for evacuation and rescue in the event of an emergency,

- Plan for restoring livelihoods, etc.

12.1.5 Competent institutions and communication

In the construction phase of the railway line (section 3), the main competence for the implementation of the measures envisaged for mitigation of the possible impacts and obligations arising from the Environmental and Social Management Plan will be the Contractor (the future contracting entity) and the supervision on the performance of the works.

The Contractor and the Supervisor shall be obliged to employ a person, an authorized environmental and occupational health and safety expert who will have relevant work experience in the field (not less than 5 years) and the capacity to respond to all requests from (ESMP), with the opportunity to engage (for the whole period of railway construction) a private company that possesses human and technical resources and licenses to implement the ESMP and report adequately on the achievements, make updates and timely identify the needs for these activities.

The Contractor and the Supervisory Authority will be in close communication with the major beneficiary of the activities - Public Enterprise *Macedonian Railways-Infrastructure* (PERI) and Ministry of Transport and Communications (MTC).

This communication will be realized through a direct contact-Project Manager (Contractor) / Controller with Supervisor with a designated Coordinator from the beneficiary (PERI) and through regular monthly meetings.

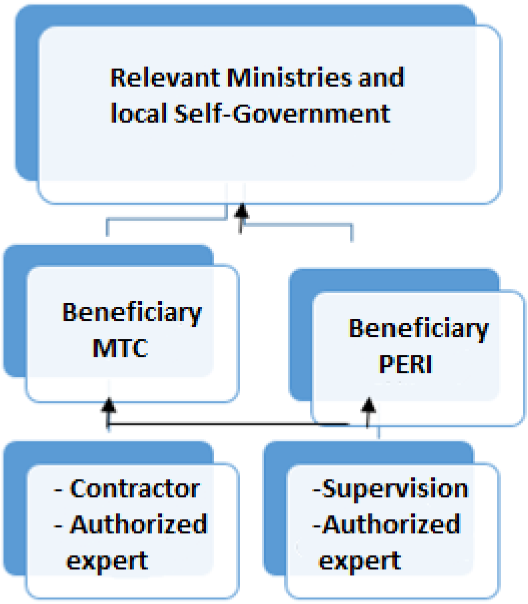
For that purpose, the Contractor will prepare weekly and monthly **work plans with Method Statement and reports** that will be submitted to the designated Coordinator of the Project beneficiaries.

Accordingly, the developer and beneficiary of the project will refer to the Ministry of Environment and Physical Planning, Ministry of Labor and Social Policy (and their local offices, if any) and the Local self-government of Kriva Palanka in order to obtain certain permits, to inform on possible incidents or injuries or regular information on the progress of the works, as will be requested by the aforementioned institutions.

Throughout the project implementation process, project beneficiaries (PERI and MTC) through their coordinators will facilitate the process of communication with the aforementioned ministries and the local self-government in order to ensure the implementation of all project activities without delay or procrastinating and their real implementation.

For its part, via the inspector's offices, the Ministry of Environment and Physical Planning, Ministry of Transport and Communications, the Ministry of Labor and Social Affairs and other competent bodies as well as local government Kriva Palanka, should control whether the contractor[79] fully implement the recommended mitigation or avoidance measures and obligations arising from EMSP.

[79] The obligations referring to the Contractor are also referring to all designated Subcontractors and other stakeholders



During the whole process, daily meetings of the Contractor team will be held regularly, as well as weekly meetings (and more frequent, if required) between the Contractor and the Supervisor and monthly meetings between the Contractor, the Supervisor and the beneficiaries of the Project (PERI and MTC).

In the operational phase of the Project, for the successful implementation of the ESMP, PERI will employ an environmental / occupational health and safety expert and will conduct regular employee training for the successful implementation of the provisions / requirements of the Plan (and specific plans / programs).

12.1.6 Employee and stakeholder training

Continuously, during the whole period of construction of the railway line and during its operability, trainings of the involved workers and other contracting entities will be implemented. This includes the preparation of training materials and information materials and knowledge checking, as well as checklists that will be filled in on the spot (location of supervision) and will be the basis for preparing reports and reporting.

12.1.7 Funding for implementation of the actions defined in the ESMP

The financial resources required for the realization of the ***ESMP in the construction phase*** will be envisaged in the Project Implementation Budget and will be subject to requests and proper allocation during the tender phase of the project.

The maintenance of the railway line, all the accompanying structures, the equipment, ensuring the safety of the transport of passengers and goods and the implementation of the actions defined in the ***ESMP during the operational phase*** of the railway line, shall be implemented with the funds provided by PERI.

12.1.8 Links between ESMP and the relevant national regulation

The relevant regulations, related to the implementation of the project activity and the obtaining of appropriate permits for the realization of the construction works and full operation of the future line, are described in Chapter 3 and Annex 3 of this Study.

12.1.9 Monitoring Program

The monitoring program aims **to assess the degree of project implementation and the effects of implementing the mitigation measures**.

12.1.10 Environmental and Social Management

The table below shows the proposed environmental and social management approach (ESMP) in the construction and operational phase.

<table>
<tr><th>Environmental and Social Management System</th></tr>
<tr><td>Environmental and Social Management System (ESMS) for the construction phase</td></tr>
<tr><td>The construction Contractor will develop and implement an Environmental and Social Management System in order to apply good practices for the protection of the environment and the society. This system will be developed and implemented in accordance with international standards (ie ISO 14001 and CA 8000) and will include:
• Defining an environmental policy, organization, responsibilities and resources,
• Prepared Environmental and Social Management Plan that includes specific plans and programs relating to: site organization, dust management, blasting management, traffic management, noise management, waste management, soil management and protection from erosion and sedimentation, biodiversity management (animal and plant species), management and removal of forest vegetation, water management and river crossing, flood management, especially for protection against “flash-floods”, hazardous substances management and leakage control, protection and rescue from natural disasters and other accidents, emergency evacuation and emergency rescue (fire, explosion, discharge of hazardous substances), occupational safety and health at temporary and mobile construction sites with implemented grievance mechanism for workers, as well as a statement of safety with risk assessment for workplaces on the construction site, a political framework for resettlement and a Resettlement Action Plan, stakeholder involvement, project recruitment, social support during construction, workers' accommodation);
• Procedures for the implementation of each program;
• Construction monitoring plan;
• Control and program process (including performance control and employment control and working conditions);
• Training program;
• Implemented grievance system for the engaged workforce and community and
• Reporting on the status of the environment and social aspects.
The construction Contractor will appoint competent persons for Environmental and Occupational Safety and Health (EOSH) which will be responsible in the process of implementation of the Environmental and Social Management System in the construction phase and the implementation of the measures that will arise from the individual Programs. Competent persons on environmental and occupational safety and health will have appropriate qualifications, training, authorizations and responsibilities, as well as resources. The competent persons for environmental and occupational safety and health will be assigned with responsibilities, including but not limited to:
• Implementation of the Environmental and Social Management System in the construction phase (including audit, corrective actions, etc.) with the included programs;
• Implementation of the Program for monitoring the environment and the social aspects;
• Preparation and filling of checklists;
• Preparation of work plans with methodology for dealing with impact / measure (Method Statement)
• Preparation of quarterly reports;
• Managing the complaints and reporting system for accidents;
• Preparation and submission of reports on environmental and social aspects monitoring to PERI (Public Enterprise Macedonian Railways-Infrastructure) and reports requested by lenders, which include control of compliance with the obligations of the ESMP.</td></tr>
<tr><td>Construction Site Management Plan (CSMP)</td></tr>
<tr><td>Prior to the construction phase, the Contractor will be obliged to prepare and implement a Site Management Plan, which will include:
• Location of borrow pits and landfills for inert waste, to be used;
• Locations of bases and construction camps;
• Access roads;</td></tr>
</table>

• Plan for clearing the construction site; • Plan for the movement of construction vehicles and mechanization (including number and type of construction vehicles) and traffic management, etc. Within the Construction Site Management Plan, the Contractor must demonstrate how he plans to mark the project area (construction site) in order to ensure that construction activities (including clearing of the construction site, the movement of machinery and vehicles) will not be performed outside the designated area, approved in the Detailed Design, and to clearly define any additional land acquisition.
Subcontractors and suppliers management
The railway Contractor / Operator will apply contractual provisions to provide services from subcontractors and suppliers to ensure that they comply with all environmental and social requirements contained in the applicable project documents and standards. The Contractor / Operator shall advise subcontractors and suppliers of their environmental, social, health and safety (including labor and working conditions) responsibilities, including relevant requirements contained in the ESMP. The applicable environmental and occupational health and safety requirements (E & OHS) will be contained in the contractual provisions, including the requirement for subcontractors to adopt the same standards for any other subcontractor and to establish provisions for reporting on environmental and health standards (E & OHS).
Environmental and Social Management System (ESMS) for the operational phase
The railway Operator will prepare and implement the Environmental and Social Management System (ESMS) in order to apply good environmental and social management practices. The ESMS in the operational phase will be developed and implemented in accordance with international standards (ie ISO 14001 and OHSAS) and will include, but will not be limited to, the following: • Organization, responsibilities and resources; • Environmental Management Plan, as well as a social management plan that, in addition to the other measures, includes the following plans / programs (Soil Management Plan and erosion and sedimentation protection, Remediation Plan for contaminated soils or replacement of polluted soil material with new and its storage in special landfills (if required), Plan for management and removal of forest vegetation, Plan for protection of weeds and ruderal vegetation, Waste Management Program if the requirements of Article 21 of the Law on Waste Management, the Hazardous Substances Management Plan and the control of leakage, Assessment of the threat of natural hazards and other accidents with the Plan for protection and rescue against natural disasters and other accidents, Plan for evacuation and rescue in Emergency situation, Life-raising plan, etc.). • Procedures for each plan / program; • Operational monitoring plan; • Training program; • Reporting on the operation from the aspect of environment and society. The railway Operator will appoint competent persons for environment and occupational safety and health (E & OHS), who will be responsible for the development, implementation and coordination of the environmental and social management system in the operational phase and for compliance with the provisions of the ESMS. The competent persons for environmental and occupational safety and health will have appropriate qualifications, training, authorizations, responsibilities and resources, including, but not limited to: • Implementation and maintenance of the ESMS in the operational phase (including control, application of corrective actions, etc.); • Implementation of the Program for monitoring the environment and the social aspects; • Preparation of quarterly reports on compliance with the ESMP (and other applicable standards / documents) related to the ESMS in the operational phase; • Control over the operation and control of safety at the railway; • Managing an accident reporting system (including cases where an accident was prevented); and • Preparation and submission of reports on environmental and social aspects monitoring to the competent institutions.

12.1.10.1 Environmental Management Plan

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
GEOLOGY AND GEOMORPHOLOGY					
Construction and operation					
Geology and geomorphology	Application of good construction practice and stabilization of steep slopes in sediments and shales with biotechnical and construction engineering activities.	Soil protection (geology and geomorphology), prevention of the emergence of contemporary geological processes and reduction of the risk of filling the rivers with sediment.	Contractor/Subcontractor/ Supervisor, PERI and MTC	Continuously during the construction phase, as well as in the operational phase if there is a need for additional stabilization of the slopes	Construction and operational costs in which are included the costs of stabilization and revitalization of the land (they will be determined with additional projects).
Geo-heritage	Application of good construction and operational practice, as well as continuous revegetation of the area, in order to maximize the "masking" of completed construction interventions in the area, in the most remarkable part of the gorge of Kiselichka Reka (76 + 0 to 77 + 0), especially during the construction, as well as on the attractive part of the gorge of the Kriva Reka between the village Zhidilovo and the village of Uzem.	Protection of the landscape and heritage in accordance with the legal regulations and strategic documents for nature protection.	Contractor/Subcontractor / Supervisor, PERI and MTC	Continuously during the construction and operation	Construction and operational costs in which are included the costs of revegetation of the area (they will be determined with additional projects).
SOIL					
Pre-construction					

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
Soil	Preparation of Soil Management Plan and protection from erosion and sedimentation, in the construction and operational phase and its implementation	Protecting the properties and quality of the soil	Contractor/Subcontractor / Supervisor, PERI and MTC	Pre-construction	Costs for preparation of the Plan: 9,000 euros The cost of the measures that will arise from the Plan will be included in construction and operating costs
	Preparation of technical documentation for stabilization of the slopes of the alignment, re-cultivation, protection against erosion and torrents, etc. and implementation of the measures that will arise from the documentation	Protection of the soil and fulfillment of the obligations from the Law on construction and by-laws	Design team that prepares the project documentation for the construction of the railway line or the Contractor	Pre-construction	Costs for preparation of project documentation 30,000 euros
	Examination of soil samples from the topsoil and subsoil layer near the village of Uzem	Determination of possible soil contamination as a result of historical pollution, establishing procedures for proper management of polluted soils, in accordance with the legal obligations	Contractor/Subcontractor/Supervisor	Pre-construction	150 Euro per sample (number of samples will be additionally confirmed)
Operation					
Soil	Continuous monitoring of possible erosion, maintenance of vegetation and, if required, increase of forested areas, maintenance of facilities, etc.	Soil and other environmental media and areas protection	PERI	Continuously during the entire operational phase	Operational costs

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
Soil	If there is a risk of serious soil contamination in the event of a major hazard or incident, it is recommended that a detailed analysis and assessment of the scope and intensity of contamination be carried out, and in accordance with the findings, to propose a Remediation Plan for contaminated soils or replace the contaminated soil with a new uncontaminated soil and store it in special landfills.	Soil and other environmental media and areas protection	PERI	Operation	It depends on the pollution scope, the parameters to be analyzed, and the price for the preparation of the Remediation Plan for Polluted Soils Soil analysis: 50-150 euros per sample
	Preparation of the Plan for protection from weeds and ruderal vegetation and its implementation	Soil and other environmental media and areas protection	PERI	Operation	Price for preparation of the Plan: 5,000 Euros The cost of the measures that will emerge from the Plan will be included in the construction costs
HYDROLOGY AND SURFACE WATERS					
Pre-construction					
Hydrology and surface waters	Preparation of a hydrological and meteorological layout for the project area by establishing appropriate correlative links between the flows at the measurement profiles and the flows at the existing hydrological stations from the state network, with detailed data on the hydrological and meteorological parameters for each profile in Section 3, which will provide the starting point for	Protection of the railway and its structures from torrents and protection of waters and other environmental media and areas	The design team that prepares the project documentation for the construction of the railway line	Pre-construction	40.000 euros

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	dimensioning of hydrotechnical structures, regulation of rivers and protection against weather conditions[80]				
	Preparation of Water Management and River Crossing Plan and its implementation	Protection of waters and other media and areas of the environment	Contractor/Subcontractor	Pre-construction	Price for preparation of the Plan: 5000 Euro The cost of the measures that will emerge from the Plan will be included in the construction costs
	Development of a Flood Management Plan in the construction phase, especially for protection from "flash floods" and its implementation	Protection of waters and other media and areas of the environment	Contractor/Subcontractor	Pre-construction	Price for preparation of the Plan: 5000 Euro The cost of the measures that will emerge from the Plan will be included in the construction costs
	Ensuring water management consent, in order to perform the construction work in the water body / rivers, as well as near the rivers in a manner defined in the water management consent issued by the MoEPP	Protection of waters and other media and areas of the environment, as well as fulfillment of legal obligations	Contractor/Beneficiary (MTC-PERI)	Pre-construction	Negligible, only in terms of running a procedure

[80] Complete analysis of floods during a longer period of time is required (some parts of Macedonia have a recurrence period of 80-100 years). This analysis will align the historical floods with the calculated 100-year floods, which in accordance with the legal requirements are competent for the dimensioning of the hydrotechnical structures. Also, the hydrological and meteorological layouts should consider the snow drifts, the direction and magnitude of winds recorded as per local inhabitant testimonies, and should be compared with the recorded data from the main meteorological station in Kriva Palanka.

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	The use of water from the rivers for technical purposes should be performed on the basis of a license for water use (right of water) issued by the Water Sector of the MoEPP or the Contractor to conclude a contract with an authorized company for supplying of technical water	Protection of waters and other media and areas of the environment, as well as fulfillment of legal obligations	Contractor/Beneficiary (MTC-PERI)	Pre-construction	The costs will depend on the available project documentation and the data necessary for obtaining a permit for water use
	The possible discharge of wastewater into the rivers should be carried out in accordance with the water permit, that is, a permit for discharge issued by the MoEPP	Protection of waters and other media and areas of the environment, as well as fulfillment of legal obligations	Contractor/Beneficiary (MTC-PERI)	Pre-construction	The costs will depend on the available project documentation and the data necessary for obtaining a permit for water use
			Construction		
Hydrology and surface waters	Protection of forest vegetation that is rare in the area of the right tributaries of Kriva Reka and reforestation with autochthonous vegetation at all stages of project development	Protection against flooding and sedimentation (with erosion with water)	Contractor/Subcontractor/Supervisor	Continuously during the construction and operational phase	Construction and operating costs
	Where the natural flow in the basin will be disturbed as a result of the project activities, for the purpose of integral protection of the railway and its protection against flooding, additional culverts or ditches	Protection from floods and protection of waters and other environmental media and areas	Contractor/Subcontractor/ Supervision in cooperation with project beneficiaries (MTC and PERI)	Construction and operational phase	The costs will be determined additionally, based on additional project documentation
			Operation		
Hydrology and surface waters	Regular control and maintenance of the drainage and stormwater	Protection of waters and other media and	PERI	Continuously during the	Operating costs

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	systems (channels, culverts, etc.), as well as the application of good operational practice.	areas of the environment, as well as protection of the structures of the railway and the railway itself		operational phase	
GROUNDWATER					
Pre-construction and construction					
Groundwater	Prior to the commencement of the activities of temporary pumping of emerged groundwater, for the purpose of dewatering the land for construction, the MoEPP should be informed and the activity should be carried out in accordance with the issued water management consent Construction activities should not be performed in conditions of high groundwater level.	Protection of groundwater and fulfillment of legal obligations (Law on Waters-Article 18)	Contractor/Subcontractor/Supervisor	Pre-construction and construction	It depends on the measures and obligations that will arise from the MoEPP
AMBIENT AIR					
Pre-construction					
Ambient air	During the final design of the railway, an optimal layout of the locations for the deposition of excavated material and building materials as well as the stationary construction sites (bases) should be given, in order to minimize the routes for transport of materials and waste.	Protection of ambient air and fulfillment of legal obligation	The design team that prepares the project documentation or the Contractor	Pre-construction	The costs are included in the price for preparation of project documentation or construction of the railway line

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	Analysis of the dispersion of pollutants (model preparation) and additional measures for reduction of emissions into ambient air according to the results.	Protection of ambient air and fulfillment of legal obligations	Contractor	Pre-construction	2.000 Euro per dispersion model for polluting substances (the number of models will be further determined, i.e the number of sites to be modeled)
	Preparation of: • Plan for the organization of the construction site; • Dust Management Plan; • Blasting plan; • Traffic Management Plan.	Protection of ambient air and fulfillment of legal obligations	Contractor	Pre-construction	~ 4,000 euros per plan The cost of the measures arising from the plans will be included in the construction costs
Construction					
Ambient air	Anemometer / mobile weather station installation at the locations where the construction activities will take place.	Protection of ambient air and sensitive receptors	Contractor/Subcontractor/Supervision	Continuously during the construction phase	50-200 euros per measuring point/equipment
	Setting a protective fence around construction sites at sensitive locations (in settlements)	Protection of ambient air and sensitive receptors	Contractor/Subcontractor/Supervision	Continuously during the construction phase, at sensitive locations	Costs are included in construction costs
NOISE					
Pre-construction					

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
Noise	A noise management plan in the construction phase, which will envisage appropriate measures for noise reduction and its implementation	Protection of sensitive receptors and fulfillment of legal obligations	Contractor	Pre-construction	Price for preparation of the Plan: 4,000 Euro The cost of the measures that will emerge from the Plan will be included in the construction costs
			Construction		
Noise	Setting of permanent sound barriers or sound insulation of the affected objects at the following chainages: Sound barriers: km 65+841 to km 65+980 (right side) km 71+038 to km 71+127.5 (right side) km 71+323.5 to km 71+419 (right side) km 71+323.5 to km 71+419 (left side) km 71+569 to km 71+602 (right side) km 72+804 to km 72+935 (right side) km 72+935 to km 73+300 (right side) km 75+340 to km 75+480 (right side) km 79+793 to km 80+003 (left side) km 82+105 to km 82+352 (left side)	Protection of sensitive receptors and fulfillment of legal obligations	Contractor/Subcontractor/Supervision	During construction	*Sound barriers:* 350 euros / m^2 *Sound insulation of objects:* Doors: 250-450 euros per piece (price depends on the type of material and dimensions) Windows: 160-500 euros per piece (price depends on the type of material and window dimensions)

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	Sound insulation of facilities: km 69+790 (right side) km 69+800 (right side) km 70+030 (right side) km 70+200 (right side) km 70+220 (right side) km 81+100 (left side)				
VIBRATIONS					
Pre-construction					
Vibrations	Recording the existing condition of all houses located along the alignment of the railway line, in a certain belt with a width of 100 m, in order to make a documented baseline of the objects, which will contribute to the fair compensation of damages that would result from the vibrations occurring in the course of the construction and operational phase of the Project. Conducting a quantitative assessment of the expected vibrations from the construction and operation of the line and implementation of the proposed measures.	Protection of sensitive receptors and fulfillment of legal obligations	Contractor, PERI, IEEES (Institute of Earthquake Engineering and Engineering Seismology, or IZIIS)	Pre-construction	It depends on the scope of work and the offer of the expert team that will assess the real situation of the existing facilities in the sensitive zones and the impact of vibration in the construction and operation phase
CLIMATE CHANGE **(possible impacts of climate change on the railway)**					
Pre-construction and construction					

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
Climate change	Application of good practices in the design and construction in order to avoid impacts on the railway resulting from climate change	Protection of the railway, the structures that make up the railway, protection of sensitive receptors, improvement of the safety of passengers and employees	Project team that prepares project documentation for railway construction Contractor/Subcontractor/ Supervision	Pre-construction and construction	The costs are included in the cost for preparation of project documentation and in construction costs
		Operation			
Climate change	*Increased temperatures* Application of good operational practice, Coloring the tracks with white color at the places that are most at risk of buckling, so that the steel will absorb less heat, etc. Application of the measures from the Plan for protection from weeds and ruderal vegetation, etc.	Protection of the railway, the structures that make up the railway, protection of sensitive receptors, improvement of the safety of passengers and employees	PERI	Continuously during the operational phase	Operating costs
	Rain: Regular presence of equipped teams with equipment for taking actions (water pumping, etc.); Placing flood defense systems (membrane-bound barriers that will prevent the penetration of water to the railway infrastructure); Regular maintenance of culverts, clearing of branches and leaves from the ditches and culverts along the railway;	Protection of the railway, the structures that make up the railway, protection of sensitive receptors, improvement of the safety of passengers and employees	PERI	Continuously during the operational phase	Operating costs, which should include flood protection costs

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	Placement of pumps at sites prone to flooding.				
	Winds Setting measuring instruments for measuring wind power (anemometer or mobile weather station) or online communication with the HMSM sector for meteorology, etc.	Protection of the railway, the structures that make up the railway, protection of sensitive receptors, improvement of the safety of passengers and employees	PERI	Continuously during the operational phase	50-200 Euros (anemometer or mobile weather station)
	Low temperatures and snow drifts Installing snow fences that will prevent snow drift on the track, near the village of Uzem; Prevention of snow and ice accumulation by applying antifreeze liquid and setting of belts for heating the contact rail and other measures.		PERI	Continuously during the operational phase	Costs for protective barriers should be determined by additional analysis and preparation of project documentation
VISUAL CHARACTERISTICS OF THE LANDSCAPE					
Pre-construction					
Landscape (visual characteristics)	Preparation of a Landscaping Design of the area that will be implemented in the construction and operation phase[81]	Protection of the visual characteristics of the landscape	Contractor	Pre-construction	10 000 euro for the project The cost of implementing the measures will be defined

[81] The Design will include data on localities, modes of plantation and types of plants for landscaping. The plantation of native trees and shrubs is recommended due to protection of the local biodiversity. The Design should envisage the creation of a plant nursery for native trees that will be used for landscaping of the project area.

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
					in the developed design
		Construction			
Landscape (visual characteristics)	Revitalization / rehabilitation of disturbed locations (areas) should be carried out immediately after the completion of the construction work at the specific locations and in accordance with the project documentation prepared for this purpose, which will include at least the mechanical work and stabilization of the land, grassing, afforestation with indigenous tree species etc.	Protection of the visual characteristics of the landscape	Contractor/Subcontractor/Supervision controlled by competent inspection authorities	Continuously during the construction phase	The costs for revitalization of the area, as well as the grassing and afforestation will be additionally determined in the project documentation and they will be included in the construction costs
		Operation			
Landscape (visual characteristics)	Implementation of the measures of the Landscaping Design of the area Maintaining the vegetation	Protection of the visual characteristics of the landscape	PERI	Immediately after the completion of the construction work and during the operation of the railway	The price will be determined in the Landscaping Design
		FUNCTIONAL CHARACTERISTICS OF THE LANDSCAPE			
		Pre-construction			
Landscape (functional characteristics)	Implementing biological monitoring in the spring season of smaller animals (amphibians and reptiles), especially in the vicinity of permanent and non-permanent	Determining the need for additional culverts for protection of smaller animals (amphibians and	Contractor	Pre-construction	3000 Euros

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	water bodies (ponds and streams), which serve as habitats for propagation of frogs.	reptiles)			
BIODIVERSITY-HABITATS					
Pre-construction					
Biodiversity-habitats	The future Contractor, together with the Ministry of Environment and Physical Planning, the Ministry of Economy, the Ministry of Transport and Communications and the municipality of Kriva Palanka, will identify locations (mostly on state land) on which preliminary investigations (hydrogeological and geodetic) will be made, which will be a base for preparation of project documentation and documentation on the impacts on the environment of future borrow pits and landfills	Protection of biodiversity and other media and areas of the environment Fulfillment of obligations in accordance with the Law on Environment and the respective by-law regulation	Contractor	Pre-construction	It depends on the scope of investigations to be carried out, the elaboration of project documentation and environmental impact assessment documentation
	Preparation of a Plan for biodiversity management (animal and plant species) in the construction phase and its implementation.	Protection of biodiversity (animal and plant species)	Contractor	Pre-construction	Price for preparation of the Plan: 4000 EUR The cost of the measures that will emerge from the Plan will be included in the construction costs
Construction					
Biodiversity-habitats	Conducting continuous monitoring by an independent expert (biologist / ecologist) during the construction of the bridges at:	Protection of biodiversity	Independent expert (biologist / ecologist), hired by the contractor of construction work	Continuously during the construction phase	Depends on the expert's offer and the workload (approximately 200 euros per day)

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	Willow and poplar woodlands, stands and tree belts; Willow and poplar groves at: km 74+020 to km 74+300 and around km 75; km 81+200 to km 81+600; Riparian willow and poplar belts: at km 74+200; from km74+800 to km 75+000; at km 75+760; at km 76+500; Gravel river banks at km 74+750 to km 75+000 and km 76+500; Rivers and streams at km 74+250; km 74+870; km 75+770; km 76+500; km 79+850; km 81+060 to km 81+170; km 81+760 to km 82+170 and km 84+100. A permanent or occasional expert supervision (biologist / ecologist) is recommended for the following habitats: willow and poplar woodlands, stands and tree belts; Wet and mesophilic meadows; beech forests, hilly pastures; rivers and streams along the entire alignment.				
	Access roads must not pass through the following habitats: Beech forests, in particular, no further disturbance of these habitats is allowed at km 81 + 500 to km 82 + 600, except for clearing the	Protection of biodiversity	Contractor/Subcontractor/Supervision	Continuously during the construction phase	/

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	vegetation necessary for the construction works and the arrangement of the rails. Wet and mesophilic meadows, especially at km 74 + 800 to km 75 + 000; Km 75 + 700 and km 81 + 100. Willow and poplar woodlands, stands and tree belts, wherever they are found in the project area. Gravel banks of watercourses (rivers and streams), wherever they are found in the project area. Through rivers and streams, wherever they are found in the project area.				
BIODIVERSITY-PLANT SPECIES					
Pre-construction and construction					
Biodiversity-plant species	Conduct a detailed insight at the alignment by a designated independent expert (biologist / forest engineer) in order to check whether there are old trees and other trees with a specific appearance, and the possible presence of plant species with conservation significance.	Protection of biodiversity, ie plant species with conservation significance	Independent expert (biologist / forest engineer), engaged by the contractor of construction work	Pre-construction	Depends on the expert's offer and the workload (approximately 180-200 euros per day)
BIODIVERSITY-ANIMAL SPECIES					
Pre-construction					
Biodiversity-animal species	Due to the presence of the otter *Lutra lutra*, appropriate design of the	Protection of animal species	Design team	Pre-construction	Costs for preparation of project documentation

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	bridges is recommended. There are two bridges that are significant from this aspect, and special attention should be given to the big bridge no. 32 at km 76 + 402 to 76 + 611.5. It is necessary to design the base of the pillars out of the river bed and at least 5-10 m from the river banks.				
	Preparation of new designs implemented in some european countries[82] is recommended, for the purpose of reducing the impacts of electrocution in birds	Bird protection	Design team	Pre-construction	Costs for preparation of project documentation
	Implementation of biomonitoring of the amphibians and reptiles during spring season[83]	Determining the need for setting additional culverts for the protection of smaller animals (amphibians and reptiles)	Contractor	Pre-construction	3000 Euros[84]
			Operation		
Biodiversity-animal species	At the bridge no. 32 at km 76 + 402 to 76 + 611.5, an area along the river in the range of 25 m should be revegetated with willows on both sides of the bridge (a total of 50 m).	Protection of biodiversity	PERI	Immediately after the completion of the construction phase	10-50 euros per tree (the total price will depend on the size of the trees and their purpose)
			FORESTRY		

[82] So far piers have not gained the appropriate attention, but recently in Germany new designs of piers are being considered.

[83] This measure is also proposed for protection of the functional characteristics of the landscape

[84] The cost/price is common for this measure and the mitigation measure for the functional characteristics of the landscape

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
		Pre-construction			
Forestry	Preparation of the Plan for management and removal of forest vegetation in the construction and operational phase	Protection of biodiversity and forestry	Contractor, as well as PERI and MTC	Pre-construction	Price for the preparation of the Plan 5000 Euro The cost of the measures that will arise from the Plan will be included in construction and operating costs
	Timely implementation of procedures for permanent conversion of forest land in construction site, in accordance with legal regulations and expropriation procedures and fair compensation for lost property forests and forest land	Timely provision of sites for construction works, protection of the surrounding land, provision of adequate compensation for the lost land and fulfillment of the legal requirements	PERI and MTC	Pre-construction	Costs will be further determined
		Construction			
Forestry	Partial arrangement of the land and the environment, as well as afforestation of certain parts where the construction is completed, in order to achieve partial compensation of the negative impacts and reduction of the risk of erosion, establishment of the natural balance, processes and dynamics of the ecosystems and habitats.	Protection of forests biodiversity, soils and forestry improvement	Contractor/Subcontractor/Supervision	Continuously during the construction phase	The costs will depend on the areas to be regulated and forested, as well as the types of forest plantations
		Operation			
Forestry	For the lost areas under forest vegetation, activities for natural or	Forest protection and promotion of forestry	PERI	After completion of	The costs will depend on the areas to be regulated

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	artificial restoration of the forest with indigenous species, which are also more adaptable to climate change, should be undertaken. If there is no possibility for the formation of new forest land, to find an appropriate land on which the forest area will be established.			the construction phase	and forested, as well as the types of forest plantations
WASTE					
Pre-construction and construction					
Waste	Preparation of the Waste Management Program in the construction phase.	Fulfillment of the legal obligations for waste management and protection of the media and areas of the environment and the health of the population	Contractor	Pre-construction	Price for the preparation of the Program: 3000 Euro
	Signing agreements with authorized companies for collection, transport and treatment of waste and handing over of waste	Fulfillment of the legal obligations for waste management and protection of the media and areas of the environment and the health of the population	Contractor/Subcontractor/Supervision	Pre-construction and construction	The price will depend on the offers of the authorized waste handlers
	Engagement of waste manager expert, which will ensure full implementation of the Program in accordance with the legal obligations	Fulfillment of the legal obligations for waste management and protection of the media and areas of the environment and	Contractor/Subcontractor/Supervision	Pre-construction and construction	The price will depend on the offer of the waste manager (~ daily allowance 180-200 euros).

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
		the health of the population			
Operation					
Waste	Placing containers with different colors for disposing of different waste streams, especially at the station, the halt and in the facilities where there will be work force	Protection of the media and areas of the environment and the health of the population	PERI	Operation	Depends on the capacity of the containers (from 30 to 70 euros per container)
	Signing agreements with authorized companies for collection, transport and treatment of waste and handing over of waste	Fulfillment of the legal obligations for waste management and protection of the media and areas of the environment and the health of the population	PERI	Operation	The price will depend on the offers of the authorized waste handlers
	Preparation of Waste Management Program in accordance with Article 21 of the Law on Waste Management. The Railway Operator shall prepare a Waste Management Program if, within one calendar year, it produces more than 200 kg of hazardous waste and / or more than 150 tonnes of non-hazardous waste	Fulfillment of the legal obligations for waste management and protection of the media and areas of the environment and the health of the population	PERI	Operation	Price for the preparation of the program: 2500 euros The cost of the measures arising from the Program will be included in the operating costs
RISKS					
Pre-construction and construction					

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
Risks	Preparation of: • Hazardous Materials Management Plan and Leakage Control; • Preparation of Fire, Explosion and Hazardous Substances Protection Plan in the construction phase • Preparation of a Plan for evacuation and rescue in case of fire, explosion; • Implementation of the measures from the plans and application of good construction practice.	Protection of the media and areas of the environment and the health of the population	Contractor/Subcontractor/Supervision	Pre-construction and construction	4000 Euros for each plan individually The cost of the measures that will arise from the plans will be included in the construction costs
	When drafting the project documentation, take into account the proximity of the tailings to the alignment of the railway and to anticipate appropriate measures for protection from a possible major accident, both in the construction and in the operational phase.	Protection of railway and associated facilities, as well as the safety of workers and passengers	Contractor/Subcontractor/Supervision	Pre-construction	Costs for preparation of project documentation
		Operation			
Risks	Preparation of a Hazardous Materials Management Plan and Leakage Control and Emergency Preparedness plans based on the analysis in the event of accidents; Assessment of the threat of natural disasters and other accidents with	Protection of the media and areas of the environment and the health of the population	PERI, controlled by the competent inspection authorities	Operation	4000 Euros for each plan / assessment individually The cost of the measures arising from the plans will be included in the operating costs

Media/areas/aspects of the environment	Proposed mitigation measures	Objective	Competent institution	Timetable	Costs for measure implementation
	the Plan for protection and rescue from natural disasters and other accidents. Preparing a Plan for evacuation and rescue in the event of an emergency.				

12.1.10.2 Social Aspects Management Plan

The Social Aspects Management Plan contains measures for:

A) introduction of an environmental management system; B) Community safety and health; C) Housing, communications and communal services; D) Economy and livelihoods; E) Material assets; F) Education and G) Labor and working conditions.

For the stated aspects, the future Contractor and railway Operator will carry out the following activities for a comprehensive and efficient management of the social aspects in the construction and operation phase.

Social impact	MITIGATION MEASURES	Objective	Competent institution	Timetable	Costs of implementation
Appoint an employee in PERI which will be responsible for managing and monitoring the implementation of mitigation measures, as well as monitoring the programs, and to regularly report to the highest authorities in the company and external stakeholders.		Successful organization and management of the negative impacts of the project, as well as the undertaken obligations related to the project.	PERI	Pre-construction	Operating costs of the company
Procurement must be carefully planned and carried out, so that the realization of the investment is not delayed The developer must start early consultations with all potentially interested companies that can engage in construction work. The developer must either allocate staff or hire an experienced external associate that will prepare all necessary documents and procedures before the tender is announced.		Timely internal organization and selection of the most suitable contractor who will be able to implement the received tasks within the given deadline. The external person will be unbiased in the assistance that should be provided to the developer.	PERI	Pre-construction	Operating costs of the company
Preparation of a **Resettlement Policy Framework (RPF)** and **Resettlement Action Plan (RAP)**. Adequate information, communication and consultation of persons whose real estate will be expropriated, at an early stage, until their final resettlement and the disappearance of the negative consequences of that resettlement. This applies also to those entities that operate in the area, in the event of cessation of their work which will result in economic losses (in the fishpond or the restaurant or other economic activities), should be compensated at market prices		Minimizing the potential risk of stalling in the implementation of the project due to incomplete or poorly undertaken expropriation; the potential risk of causing negative social impacts related to housing and potential negative economic effects	PERI	Pre-construction	30000 EUR (PRP and APR) The value of expropriation cannot be estimated at this stage of the project.
1) Realization of a series of consultative activities with stakeholders, especially those who own land near or along the alignment of the railway. A mechanism for grievance and complaints must be created, and it should be publicly available in every affected settlement, at the headquarters of the Public Enterprise and the premises in the field, as well as in the premises of the municipality of Kriva Palanka. 2) Drafting a **Stakeholder Engagement Plan** (SEP) that will be developed in accordance with good international practice that IFIs		Reduce the negative impacts of the project, but also the negative attitude towards the project and better and timely information of stakeholders concerned.	PERI (1) Contractor	Pre-construction	Operating costs of the company (1)

Social impact	MITIGATION MEASURES	Objective	Competent institution	Timetable	Costs of implementation
	promote. 3) Organization of a facility / office that will serve as an information office of the project. It will be a public location where all information and documents related to the project will be available to the public.		(2 и 3)		2500 EUR (SEP) (2) Operating costs of the company (3)
	Maintain an open communication channel with stakeholders and project stakeholders in the construction phase. The company must regularly hold semi-annual meetings with representatives of local populations and other interested stakeholders. A strong emphasis must be put on the presence of women at those meetings.	Maintaining contact with affected communities (settlements) along the railway line	PERI	Construction	Operating costs of the company
	Preparation of the **Employment Plan for the needs of the project** (EPNP), in cooperation with the local ESA office, with a special emphasis on engaging the local workforce and reducing the pressure from losing qualified personnel at the other economic entities in the Municipality	Engaging the available local workforce Minimizing the potential adverse economic effects	Contractor	Pre-construction	2000 EUR (EPNP)
	1) The developer must implement the **Occupational Safety and Health Management System (OHSMS).** 2) **Occupational Safety and Health Plan (OSHA)** of temporary and mobile construction sites with implemented grievance mechanism for workers, as well as a statement of safety with risk assessment for construction site workplaces	Minimizing the negative risks to the health and safety of workers, as well as the society	PERI (1) Contractor (2)	Pre-construction Construction	7000 EUR (OHSMS) 4000 EUR (OSHA)
	1) Development and application of procedures for protection of the health and safety of local communities, population and their livestock. 2) **Plan for the organization of a construction site** in order to respond to the unfortunate and urgent cases in a manner appropriate to the construction risks 3) Safe pedestrian and traffic corridors through the construction site marked with visible signs, but also communicated with the representatives of the local local communities, as well as the schools. 4) Creation and implementation of a **Campaign for the safety of the population during the construction of infrastructure projects**	Minimizing the risks to the population and livestock	Contractor	Pre-construction Construction	4000 EUR for the Plan for organization of a construction site The remaining costs are unknown at this stage of the project
	Preparation of an Emergency and Emergency Rescue Plan (Fire,	Reduction of potential material and	Contractor	Construction	4000 EUR (EERS)

Social impact	MITIGATION MEASURES	Objective	Competent institution	Timetable	Costs of implementation
Explosion, Discharge of Hazardous Materials), Material damage must be compensated in full, at market prices of materials and services, for their placement in their original condition.		human losses related to railway accidents.			
All employees, even those of subcontractors, must sign a Code of Conduct, which should be accessible and visible, and each employee must understand the weight of the document and the consequences it brings if it violates it.		Reducing the risks associated with the workforce, and the attitude of workers	Contractor	Construction	Operating costs of the company
Preparation and full implementation of the **Traffic Management Plan** in the settlements, actively communicated with the stakeholders from the affected settlements and the local public. All critical points that must be covered by the plan must have the appropriate traffic signalization during the construction phase and the speed limit that will correspond to the newly occurred situation. The notification of the existence of the plan must be communicated in a timely manner with the local communities, and publicly displayed in the municipality and the premises of the project's information office		Reducing the traffic jams and the risks of road accidents	Contractor	Construction	4000 EUR Construction costs
The developer must implement a regular practice of raising local awareness about the negative aspects of disregarding the signalization of the road crossings through the railway.		Elimination of human casualties at road crossings	PERI	Operation	Operating costs of the company
Meetings with the local population, where all the negative consequences of the project will be explained, in particular a review will be given of the noise, the frequency of vehicles and workers, as well as the safety of the population during the upcoming period of construction activities in the immediate vicinity of their homes.		Minimizing the disturbance of the local population due to noise from construction activities	Contractor and PERI	Construction	Operating costs of the company
Drafting of an **Action Plan for Social Support during Construction** (APSSC) and signing an agreement with the Intermunicipal Center for Social Welfare Kriva Palanka for dealing with the needs of adults in remote areas and delivering the agreed obligations.		Minimizing and preventing potential negative social consequences	Contractor	Construction	2500 EUR (APSSC)

Social impact	MITIGATION MEASURES	Objective	Competent institution	Timetable	Costs of implementation
Public availability of the **timeframes of construction activities**, especially for each settlement, to reduce the impact that stems from the lack of availability of desired destinations. Engaging an appropriate % of the workforce for this project from the entire project area, with a special advantage given to the applicants from the rural populated areas of the project area.		Informed local community	Contractor	Construction	Operating costs of the company
Upon completion of the construction activities, the Contractor must repair the damaged local roads used for the transport of goods and people.		Minimizing the impact on material assets	Contractor	Construction	Not known at this stage of the project
Record the baseline scenario of all houses located along the alignment in the width of 100 m, and document the situation that will serve for proper compensation of possible damages caused by the vibrations generated in the construction and operational phase.		Minimizing the potential risk of causing negative social impacts related to housing	Contractor	Construction	(See above in the chapter on vibration)
Preparation of the **Plan for the renewal of the livelihoods (PRL)** for the persons employed by the project, who were left unemployed after the completion of the construction phase of the project, in cooperation with the local ESA office and other competent state institutions, in order to reduce the possible migration		Minimizing the potential adverse economic effects after the completion of the construction phase	Contractor	Operation	2000 EUR (PRL)
In case of interruption of access to communal infrastructure, the contractor is obliged to service the interruption as soon as possible or to provide an alternative approach. The Contractor will compensate for any damages incurred.		Successful organization and management of the negative impacts of the project, as well as the undertaken obligations related to the project.	Contractor	Construction	Operating costs of the company
A communication and information channel must be established between the contractor and the local authorities and the affected communities, at the very beginning of the construction phase. It should be maintained until the very completion of the construction activities. The local population in the city and the populated areas where the explosions will unfold must be reported on the order of the planned explosions on a weekly basis in order to reduce their anxiety.		Reducing the harmful consequences on the educational process	Contractor	Construction	Operating costs of the company
Drafting of a Worker Accommodation Plan (WAP) that will be in line with the standards of good international practice transposed through the		Minimizing the risks to the safety and health of workers	Contractor	Construction	2500 EUR (WAP)

Social impact	MITIGATION MEASURES	Objective	Competent institution	Timetable	Costs of implementation
experience and standards of the IFIs					
Provide special training for workers for handling flammable materials and protection and fire prevention.		Minimizing the risks to the safety and health of workers	Contractor	Construction	Operating costs of the company
Proper **training of employees for using, servicing and integrity of PPE** (personal protection equipment). Use of anti-fall devices.		Minimizing the risks to the safety and health of workers	Contractor	Construction	Operating costs of the company
The use of specially designed machines that eliminate the danger of a trap (when workers are nearby or work with rotating and moving equipment), as well as ensuring that the limbs are secured from danger of injury under normal operating conditions.		Minimizing the risks to the safety and health of workers	Contractor	Construction	Operating costs of the company
Training and licensing of industrial vehicle operators for safe handling of specialized vehicles such as forklifts, including safe (un)loading, load limits, and regular control of their health, in accordance with the Law.		Minimizing the risks to the safety and health of workers	Contractor	Construction	Operating costs of the company
Workers should undergo basic training on the procedure for a randomly discovered archaeological site.		Minimizing the possibility of damage to archaeological sites and objects	Contractor	Construction	Operating costs of the company
Preparation of **Weekly Activity Plan** (WACP) that refers to sources that will generate strong noise and vibrations and place it in public locations in settlements.		Avoiding the possibility of harassment of the local population	Contractor	Construction	Operating costs of the company

12.2 Environmental and Social Monitoring Program

12.2.1 Environmental Monitoring Program

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
GEOLOGY AND GEOMORPHOLOGY						
Pre-construction phase						
Geology and geomorphology	In the project office	Verification of the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of the construction activities	Appropriate implementation of the project in accordance with the requirements of the national legislation and good practices	Construction costs Cost of engagement of an environmental expert (Engaged expert: daily allowance ~ 200 euros employee: ~ 1000 Euros per month) [1]	Contractor (engaged environmental expert)
Construction and operational phase						
Geology and geomorphology	In the project office and in the office of PERI	Verification of the prepared project and technical documentation, reports, plans and checklists	Twice a month during the construction phase Prior to the official start of the operational phase and once a month during the operational phase	Protection of geology and geomorphology, as well as other media and areas of the environment in accordance with the requirements of national legislation	Building and operating costs Cost of engagement of an environmental expert	Contractor (engaged environmental expert), supervised by the Supervision, PERI and the competent inspection bodies
	At construction sites along the alignment and in their immediate vicinity	Visual monitoring of the condition of the inclines of the rocks, application of the measures for their stabilization and their efficiency, as well as	*Construction phase* Daily by the contractor and supervision Twice a week from	Prevent the occurrence of modern geological processes and their distribution	Building and operating costs Cost of an engaged expert: daily fee ~ 200 euros Employee: ~ 500-	Contractor (engaged environmental expert), supervision, PERI and the competent inspection bodies

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		monitoring of the implementation of all other measures from the Environmental Management Plan in the construction and operation phase	an environmental expert *Operational phase* Once a month by PERI and the engaged environmental expert or when required, especially in case of heavy rains		700 Euro per month	
	In the valleys of Kriva Reka, Kiselichka River, Gradechka River	Visual monitoring of the implementation of the measures for stabilization of the rocks and their efficiency, as well as the other measures from the plan for environmental management in the construction and operational phase	*Construction phase* Daily by the contractor and supervision Twice a week from an engaged environmental expert *Operational phase* Once a month by PERI and an environmental expert or when required, especially in the case of heavy rains	Protection of rivers from filling with sediment as a result of the possible occurrence of modern geological processes	Building and operating costs Cost of engagement of an environmental expert	Contractor (engaged environmental expert), supervision, PERI and the competent inspection bodies
Geo-heritage	In the gorge of the Kiselichka Reka (76 + 0 to 77 + 0) and the gorge of the	Visual monitoring of the construction activity performance, revegetation of the	*Construction phase* Daily by the	Protection of the geo-heritage in accordance with the legal requirements	Building and operating costs Cost of engagement	Contractor (hired or employed environmental expert), supervision, PERI,

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	Kriva Reka between the village of Zhidilovo and the village of Uzem	area, as well as the implementation of all the measures from the Environmental Management Plan in the construction and operation phase	contractor and supervision Twice a week from an engaged environmental expert *Operational phase* Once a month by PERI, or by an environmental expert		of an environmental expert	and the competent inspection bodies
SOIL						
Pre-construction phase						
Soil	Near the village of Uzem, downstream of the tailings from the Toranica mine (if there are indications of soil contamination)	Sampling of soil for analysis of parameters: Pb, Zn, Cd, Mn, by a certified laboratory	Before the construction phase, during the preparation of the technical documentation	To determine the soil quality and, if it comes to polluted soils, to obtain directions from the MoEPP how to manage the excavated contaminated soil	150 Euro per sample (number of samples will be additionally confirmed)	Contractor (external or internal environmental expert),
	In the project office	Verification of the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of the construction activities	Appropriate implementation of the project in accordance with the requirements of the national legislation and good practices	Construction costs Cost of engagement of an environmental expert	Contractor (engaged or employed environmental expert), supervision and competent inspection bodies
Construction phase						
Soil	In the project office	Verification of the prepared technical	Twice a month during the	Protection of soils and other environmental	Construction costs Cost of engagement	Contractor (internal or external

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		documentation, reports, plans and checklists,	construction phase	media and areas in accordance with the requirements of national legislation	of an environmental expert	environmental expert), supervision and competent inspection bodies
	Along the alignment of the construction sites and the immediate surroundings, accessible ***Sensitive locations*** *Removing the topsoil* - from km 70 + 220 to 71 + 100, - near the entrance to tunnel no. 12 (75 + 980), - from the beginning of the bridge no. 27 (73 + 760) to bridge no. 28 (74 + 300) and the section between the exit to the tunnel no. 12 (75 + 980) to entrance to tunnel no.13 (76 + 620), From the mouth of Kiselichka River in	Visual control of the implementation of all the measures proposed in the Study, the measures from the further developed project documentation and plans (especially the control of topsoil management, the parent substratum, earth heaps, control of possible erosion and soil contamination) Laboratory tests of the soil during incidental leakages	Every day from the contractor and supervision Twice a week from an engaged environmental expert In case of unwanted leaks	Protection of soils (properties and quality) to prevent possible erosion or if it already occurs, to take appropriate measures, and also to provide protection to other environmental media and areas, in accordance with the requirements of national legislation	Construction costs Cost of engagement of an environmental expert Analysis of contaminated soil during incidents (50-150 euros per sample)	Contractor (external or internal environmental expert), supervision and competent inspection bodies

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	the Kriva Reka, to the village Zidilovo; -the village of Zhidilovo to above the village of Uzem, where the alignment turns in a wide circle to the point 85 + 120 -85 + 220, to the exit of tunnel no. 21 (86 + 140) - from the tunnel exit no.21 (86 + 140) to the entrance to tunnel no. 22 (87-220). *Soil contamination:* In the vicinity of the village of Uzem Unwanted leaks can occur along the alignment *Soil erosion:* The locations shown in Table 30					
Operational phase						
Soil	In the office of PERI	Verification of the prepared project and technical	Prior to the official start of the operational phase	Ensure efficient railway operation and protection of soils and	Operating costs Cost of engagement of an environmental	PERI (external or internal environmental expert), and the

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		documentation, plans and checklists, permits, consents, approvals, etc.	and once a month during the operational phase	other environmental media and areas in accordance with requirements of the national legislation and good practices	expert	competent inspection bodies
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all measures proposed in the Study, the measures from the further developed project documentation and plans	Once a month	Control of the implemented measures, their efficiency and monitoring of the operation of the railway	Operating costs Cost of engagement of an environmental expert	PERI (external or internal environmental expert) and competent inspection bodies
	Along the alignment of the railway where there are culverts, ditches, the locations where the stabilization and remediation was performed	Visual control of the state of the culverts, the management of stormwater, the maintenance of vegetation	Once a month or if required, especially in periods of torrential rains	Avoiding the possible occurrence of floods and erosion of the soil	Operating costs Cost of engagement of an environmental expert	PERI (external or internal environmental expert) and the competent inspection bodies
	Along the alignment of the railway and the immediate surroundings	Visual control for the possible occurrence of unwanted leakages and soil contamination	Once a month or in case of an accident	To determine possible contamination of the soil from unwanted leaks	Cost of engagement of an environmental expert	PERI - (external or internal) environmental expert and competent inspection bodies
HYDROLOGY AND SURFACE WATER						
Pre-construction phase						
Hydrology and	In the project office	Verification of the	Before the official	Appropriate	Construction costs	Contractor (external or

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
surface waters		prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	start of the construction activities	dimensioning and implementation of the project, protection of waters in accordance with the requirements of the national legislation	Cost of engagement of an environmental expert	internal environmental expert)
			Construction phase			
Hydrology and surface waters	In the project office	Verification of the prepared technical documentation, reports, plans and checklists	Twice a month during the construction phase	Appropriate implementation of the project, protection of waters and other environmental media and areas in accordance with the requirements of national legislation	Construction costs Cost of engagement of an environmental expert	Contractor (external or internal environmental expert), supervision and competent inspection bodies
	At the construction sites and the immediate surroundings	Visual control over the implementation of all measures proposed in the Study, the further developed project documentation and plans	Daily by the supervision Twice a week from an environmental expert	Protection of waters and fulfillment of obligations in accordance with national legislation	Construction costs Cost of engagement of an environmental expert	Contractor (external or internal environmental expert), supervision and competent inspection bodies
	All rivers and streams in the project area, especially Kriva Reka, Kiselicka Reka (bridge construction, water diversion, river bed arrangement,	Visual control of the condition of rivers and streams	Every day from the contractor and supervision Twice a week from an environmental expert	Avoiding the possible occurrence of floods and erosion of the soil, filling the rivers with a sediment, providing minimal biological flow	Cost of engagement of an environmental expert	Contractor (external or internal environmental expert), supervision and competent inspection bodies

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	sewage discharge, drainage of construction sites, etc.).					
	All rivers and streams where the main construction activities, ie activities in the riverbed will be performed	Sampling of water by a certified laboratory and determining the physical and chemical characteristics of the water (flow, pH, turbidity, temperature, total dissolved particles, electrical conductivity, BOD, COD, phosphorus, nitrogen (NO_{3-} N), oils, etc.	Once, immediately prior commencement of the construction activity and once after the activity is completed (or for a shorter period if necessary)	Water protection	~ 300 € per sample	Contractor (external or internal environmental expert), supervision and competent inspection bodies
Operational phase						
Hydrology and surface waters	In the office of PERI	Verification of the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of the operational phase	Proper line operation and water protection in accordance with the requirements of national legislation	Operating costs Cost of engagement of an environmental expert	PERI (external or internal environmental expert) and competent inspection bodies
	Along the track	Visual control of the implementation of all measures proposed in the Study, the measures from the further developed	Once a month	Control of the implementation of the measures and monitoring of the operation of the railway	Operating costs Cost of engagement of an environmental expert	PERI (external or internal environmental expert) and competent inspection bodies

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		project documentation and plans				
	Rivers and streams along the alignment of the railway and the immediate surroundings	Visual control of the condition of rivers and streams	Once a month	Determining the possible occurrence of floods and erosion of the soil, as well as siltation	Operating costs Cost of engagement of an environmental expert	PERI (external or internal environmental expert), and competent inspection bodies
	Culverts and ditches along the akignment of the railway and the immediate surroundings, the sites where soil stabilization and revegetation has been carried out	Monitoring of the state of the culverts, the management of stormwater, the maintenance of vegetation	Once a month	Avoiding the possible occurrence of floods and erosion of the soil	Operating costs Cost of engagement of an environmental expert	PERI (external or internal environmental expert), and competent inspection bodies
	At the train station	Visual control of the wastewater management from the railway station	Periodically	Avoiding possible pollution of the environmental media and fulfilling the legal obligations for waste water management	Operating costs Cost of engagement of an environmental expert	PERI (external or internal environmental expert), controlled by the competent inspection bodies
GROUNDWATER						
Pre-construction phase						
Groundwater	In the project office	Verification of the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of the construction activities	Appropriate dimensioning and implementation of the project, protection of waters in accordance with the requirements of the national legislation	Construction costs Cost of engagement of an environmental expert	Contractor (external or internal environmental expert)
Construction phase						

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
Groundwater	In the project office	Verification of the prepared technical documentation, reports, plans and checklists	Twice a month during the construction phase	Appropriate implementation of the project, protection of waters and other environmental media and areas in accordance with the requirements of national legislation	Construction costs Cost of engagement of an environmental expert	Contractor (external or internal environmental expert), supervision and competent inspection bodies
	At the construction sites and the immediate surroundings	Visual control of the implementation of all measures proposed in the Study, the measures from the further developed project documentation and plans	Daily by the contractor and supervision Twice a week from an environmental expert	Protection of waters and fulfillment of obligations in accordance with national legislation	Construction costs Cost of engagement of an environmental expert	Contractor, supervision and competent inspection bodies
	At the locations along the alignment where there will be a high level of groundwater, and in particular at the following chainages: Km 65 + 952, km 70 + 032, km 71 + 767, km 76 + 517, km 77 + 737, km 79 + 877, km 82 + 092, km 82 + 500 to 82 + 628, km 82 + 500 to 82 +628 etc.	Monitoring the manner of drainage and management of pumped waters	Daily by the contractor's supervision Twice a week from an environmental expert	Proper management of groundwater in accordance with the legal regulations	Cost of engagement of an environmental expert	Contractor (external or internal environmental expert), supervision and competent inspection bodies

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
AMBIENT AIR						
Pre-construction phase						
Ambient air	In the project office	Review of the prepared technical and project documentation, the dispersion model as well as the plans and checklists	Before the official start of the construction activities	Proper implementation of the project, providing information and taking measures to protect the ambient air in accordance with national legislation requirements	Construction costs Costs for engagement of an environmental expert	Contractor (external or internal environmental expert)
Construction phase						
Ambient air	In the project office	Review of documents (project documentation, reports, checklists for all plans, etc.).	Twice a month during the construction phase	Protection of air and other media and environmental areas	Construction costs Costs for engagement of an expert on environment	Contractor, supervision and competent inspection authorities
	In the project area and the immediate surroundings	Visual control of the implementation of all the measures proposed in the Study and the measures that will arise from further elaborated project documentation and plans	Daily by supervision Twice a week by environmental experts	Control of the implementation of the measures and the protection of ambient air	Construction costs Costs for engagement of an expert on environment	Contractor, supervision and competent inspection authorities
	In areas with sensitive receptors-human settlements and significant wildlife areas	Visual monitoring of working conditions and the implementation of	Daily by supervision Twice a week by environmental	Meeting the standards for air quality and minimizing impacts on sensitive	Construction costs Costs for engagement of an expert on environment	Contractor, supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		construction practices at the construction site Measuring wind speed	experts Daily measurements of wind speed at construction sites by using an anemometer	receptors		
	Areas with sensitive receptors-settlements	Measuring emissions of dust and exhaust gases in the ambient air (PM10, total dust, CO, CO_2, NOx, PAH, SO_2), by a certified laboratory	Every 2 months	Meeting the standards for air quality and minimizing impacts on sensitive receptors	~ 200 € per measuring point (the number of measurement points will result from the pattern of dispersion and the Dust Management Plan)	Contractor, supervision and competent inspection authorities
Operational phase						
Ambient air	In the office of PERI	Review of documents (project documentation, reports, checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and air protection in accordance with the requirements of national legislation	Operating costs Costs for engagement of an environmental expert	PERI (external or internal environmental expert) and the competent inspection authorities
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all the measures proposed in the Study and the measures of further elaborated project documentation and plans	Once a month by PERI i.e. by an environmental expert	Control of the implemented measures, their effectiveness and monitoring the operation of the railway	Operating costs Costs for engagement of an environmenrtal expert	PERI (external or internal environmental expert) and the competent inspection authorities
NOISE						
Pre-construction phase						

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
Noise	In the project office	Review of the Noise Management Plan and checklists	Before the official start of construction activities	Proper implementation of the project and the protection of sensitive receptors from increased noise level, in accordance with legal requirements	Construction costs Costs for engagement of an environmental expert	Contractor (external or internal environmental expert)
			Construction phase			
Noise	In the project office	Review of documents (project documentation, reports, checklists for the plan, etc.).	Twice a month during the construction phase	Proper implementation of the project, protection of sensitive receptors from increased noise level and reaching thresholds in accordance with national legislation requirements	Construction costs Costs for engagement of an environmental expert	Contractor (external or internal environmental expert), supervision and competent inspection authorities
	In areas with sensitive receptors	Visual control of the implementation of all the measures proposed in the Study and the measures from the further elaborated project documentation and plans	Daily by supervision Twice a week by environmental experts	Reducing the noise generated by construction activities and the achievement of the permitted thresholds for noise level	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and competent inspection authorities
	In areas with sensitive receptors, particularly the following chainages: 950 + 69 (before	Measuring the level of noise at sensitive receptors, by a certified laboratory	If necessary or after resident grievance	Control the level of noise in order to take appropriate action if limits are exceeded	~ 35 € per measuring point (the total number of measuring points arising from the Noise Management	Contractor (external or internal environmental expert), supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	bridge no. 16) to 71 + 850 (upon entry into the tunnel no. 8) (before entering Kriva Palanka station and after the station in Kriva Palanka) 72 + 760 (before the exit of the tunnel no. 8) to 73 + 850 (upon entry into the tunnel no. 9)-Kriva Palanka 79 + 720 (exit of the tunnel no. 16) 070 + 80 (exit of the bridge no. 37) c. Zhidilovo, 81 + 500 to 82 + 680 (at the entrance to the tunnel no. 19) v. Uzem, 85 + 570 (before the exit of the tunnel no. 20) 630 + 85 (exit of the bridge no. 45) v. Uzem.				Plan)	
Operational phase						
Noise	In the office of PERI	Review of documents (reports, letters, etc.).	Monthly during the operational phase	Proper implementation of the project and taking measures to reduce the noise	Operating costs Costs for engagement of an environmetal	PERI (external or internal environmental expert) and the competent inspection

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
				generated by the operation of the railway	expert	authorities
	The sensitive locations at the railway alignment	Visual monitoring of the implementation of all the measures proposed in the Study and the measures from further elaborated project documentation and plans	Once a month by PERI, i.e. by the environmental experts or if required	Control of the implementation of the measures and monitoring the operation of the railway	Operating costs Costs for engagement of an environmental expert	PERI (external or internal environmental expert) and the competent inspection authorities
	In areas with sensitive receptors, particularly the following chainages: Chainage km 760 + 65 to 66 + 100 (village Talminci) Among chainages km 70 + 600 and 71 + 807 (Station Kriva Palanka) In the vicinity of the chainages of 72 km to 73 + 774 + 840 (Kriva Palanka) Among chainages km 75 + 180 and 75	Measurements of noise level in the periods: day-evening-night	Once during the start of operation of the line, or more frequently, if necessary, i.e. in case of complaints of the local residents	Control of the efficiency of measures to reduce the noise level and if necessary to take additional measures in order to meet the acceptable thresholds on noise levels	~ 35 € (per measuring point) (the number of measurement points will be determined during the operational phase of the project)	PERI (external or internal environmental expert) and the competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	+ 500 (Pashina Vodenica) Chainages between 79 km and 731 + 80 + 080 (Zhidilovo) Among chainages km 82 + 020 and 82 + 520 (Uzem)					
			Vibration			
			Pre-construction phase			
Vibration	In the project office	Review of the prepared technical and project documentation for vibration protection, as well as plans and checklists	Before the official start of construction activities	Proper implementation of the project, protection of sensitive receptors from increased levels of vibration in the construction and operational phases	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert)
			Construction phase			
Vibration	In the project office	Review of documents (project documentation, reports, checklists for the plan, etc.).	Twice a month during the construction phase	Proper implementation of the project, protection of sensitive receptors from increased levels of vibration and reaching acceptable limits in accordance with national legislation requirements	Construction costs Costs for engagement of an environmental expert	Contractor (external or internal environmental expert), supervision and competent inspection authorities
	Sensitive areas along the alignment	Visual control of the implementation of all	Daily by supervision	Control of the implementation of the	Construction costs Costs for	Contractor (external or internal environmental

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	of the railway	the measures proposed in the Study and the measures from the further elaborated project documentation	Twice a week by environmental experts	measures and reaching acceptable levels of vibration in accordance with the requirements of national legislation	engagement of an expert on environment	expert), supervision and competent inspection authorities
	At sensitive locations	Measuring the level of vibration, by an authorized laboratory	The measuring points as where to perform the measurement of vibration level in the construction and operational phases will be determined in the project documentation	Reduce vibration from construction and operational activities on track and meeting the acceptable limits of vibration levels	TBD	Contractor (external or internal environmental expert), supervision and competent inspection authorities
Operational phase						
Vibration	In the office of PERI	Review of documents (reports, letters, etc.).	Monthly during the operational phase	Proper implementation of the project and reduce the level of vibrations from the operation of the railway	Operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
	Along the alignment, especially in sensitive locations	Review of implementation of the measures proposed in the technical documentation should be further developed and contain measures to reduce vibrations in the operational phase	Once a month or as needed	Control of the implementation of measures to reduce vibrations and monitor the operation of the railway	Operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
	In areas with	Measurements of	Once the start of	Checking the	TBD	PERI (external or

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	sensitive receptors	vibrations by certified laboratory	operation of the line, or more frequently, if necessary, in case of complaints from the local residents	efficiency of measures to reduce the level of vibration and if necessary additional measures in order to meet the acceptable limits on levels of vibration		internal environmental expert) and the competent inspection authorities
CLIMATE CHANGE (Possible effects on climate change caused by construction and operational activities of the railway)						
Pre-construction phase						
Climate change	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project and providing information and measures to reduce greenhouse gases	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental experts)
Construction phase						
Climate change	In the project office	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and competent inspection authorities
	In the project area and the immediate surroundings	Visual monitoring of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and	Daily by supervision Twice a week by environmental experts	Control of the implementation of the measures and the reduction of greenhouse gases	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		plans				
Operational phase						
Climate change	In the office of PERI	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and the reduction of greenhouse gases	operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Once a month by PERI, i.e. environmental experts	Control of the measures implemented, their effectiveness and monitoring the operation of the railway	operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
CLIMATE CHANGE (Possible impacts of climate change on the railway)						
Pre-construction phase						
Climate change	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project, protecting the railway from climate change	construction costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
Construction phase						
Climate change	In the project office	Review of documents (project	Twice a month during the	Proper implementation of the project in	construction costs Costs for	Contractor (external or internal environmental

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		documentation, reports, Checklists for all plans, etc.).	construction phase	accordance with legal requirements and best practices	engagement of an expert on environment	expert), supervision and competent inspection authorities
	In the project area and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Daily by supervision Twice a week by environmental experts	Control of the implementation of the measures and the reduction of greenhouse gases	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and inspection authorities competent
Operational phase						
Climate change	In the office of PERI	Review of documents (project documentation, reports, checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and reduce the risks and threats posed by climate change	operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures of further elaborated project documentation and plans	Once a month by PERI, i.e. by environmental experts	Control of the measures implemented, their effectiveness and monitoring the operation of the railway	operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
	Along the alignment of the line, especially on the sections of track exposed on the south side of the valley of Kriva Reka,	Visual control of the stability of the track and facilities	Once a month by PERI, i.e. the environmental experts, and especially in extreme weather conditions	Maintenance of track and facilities in satisfactory condition, avoiding the occurrence of accidents and improving the safety of	operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	near the village of Uzem			passengers and staff		
VISUAL CHARACTERISTICS OF LANDSCAPE						
Pre-construction phase						
Landscape - visual features of the landscape	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project, protection of the visual features of the landscape	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert)
Construction phase						
Landscape - visual features of the landscape	In the project office	Review of documents (project documentation, reports, checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and competent inspection authorities
	In the project area and the immediate environment, especially the following chainages: -km 64 + 940 to km 66 + 100 and km 69 + 000 to km 69 + 200 -From km 70 + 500 to approximately km 73 + 800 In Kiselicka River and the village of	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Daily by supervision Twice a week by environmental experts	Control of the implementation of the measures and the protection of the landscape	construction costs Costs for engagement of environmental experts	Contractor (external or internal environmental expert), supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	Kostur at the following chainages: 76 km to 402 km + 76 + 611.5, 84 km + 84 km to 094.5 + 107.5					
Operational phase						
Landscape - visual features of the landscape	In the office of PERI	Review of documents (project documentation, reports, checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and the protection of the landscape	operational costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	once a month	Control of the measures implemented, their effectiveness and monitoring the operation of the railway	operating costs Costs for engagement of an environmental expert	PERI (external or internal environmental expert) and the competent inspection authorities
FUNCTIONAL CHARACTERISTICS OF LANDSCAPE						
Pre-construction phase						
Functional features of the landscape	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents,	Before the official start of construction activities	Proper implementation of the project, protection of the functional features of the landscape	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		approvals, etc.				
	Near the permanent and seasonal water bodies (especially ponds and streams) that serve as habitats for breeding of frogs	Conducting a biomonitoring of the fauna of amphibians and reptiles	Once, in the spring season, before commencement of the construction activities	Determining the need for placing additional culverts to protect the smaller animals (fauna of amphibians and reptiles)	construction costs 2000 Euro- engagement of a biologist	Contractor (engaged biologist)
Construction phase						
Functional features of the landscape	In the project office	Checking the prepared project and technical documentation, reports, plans and checklists by environmental experts	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and competent inspection authorities
	In the project area and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Daily by supervision Twice a week of environmental experts	Control of the implementation of the measures and the protection of the landscape	construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert and biologist), supervision and competent inspection authorities
Operational phase						
Functional features of the landscape	In the office of PERI	Review of documents (project documentation, reports, checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational	Proper operation of the railway and the protection of the functional features of the landscape	operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert and biologist) and the competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
			phase			
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures of further elaborated project documentation and plans	once a month	Control of the measures implemented, their effectiveness and monitoring the operation of the railway	operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert and biologist) and the competent inspection authorities
BIOLOGICAL DIVERSITY-HABITATS						
Pre-construction phase						
Biological diversity-habitats	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project, protection of habitats	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and competent inspection authorities
Construction phase						
Biological diversity-habitats	In the project office	Review of documents (project documentation, reports, checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert and independent expert biologist / ecologist), supervision and competent inspection authorities
	In the project area and the immediate surroundings	Visual monitoring of the implementation of all the measures proposed in the study, measures	Daily by supervision Twice a week by environmental	Control of the implementation of the measures and the protection of habitats	Construction costs Costs for engagement of an expert on	Contractor (external or internal environmental expert and independent expert biologist / ecologist), supervision

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		from further elaborated project documentation and plans	experts		environment	and inspection authorities competent
	When building bridges in: **willow and poplar groves, stands and tree belts;** **Willow and poplar woodlands** at km 020 + 74 to 300 + 74 km and about 75 km; 81 km to 200 km + 81 + 600; **Riparian willow and poplar belts**: at km 74 + 200; from km74 + 800 75 + 000 km; at 75 km + 760; at 76 km + 500; **Gravel river banks** 74 km + 75 km to 750 + 000 + 76 at 500 km; **Rivers and streams** at km 74 + 250; km 74 + 870; km 75 + 770; km 76 + 500; km 79 +	Visual control of habitats during execution of construction works along the alignment and near habitats	Daily by supervision Twice a week by environmental experts and an independent expert biologist / ecologist	Control of the implementation of the measures and the protection of habitats	Construction costs Costs for involved experts (approximately 180-200 euros per day per expert)	Contractor (external or internal environmental expert and **independent expert biologist / ecologist**), supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	850; 81 km to 060 km + 81 + 170; km 81 + 760 to km 82 + 170 to km 84 + 100. **Monitoring along the alignment at the following habitats:** poplar and willow groves, tree stands and belts; wet and mesophilic meadows; beech forests, hilly pastures; rivers and streams along the entire alignment.					
	Beech forests, especially: km 81 + 500 to km 82 + 600 (vegetation clearance is only acceptable for the purpose of alignment establishment and mounting of rails). **Wet mesophilic meadows**, particularly at km 74 km 800 + 75 +	Visual control of habitats during construction of access roads, as well as performance of other activities nearby habitats during construction of civil works	Daily by supervision Twice a week by environmental experts and an independent expert biologist / ecologist	Control of the implementation of measures	Construction costs Costs for involved experts (approximately 180-200 euros per day per expert)	Contractor (external or internal environmental expert and **independent expert biologist / ecologist**), supervision and inspection authorities competent

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	000; 75 km and 700 km + 81 + 100. **Willow and poplar groves, stands and tree belts** wherever they are found during construction. **Gravel banks of waterways (rivers and streams)**, everywhere they are to be found during construction. **Through rivers and streams,** everywhere they are to be found during construction.					
			Operational phase			
Biological diversity-habitat	In the office of PERI	Review of documents (project documentation, reports, checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and the protection of habitats	Operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert and **independent expert biologist / ecologist**) and the competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Once a month by PERI, i.e. from environmental experts	Control of measures implemented, their effectiveness and monitoring the operation of the railway	Operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert and **independent expert biologist / ecologist**) and the competent inspection authorities
BIOLOGICAL DIVERSITY-PLANT SPECIES						
Pre-construction phase						
Biodiversity-plant species	In the project area	Conducting detailed inspection at the alignment by the appointed independent expert (biologist / forester) to check whether there are old trees and other trees with a distinctive appearance, and possibly the presence of plant species with conservation importance.	Pre-construction phase	Proper implementation of the project, protection of plant species with conservation importance	Construction costs Costs for engagement of an expert biologist / forester (180-200 euros per day)	Contractor (external or internal environmental expert and **independent expert biologist / ecologist**)
	In the project office	Review of the prepared technical documentation, plans and checklists	Before the official start of construction activities	Proper implementation of the project, protection of plant species	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert and **independent expert biologist / ecologist**)

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
			Construction phase			
Biodiversity-plant species	In the project office	Review of documents (project documentation, reports, checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert and **independent expert biologist / ecologist**), supervision and competent inspection authorities
	In the project area and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Daily by supervision Twice a week by an expert on environment-ecologist / biologist / forester	Control of the implementation of the measures and the protection of the landscape	Construction costs Costs for engagement of expert ecologist / biologist / forester (180-200 euros per diem)	Contractor (external or internal environmental expert and independent expert biologist / ecologist / forester), supervision and competent inspection authorities
			Operational phase			
Biodiversity-plant species	In the office of PERI	Review of documents (project documentation, reports, checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and the protection of species	Operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities
	Along the alignment of the railway and the immediate surroundings	Visual control of the implementation of all the measures proposed in the study, measures from further	Once a month by PERI, i.e. from environmental experts	Control of measures implemented, their effectiveness and monitoring the operation of the railway	Operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert) and the competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		elaborated project documentation and plans				
BIOLOGICAL DIVERSITY-ANIMAL SPECIES						
Pre-construction phase						
Biodiversity, animal species	Near the permanent and seasonal water bodies (especially ponds and streams) that serve as habitats for breeding frogs	Conducting a biomonitoring of the fauna of amphibians and reptiles, by biologist	Once, in the spring season, before starting the construction works	Determining whether the placement of additional culverts to protect the minor animals (fauna of amphibians and reptiles) is neccessary	Construction costs 2000 Euro-engagement of a biologist	Contractor (hired expert biologist)
	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project, the protection of animal species	Construction costs Costs for engagement of an expert on environment	Contractor (hired expert biologist), supervision and competent inspection authorities
Construction phase						
Biodiversity, animal species	In the project office	Review of documents (project documentation, reports, checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert and independent expert biologist / ecologist / forester), supervision and competent inspection authorities
	In the project area and the immediate	Visual control of the implementation of all	Daily by supervision	Control of the implementation of	Construction costs Costs for	Contractor (external or internal environmental

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	surroundings	the measures proposed in the study, measures from further elaborated project documentation and plans	Twice a week by an ecologist / biologist	the measures and the protection of animal species	engagement of expert ecologist / biologist / forester (180-200 euros per diem)	expert and independent expert biologist / ecologist / forester), supervision and competent inspection authorities
Operational phase						
Biodiversity, animal species	In the office of PERI	Review of documents (project documentation, reports, checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and the protection of animal species	Operating costs Costs for engagement of an expert on environment	PERI (external or internal environmental expert and **independent expert biologist / ecologist**) and the competent inspection authorities
	Along the alignment of the railway and the immediate surroundings, especially the station km 76 + 402 to 76 + 611.5.	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Once a month by PERI, from environmental experts and a biologist or forester	Control of measures implemented, their effectiveness and monitoring the operation of the railway	Operating costs Costs for engagement of an expert for Environment or biologist or forester	PERI (external or internal environmental expert and **independent expert biologist / ecologist**) and the competent inspection authorities
BIOLOGICAL DIVERSITY-DIATOMS AND MACROINVERTEBRATES						
Pre-construction phase						
Biodiversity-diatoms and macroinvertebrates	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project, species conservation	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and inspection authorities competent
Construction phase						

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
Biodiversity-diatoms and macroinvertebrates	In the project office	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert), supervision and inspection authorities competent
	On construction sites, in the rivers and streams where they perform major works	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans by the environmental expert or a biologist / ecologist	Daily by supervision Twice a week by environmental expert-biologist / ecologist	Protecting diatoms and macroinvertebrates	Construction costs Costs of hired experts	Contractor (external or internal environmental expert / biologist), supervision and inspection authorities competent
	The river Gaberska	Monitor the situation of the populations of dragonfly species *Cordulegaster heros, Caliaeschna microstigma,* by hydrobiologists	Twice a week by hydrobiologists 1 expert for adult dragonflies (Odonata) and 1 expert on aquatic macroinvertebrates (larvae of dragonflies)	Control of performance of works and protection of dragonflies	Construction costs Cost for engagement of hydrobiologist ~ EUR 200 per diem for experts	Contractor (hired or employed an expert on environmental / biologist)
Operational phase						
Biodiversity-diatoms and macroinvertebrates	In the office of PERI	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational	Proper operation of the railway and species protection	Operating costs Costs for engagement of an expert on environment	PERI (engaged or employed environmental expert / biologist) and the competent inspection

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
			phase			authorities
	In the project area	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Once a month by PERI, i.e. from environmental experts	Control of measures implemented, their effectiveness and monitoring the operation of the railway	Operating costs Costs for engagement of an expert on environment	PERI (engaged or employed environmental expert / biologist) and the competent inspection authorities
BIOLOGICAL DIVERSITY- PROPOSED AREAS FOR PROTECTION AND INTERNATIONAL RECOGNIZED AREAS						
Pre-construction phase						
Biodiversity-proposed conservation areas and internationally recognized areas	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project and protection of the proposed conservation areas and internationally recognized areas	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert / biologist), supervision and competent inspection authorities
Construction phase						
Biodiversity-proposed conservation areas and internationally recognized areas	In the project office	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert / biologist), supervision and competent inspection authorities
	Emerald area "Pchinja-German" from km 75 + 213 to km 77 + 070 ie a length of 1,857 km,	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and	Daily by supervision Twice a week by the expert on environment or biologist / ecologist	Protecting the proposed conservation areas and internationally recognized areas	Construction costs Costs involved experts	Contractor (external or internal environmental expert or the biologist / ecologist), supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	Emerald area "Osogovo" the alignment of the line passes from km 83 + 080 to km 83 + 630, especially km 83 + 080 to km 83 + 630, **Protected Landscape “Osogovo Mountains”**, km 82 + 376 to 82 + 658 82 + 656 to km 84 + 056, **Kiselicka River gorge**-the presence of the otter. Throughout this area the railway passes with a total length of 2,366 km (from km 75 + 146 to km 77 + 512), in particular the bridge no. 32 (km 402 + 76 to 76 + 611.5)	plans				
Operational phase						
Biodiversity-	In the office of	Review of documents	Before the official	Proper operation of	Operating costs	PERI (external or

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
proposed conservation areas and internationally recognized areas	PERI	(project documentation, reports, Checklists for all plans, etc.).	start of the operational phase and monthly during the operational phase	the railway and the protection of the proposed conservation areas and internationally recognized areas	Costs for engagement of an expert on environment	internal environmental expert or the biologist / ecologist) and the competent inspection authorities
	In the project area	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Once a month by PERI, i.e. from environmental experts	Control of measures implemented, their effectiveness and monitoring the operation of the railway	Operating expenses Costs of engagement of environmental experts	PERI (external or internal environmental expert or the biologist / ecologist) and the competent inspection authorities
FORESTRY						
Pre-construction phase						
Forestry	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc.	Before the official start of construction activities	Proper implementation of the project and protection of forests and forestry	Construction costs Costs for engagement of an expert on environment	Contractor controlled by the supervision and competent inspection authorities
Construction phase						
Forestry	In the project office	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	Construction costs Costs for engagement of an expert on environment	Contractor (external or internal environmental expert for Environment or the biologist / forester), supervision and inspection authorities competent

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
	In the project area, especially at locations represented forests and forest land	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Daily by supervision Twice a week by the environmental expert or biologist / ecologist	Protection of forests and forest land	Construction costs Costs involved experts	Contractor (external or internal environmental expert or the biologist / forester), supervision and inspection authorities competent
			Operational phase			
Forestry	In the office of PERI	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper operation of the railway and the protection of forests and forest land	Operating costs Costs for engagement of an expert on environment	PERI contractor (hired forestry engineer), competent supervision and inspection bodies and competent inspection authorities
	In the project area	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Once a month by PERI, i.e. from environmental experts	Control of measures implemented, their effectiveness and monitoring the operation of the railway	Operating costs Costs for engagement of an expert for Environment or biologist or forester	PERI contractor (hired forestry engineer), competent supervision and inspection bodies and competent inspection authorities
			WASTE			
			Pre-construction phase			
Waste	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals , etc.	Before the official start of construction activities	Proper implementation of the project and waste management in accordance with legal obligations and good practices	Construction costs Costs for engagement of an expert on environment	Contractor (hired employee or environmental expert), supervision and competent inspection authorities

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
Construction phase						
Waste	In the project office	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	Construction costs Costs for engagement of Waste Manager (~ 200 Euros per day)	Contractor (external or internal environmental expert / Waste Manager), supervision and competent inspection authorities
	In the project area, especially at locations where there are forests and forest land	Visual control of the implementation of all the measures proposed in the study and the plans	Daily by supervision Twice a week by the Waste Manager	Proper waste management in accordance with legal obligations and good practices and environmental protection	Construction costs Costs for engagement of Waste Manager (~ 200 Euros per day)	Contractor (external or internal environmental expert / Waste Manager), supervision and competent inspection authorities
Operational phase						
Waste	In the office of PERI	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Before the official start of the operational phase and monthly during the operational phase	Proper waste management in accordance with legal obligations and good practices and environmental protection	Operating costs Costs for engagement of environmental expert and waste manager	PERI (Waste Manager) and the competent inspection authorities
	In the project area	Visual control of the implementation of all the measures proposed in the study and the plans	Once a month by PERI, i.e. from Waste Manager	Proper waste management in accordance with legal obligations and good practices and environmental protection	Operating Costs for engagement of experts (employed or contracted)	PERI (Waste Manager) and the competent inspection authorities
RISKS						
Pre-construction phase						

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
Risks	In the project office	Checking the prepared project and technical documentation, plans and checklists, permits, consents, approvals, etc. by environmental experts	Before the official start of construction activities	Proper implementation of the project, protection from accidents and hazards	Construction costs Costs for engagement of an expert on environment	Contractor (hired employee or expert on the environment), supervision and competent inspection authorities
			Construction phase			
Risks	In the project office	Review of documents (project documentation, reports, Checklists for all plans, etc.).	Twice a month during the construction phase	Proper implementation of the project in accordance with legal requirements and best practices	construction costs Costs for engagement of an expert	Contractor (hired employee or expert on the environment), supervision and inspection authorities competent
	In the project area, and the environment	Visual control of the implementation of all the measures proposed in the study, measures of further elaborated project documentation and plans	Daily by supervision Twice a week by environmental expertise or more, in particular an increased risk of accidents and hazards or their occurrence	Environmental protection and health and safety implications	Construction costs Costs for engagement of an expert on environment	Contractor (hired employee or environmental expert), supervision and competent inspection authorities
			Operational phase			
Risks	In the office of PERI	Review of documents (project documentation, reports, Checklists	Before the official start of the operational phase and	Proper operation of the railway and species protection	Operating costs Costs for engagement of an expert on	PERI, authorities and inspection

Receptor / Parameter to be monitored	Where will the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		for all plans, etc.).	monthly during the operational phase		environment	
	In the project area	Visual control of the implementation of all the measures proposed in the study, measures from further elaborated project documentation and plans	Once a month by PERI, i.e. from environmental experts, or more frequently, in particular at increased risk of accidents and hazards or their occurrence	Control of measures implemented, their effectiveness and monitoring the operation of the railway	Operating costs Costs for engagement of an expert	PERI, authorities and inspection

12.2.2 Social Aspects Monitoring Program

Receptor / parameter to be monitored	Where should the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
PRE-CONSTRUCTION PHASE						
Preparation of documents for impact assessment of expropriation: - **Resettlement Policy Framework (RDP)** - **Resettlement Action Plan (RAP)**	Office and field	Review of the documentation and progress of the process of acquiring land	Once Before the official start of construction activities	Avoiding possible extensions of deadlines for the completion of construction activities and the elimination of all negative influences from expropriation	200 EUR person / day	Contractors (external evaluator)

Receptor / parameter to be monitored	Where should the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
Drafting of **Stakeholder Engagement Plan** (SEP)	office	Review of the document	Once	To avoid future potential social conflicts.	200 EUR person / day	Contractors (external evaluator)
Organization of a facility / office that will serve as the **Project Information Office**.	Office and field	Review of documentation and progress of the process of acquiring land	Once. Before the official start of construction activities	Determining whether the office meets the criteria to become an informational contact point	Calculated in the project	Contractor and PERI
Drafting of **Employment Plan (EP)**	office	Number of hired locals Control of the Registry on engaged workforce	Once, before the official start of construction activities. Register-semiannually.	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)
Drafting of an **Action Plan for social support** in the construction phase	office	Review of the final Version of the document and the signed cooperation agreement with Intermunicipal Center for Social Work-Kriva Palanka	Once before the official start of construction activities	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)
Occupational Health and Safety Plan (OHSP) with implemented grievance mechanism	office	Review of the final document Evidence from an independent advisor if OHSP is compliant	Once, before the official start of construction activities	Safety of workers	200 EUR person / day	Contractors (external evaluator)

Receptor / parameter to be monitored	Where should the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
		with the national laws				
Code of conduct for employees	office	Signed document Control of the Registry on engaged workforce	Once	Safety of workers	200 EUR person / day	Contractors (external evaluator)
Emergency Preparedness Plan (EPP)	office	complete document	Once before the official start of construction activities	Human safety	200 EUR person / day	Contractors (external evaluator)
Traffic Management Plan (TMP)	office	Review of the final document, evidence from an independent advisor if TMP is in accordance with national laws and PS World Bank	Once, before the official start of construction activities	Human safety	200 EUR person / day	Contractors (external evaluator)
Conducting a **Campaign for community safety during the construction of infrastructure projects**	office	Drafting of a document	Semiannually	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)
Training on the use, maintenance and integrity of the required PPE	office	Number of engaged employees who attended the OSH training and PPE training	Once, before the official start of construction activities	Safety of workers	5 EUR per worker	Contractors (external evaluator)
Worker Accommodation Plan	office	Final document	Once, before the official start of construction	Improving working conditions and implementing good	200 EUR person / day	Contractors (external evaluator)

Receptor / parameter to be monitored	Where should the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
			activities	international practice		
Labor issues and working conditions (Review the relevant attached documents for the current health status, qualifications, occupational safety and health and the code of conduct of the employees who will be engaged in this project)	office	Review of documents	Once. Before the official start of construction activities	To avoid potential incidents	Cost calculated in ongoing work Calculated in the Contract for supervision	PERI, supervision, State Inspectorate for Occupational Safety and Health
Recording the current state of all the houses that are located 100 meters in width along the alignment, and to document the state of all the houses.	field	Drafting of a Registry and providing photographic evidence of the condition of facilities	Before the construction phase	Implementation of mitigation measures	200 EUR person / day	Contractor
Employee training for the procedure on potential identification of an archaeological discovery and the procedures for accidental archaeological discovery	office	Number of trained workers	Signed list of participants	Implementation of mitigation measures	200 EUR person / day	Contractor
CONSTRUCTION PHASE						
Monitoring of the **Employment Plan (EP)**	office	Number of hired locals Control of the Registry on engaged workforce	Register of employees, semiannually.	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)
Monitoring of the grievance and complaints (intended for the public,	Review of the document	Drafting a Logbook	semi-annually	Noted complaints in the logbook and	Company operating costs	Contractor and PERI

Receptor / parameter to be monitored	Where should the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
employees, etc.)				responds		
Implementation of the **Stakeholder Engagement Plan (SEP)** and its accessibility to the public	Office and field	Review the Stakeholder Engagement Plan. The number and type of activities involving stakeholders should be monitored and recorded: -How many public meetings were held, -How many people attended them -What issues were discussed, -The comments / complaints refer to what issues, -In what way were they delivered, etc. -Review of documents (number and type of complaints received)	semi-annually	Reduce the risks of conflict with the local community	200 EUR person / day	Contractors (external evaluator)
Review of submitted certificates and evidence relating to acquired experience and qualifications of workers to be engaged in this project	office	List of engaged individuals and documentation for each of them	semi-annually	Safety of workers	200 EUR person / day	Contractors (external evaluator)
Implementation of the campaign for	terrain	Meetings, number of	semi-annually	Community safety	200 EUR	Contractors

Receptor / parameter to be monitored	Where should the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
community safety during the construction of infrastructure projects		informed people and their township, and other parameters identified with the campaign			person / day	(external evaluator)
Public release of the timetable of construction activities, in particular for each settlement	Office and field	Photographs taken from where the chronology of construction activities is visible Printed records of the captured images must be stored and registered in the project logbook	semi-annually	Informed local community	200 EUR person / day	Contractors (external evaluator)
Conducting a campaign for public safety and awareness	office	List of appointments and promotions held at all local schools and local community facilities	semi-annually	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)
Control of working conditions and personal protective equipment	Office and field	Taken photos from the construction site and completed checklist Printed records of captured images must be stored and registered in the project logbook	quarterly	Safety of workers	200 EUR person / day	Contractors (external evaluator)

Receptor / parameter to be monitored	Where should the parameter be monitored?	How will the parameter be monitored?	When will the parameter be monitored (frequency)?	Why will the parameter be monitored?	Price (EUR)	Responsibility
Implementation of the Action Plan for Social Support	office	Number of visits per week supported by the Intermunicipal Center for Social Work from Kriva Palanka, including a signature of workers	semi-annually	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)
Availability of the **Traffic Management Plan** in the premises of the contractor and local government	office	Visually and checklist	semi-annually	Good international practice	200 person / day	Contractors (external evaluator)
Public release of **the timeframes of construction activities** , separately for each settlement	On the field	Photographs taken from the place where there are prominent timeframes Printed records of the captured images must be stored and registered in the project logbook	semi-annually	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)
Implementation of the **Livelihood Recovery Plan (LRP)** for the persons employed on the project, and who lost their jobs after the construction phase of the project, and its accessibility to the public	Office and field	Review of the Plan. The number and type of activities included in the plan and its indicators to monitor its implementation	Once, before the end of construction activities	Reducing social risks in the local community	200 EUR person / day	Contractors (external evaluator)
Repair damaged local roads	On the field	Fixed road Visual contact	Once, at the end of construction activities	Implementation of mitigation measures	200 EUR person / day	Contractors (external evaluator)

13 IDENTIFIED GAPS DURING THE DEVELOPMENT OF THE ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY

During the preparation of the Environmental Impact Assessment Study for the construction of the new railway line Kriva Palanka-Border with the Republic of Bulgaria, as part of Corridor VIII, its developers faced the lack of data in order to provide a more detailed description of the Project activities, as well as environmental conditions. Below is an overview of the reasons for the lack of data and the consequences and the difficulties of the lack of them:

- The ESIA study was prepared on the basis of the Feasibility Study, and then information and layouts were provided, as well as part of the preliminary designs. There are no precise data on: a) the type and quantities of materials to be used in the construction phase; b) the manner of their supply, the exact locations on the borrow pits, quarries, concrete batching plants, locations for the storage of materials; c) locations for permanent waste disposal; d) number and type of vehicles and construction mechanization, manner of their maintenance, routes for the transport of materials and waste, water supply, electricity, wastewater, etc. Due to the afore mentioned, the assessment of some possible impacts was done more general;
- In order to provide clear information about incorporation of the proposed mitigation measures from the ESIA study into the Main design, a check list has been developed which was communicated within the Project team (environment experts and engineers-designers). The check list is presented in Annex 22.
- The available project documentation lacks labor force data, ie the number of engaged workers, work camp sites, work days / shifts, hours, water supply for hygiene maintenance, waste water management, generated waste management, etc. which resulted in a more general definition of possible impacts and measures to be applied;
- Lack of continuous data for monitoring of emissions and environmental quality in the environment (air, noise, soil, water)resulted in more general definition of possible impacts and measures to be applied;
- When collecting data on the current social situation and their processing, there were restrictions as a result of the institutional organization and authorizations, organization of labor, or financial reasons.

14 UPDATE OF THE ESIA STUDY

The study on environmental impact assessment for the construction of the new railway line Kriva Palanka-Border with the Republic of Bulgaria, as part of Corridor VIII, should be updated if:

- Significant changes have occurred in the alignment of the railway;
- Significant changes have occurred in the design of the railway (facilities and infrastructure);
- The conducted investigations show new conditions that may affect the environment and the community;
- Changes in the legislation have occurred, etc.

15 ANNEXES

Annex 1 Bilateral agreements between the Republic of Macedonia and the Republic of Bulgaria regarding the connection of the railway networks of both countries

ПРОТОКОЛ
од заедничката експертска средба,
на која се разгледаа техничките решенија
за поврзување на железничките линии
на Република Македонија и Република Бугарија

За извршување на точката 3 од заклучоците во протоколот од средбата на министерот за урбанизам, градежништво, сообраќај и екологија на Република Македонија и министерот за сообраќај на Република Бугарија, одржана на 19.10.1993 година, денеска [redacted] година во месноста „Паничиште" до град Дупница - Бугарија се одржа заедничка експертска средба на двете министерства, на која што се разгледаа техничките решенија за поврзување на железничките линии на Република Македонија и Република Бугарија.

Заедничката експертска средба се одржа под раководство на двата копретседатели:

- од Македонска страна - г-н Ристо Андреев, подсекретар во Министерството за урбанизам, градежништво, сообраќај и екологија;
- од Бугарска страна - г-н Николай Николов, заменик на министерот за сообраќај.

Составот на учесниците на средбата на двете страни е даден во прилозите број 1 и број 2.

Од името на Македонската страна ставови изнесе г-н Ристо Андреев, подсекретар.

Од името на Бугарската страна ставови изнесе г-н Атанас Тонев - Генерален директор на БДЖ.

Македонскиот дел на проектот го образложи г-н Драган Илиев - раководител на инвестиции при Македонските железници.

2.

Бугарскиот дел на проектот го образложи г-н Христо Велев, директор во „Жп изградба".

Врз основа на досегашните активности, анализи на варијантните решенија и соодветните проучувања, како и по обавените дискусии на заедничката експертска средба се

РЕШИ:

1. Се прифакаат образложените од македонска и бугарска страна проектните разработки за железничката врска помегу Македонија и Бугарија и се оценува како голем допринос на проектантите за постигнатиот квалитет во проектирането.

2. Поврзвунето на железничките мрежи помегу Р Македония и Р Бугарија да се изврши по правецот Куманово - Жидилово - Гуешево - Кустендил, како дел од европскиот ТЕR-коридор број 8.

3. Железничката врска да се проектира и изгради на територијата на Р Македонија за брзина од 80-100 km/h и во перспектива за 160 km/h, а на територијата на Р Бугарија за брзина од 130 km/h и во перспектива за 160 km/h, со носива способност на пругата од 23 тони/оска, ширина на колосекот 1435 mm и слободен профил за електрифицирана пруга и за комбинирани превози.

Делницата Кустендил - Гуешево - Крива Паланка да се проектира и изгради со максимален надолжен наклон до 25 ‰

4. За реализиране на железничката врска да се искористи постојниот (недовршен) граничен тунел помегу Гуешево и Жидилово.

5. Станицата Гуешево да биде проектирана и изградена како заедничка погранична станица, а во станицата Жидилово ке се врши гранична контрола.

6. Врз основа на усвоените технички параметри да се започне со изработка на главниот проект и изградба на пругата во најкраток можен

ѓск. Двете страни да ги преземат сите можни мерки за брзо и едновремено завршуване на градбата.

Истовремено да бидат реконструирани постојните делници Куманово - Белјаковци и Кустендил - Гуешево.

7. Врз основа на усвоените решенија секоја од земјите ќе изработи проектни задачи за изработка на главен проект.

8. Во согласност со постигнатите договори и решенија заедничката експертска група предлага на владите на двете земји да подготват и потпишат по можност до крајот на месец април 1994 година спогодба за изградба на железничката врска Кустендил - Куманово.

Овој протокол е составен во два идентични примероци на македонски и бугарски јазик, и двата текста имаат иста важност.

ЗА МАКЕДОНСКАТА СТРАНА:	ЗА БУГАРСКАТА СТРАНА:
....	....
(Р.Андреев - подсекретар)	(Н.Николов - зам.министер)

26 мај 1999 Службен весник на Република Македонија – Меѓународни договори Бр. 32 – Стр. 245

38.

Врз основа на член 75 ставови 1 и 2 од Уставот на Република Македонија, претседателот на Република Македонија и претседателот на Собранието на Република Македонија издаваат

УКАЗ

ЗА ПРОГЛАСУВАЊЕ НА ЗАКОНОТ ЗА РАТИФИКАЦИЈА НА СПОГОДБАТА МЕЃУ ВЛАДАТА НА РЕПУБЛИКА МАКЕДОНИЈА И ВЛАДАТА НА РЕПУБЛИКА БУГАРИЈА ЗА ПОВРЗУВАЊЕ НА ЖЕЛЕЗНИЧКИТЕ МРЕЖИ НА ДВЕТЕ ДРЖАВИ

Се прогласува Законот за ратификација на Спогодбата меѓу Владата на Република Македонија и Владата на Република Бугарија за поврзување на железничките мрежи на двете држави, што Собранието на Република Македонија го донесе на седницата одржана на 20 мај 1999 година.

Претседател
на Република Македонија,
Киро Глигоров, с.р.

Број 07-2042/1
20 мај 1999 година
Скопје

Претседател
на Собранието на Република
Македонија,
д-р Саво Климовски, с.р.

ЗАКОН

ЗА РАТИФИКАЦИЈА НА СПОГОДБАТА МЕЃУ ВЛАДАТА РЕПУБЛИКА МАКЕДОНИЈА И ВЛАДАТА НА РЕПУБЛИКА БУГАРИЈА ЗА ПОВРЗУВАЊЕ НА ЖЕЛЕЗНИЧКИТЕ МРЕЖИ НА ДВЕТЕ ДРЖАВИ

Член 1

Се ратификува Спогодбата меѓу Владата на Република Македонија и Владата на Република Бугарија за поврзување на железничките мрежи на двете држави, склучена во Скопје на 12 март 1999 година.

Член 2

Спогодбата во оригинал на македонски и на бугарски јазик гласи:

СПОГОДБА
меѓу
Владата на Република Македонија
и
Владата на Република Бугарија
за поврзување на железничките мрежи на двете држави

Владата на Република Македонија
и
Владата на Република Бугарија

подолу наречени "Договорни страни"

Сакајќи да го подобрат транспортот на стоки и патници согласно определбите во Декларациите од Втората Пан-Европска Конференција на Министрите за транспорт во Крит во 1994 година и на приоритетните транспортни коридори, предложени на Конференцијата и истите потврдени на Третата Пан-Европска Конференција во Хелсинки од 1997 година, како основа за понатамошно работење ,

Имајќи ги во предвид добрите меѓусебни односи меѓу Република Македонија и Република Бугарија како и заедничките цели за интегрирање во заедничките Европски структури,

Сакајќи да го истакнат големото значење на активностите за развојот на Пан-европски транспортен Коридор број 8, во врска со приоритетниот развој на железничките врски во рамките на изградбата на Пан-Европската транспортна мрежа.

За продолжување на веќе започнатите активности во врска со Коридорот број 8 од заинтересираните земји и од меѓународните институции (Г-24, Црноморската економска соработка, ЦЕИ, ИКЕ на ООН, Европската Конференција на Министрите за Сообраќај, Европската Унија),

Како и одговор на покажаниот интерес за развој на регионот, искажан од Соединетите Американски Држави преку иницијативата за соработка во Југо-Источна Европа (СЕЦИ) и Иницијативата за развој на Јужниот Балкан (СБДИ),

Се спогодија за следното:

Член 1

Да се изгради железничка пруга со растојание меѓу шините од 1435 мм, во правец, Ќустендил - заедничка гранична станица Ѓуешево-Бељаковци-Куманово, соодветно:

- на територијата на Република Бугарија од заедничката гранична станица Ѓуешево до границата со Република Македонија;

- на територијата на Република Македонија од границата со Република Бугарија до Бељаковци.

Член 2

Да се изврши реконструкција на постојните железнички делови, соодветно:

- на територијата на Република Бугарија - од Ќустендил до заедничката гранична станица Ѓуешево;

- на територијата на Република Македонија - од Куманово до Бељаковци.

Член 3

Проектирањето и изградбата на новите делови од железничката пруга како и реконструкцијата на постојните железнички делови да се изврши согласно одобрените технички параметри, содржани во Протоколот на Мешовитиот експертски совет, одржан на 30 март 1999 година.

Член 4

Секоја од земјите ќе го проектира , финансира и ќе го гради делот од железничката пруга на својата територија.

Бугарската страна може да учествува во изградбата на деловите и на територијата на Република Македонија.

Член 5

За усогласување и координирање на работата за поврзувањето на железничките пруги на двете држави, се формира Управен одбор, составен од претставници на двете држави.

Составот и Деловникот за работата на Управниот одбор ќе биде утврден од министрите за сообраќај на двете држави и ќе отпочне да работи по датумот на влегувањето во сила на оваа Спогодба.

Член 6

Двете страни се согласија во рок од три месеци, по датумот на влегувањето во сила на Спогодбата, да изготват динамичен план за извршување на градежните и други работи за изградбата на железничката пруга, наведена во член 1.

Двете страни се согласни при изработката на динамичниот план од став 1 да преземат активности за забрзување на изградбата на железничката пруга заради поврзување на железничките мрежи меѓу териториите на Република Македонија и Република Бугарија.

Член 7

Двете страни се согласија изградбата на железничката пруга да се изврши согласно динамичниот план од член 6.

Член 8

Роковите за реконструкција на железничките делови наведени во член 2, ќе бидат усогласувани дополнително меѓу Министерствата за сообраќај на двете држави.

Член 9

Спогодбата влегува во сила 15 дена по датумот на депонирање на вториот документ за ратификација или одобрување, согласно прописите на двете држави.

Потпишана во Скопје, на 12 март 1999 година, во два оригинални примерока, секој од нив на официјалните јазици на двете држави - македонски јазик, согласно Уставот на Република Македонија и бугарски јазик, согласно Уставот на Република Бугарија, при што и двата текста имаат иста важност.

За Владата на Република Македонија	За Владата на Република Бугарија
Александар Димитров, с.р.	Надежда Михајлова, с.р.
Министер за надворешни работи	Министер за надворешни работи

СПОГОДБА
МЕЖДУ ПРАВИТЕЛСТВОТО НА РЕПУБЛИКА МАКЕДОНИЯ И ПРАВИТЕЛСТВОТО НА РЕПУБЛИКА БЪЛГАРИЯ ЗА СВЪРЗВАНЕ НА ЖЕЛЕЗОПЪТНИТЕ МРЕЖИ НА ДВЕТЕ СТРАНИ

Правителството на Република Македония

и

Правителството на Република България

"Наричани по-долу „Договарящи страни"

Като желаят да подобрят транспорта на стоки и пътници, чрез ускоряване на прилагането на Декларациите от Втората Общоевропейска Транспортна конференция в Крит през 1994 година и на приоритетните транспортни коридори, подкрепени на конференцията и тези, приети на Третата Общоевропейска конференция на министрите на транспорта в Хелзинки през 1997 година, като основа за по-нататъшно сътрудничество,

Отчитайки, добрите взаимоотношения между Република Македония и Република България и техните общи цели за интегриране в общоевропейските структури

Като отчитат голямото значение на сътрудничеството при развитието на Общоевропейски транспортен коридор N 8, във връзка с приоритетното развитие на железопътните връзки и в рамките на изграждащата се Общоевропейска траспортна мрежа,

Като приветстват вече предприетите действия по отношение на Коридор N 8 от заинтересованите страни и от международните институции (Г-24, Черноморското икономическо сътрудничество, ЦЕИ, ИКЕ на ООН, Европейската Конференция на Министрите на транспорта, Европейския съюз),

Както и в отговор на значителния интерес за прогрес в региона, показан от Съединените американски щати чрез Инициативата за сътрудничество в Югоизточна Европа (SECI) и Инициативата за развитие на Южните Балкани (SBDI),

се споразумяха за следното:

ЧЛЕН I

Да се изгради железопътната линия с междурелсие 1435 мм по направлението Кюстендил - Обща гранична гара Гюешево - Беляковци - Куманово, съответно:

- на територията на Република България - от Обща гранична гара Гюешево до границата с Република Македония;
- на територията на Република Македония - от границата с Република България до Беляковци.

ЧЛЕН II

Да се извърши реконструкцията на съществуващите железопътни участъци, съответно:

- на територията на Република България - от Кюстендил до Обща гранична гара Гюешево;
- на територията на Република Македония - от Куманово до Беляковци.

ЧЛЕН III

Проектирането и изграждането на новите участъци от железопътната линия, както и реконструкцията на съществуващите железопътни участъци, да се извърши съгласно одобрените технически параметри, съдържащи се в Протокола на Съвместния експертен съвет, проведен на 30 март 1994 година.

ЧЛЕН IV

Всяка от страните ще проектира, финансира и изгражда частта от железопътната линия на своята територия.

Българската страна може да участва в строителството на участъка и на територията на Република Македония.

Annex 2 Notice and publishment of the enforcement of an EIA procedure and Decision on the enforcement of EIA laid down by the Ministry of Environment and Physical Planning

20 ОГЛАСИ Вечер четврток, 20 април 2017

Република Македонија
Министерство за животна средина
и просторно планирање

Информација за поднесено известување за намера за изведување на Проектот: Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија

Министерството за животна средина и просторно планирање ја известува заинтересираната јавност дека инвеститорот Министерство за транспорт и врски со седиште на ул. „Црвена Скопска Општина„ бр.4 во Скопје, достави известување за намера за изведување на проектот и утврдување на потребата од оцена на влијанието на проектот врз животната средина: Информација за поднесено известување за намера за изведување на Проектот: Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка – Граница со Република Бугарија, трасата ќе поминува на територијата на општина Крива Паланка, за потребите на Министерство за транспорт и врски од Скопје.

Трасата на оваа делница целосно ќе поминува на територијата на општина Крива Паланка, ќе започне од крајот на делницата 2 на катастарската парцела 65, во околината на село Длабочица и ќе се движи до граничниот премин Деве Баир на катастарска парцела 88,5. Оттука преку тунел бр.22, пругата преминува на територијата на Република Бугарија, кон селото Ѓушево. Должината на трасата изнесува 23,4 км.

Надлежен орган за донесување на одлуката е Министерството за животна средина и просторно планирање.

Целосното известување за намера за изведување на Проектот: Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка – Граница со Република Бугарија на територијата на општина Крива Паланка, може да се види на интернет страната на Министерството за животна средина и просторно планирање, со седиште на бул.Гоце Делчев бр. 18, 1000 Скопје. www.moepp.gov.mk

Контакт лица:
Менка Спировска–Друштво за еколошки консалтинг „ДЕКОНС–ЕМА„ ДОО
ул. „Митрополит Теодосиј Гологанов„ бр.44–1/4; тел:02 3246–402
e-mail: office@ema.com.mk

Министерство за животна средина и просторно планирање
бул. „Гоце Делчев„ бр. 18, 1000 Скопје

Александар Петковски – Помошник раководител на Сектор за животна средина
бул. „Гоце Делчев„ бр. 18, 1000 Скопје,
тел: 076455460;
e-mail: a.petkovski@moepp.gov.mk

Дејана Тодоровска –Раководител на одделение
бул. „Гоце Делчев„ бр. 18, 1000 Скопје,
тел: 076455428;
e-mail: d.todorovska@moepp.gov.mk

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Republika e Maqedonisë
Ministria e Mjedisit Jetësor dhe Planifikimit Hapësinor

Informatë për parashtrimin e lajmërimit për qëllimin e realizimit të Projektit : Ndërtimi i seksionit 3 nga Korridori i Hekurudhave VIII, Kriva Pallankë – Kufiri me Republikën e Bullgarisë

Ministria e Mjedisit Jetësor dhe Planifikimit Hapësinor e lajmëron publikun e interesuar se investuesi Ministria e Transportit dhe Lidhjeve me seli në rr. "Crvena Skopska Opshtina" nr. 4 në Shkup, dorëzoi lajmërim për qëllimin e realizimit të projektit dhe përcaktimin e nevojës nga vlerësimi i ndikimit të projektit ndaj mjedisit jetësor: Informatë për parashtrimin e lajmërimit për qëllimin e realizimit të Projektit: Ndërtimi i seksionit 3 nga Korridori i Hekurudhave VIII, Kriva Pallankë – Kufiri me Republikën e Bullgarisë, rruga do të kalojë në territorin e e komunës së Kriva Pallankës, për nevojat e Ministrisë së Transportit dhe Lidhjeve nga Shkupi.

Rruga e këtij seksioni do të kalojë tërësisht në territorin e komunës së Kriva Pallankës, do të fillojë nga fundi i seksionit 2 të kadastrës së parcelës 65, në afërsi të fshatit Dllaboçicë dhe do të lëvizë deri në vendkalimin kufitar Deve Bair në parcelën kadastrale 88.5. Prej këtu nëpërmes tunelit nr.22, hekurudha kalon në territorin e Republikës së Bullgarisë, nëpër fshatin Gjushevë. Gjatësia e rrugës është 23.4 km.

Organi kompetent për sjelljen e vendimit është Ministria e Mjedisit Jetësor dhe Planifikimit Hapësinor.

Lajmërim të plotë për qëllimin e realizimit të Projektit: Ndërtimi i seksionit 3 nga Koridori i Hekurudhave VIII, Kriva Pallankë – Kufiri me Republikën e Bullgarisë në territorin e komunës së Kriva Pallankës, mund të shihet në faqen e internetit të Ministrisë së Mjedisit Jetësor dhe Planifikimit Hapësinor, me seli në bul. Goce Dellçev nr.18, 1000 Shkup www.moepp.gov.mk.

Personat për kontakt:

Menka Spirovska – Shoqata për konsultime ekologjike "DEKONS EMA" SHPK
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Ministria e Mjedisit Jetësor dhe Planifikimit Hapësinor
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Aleksandar Petkovski – Ndihmës udhëheqës i Sektorit të Mjedisit Jetësor
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Dejana Todorovska – Udhëheqëse e Departamentit
bul. Goce Dellçev nr.18, 1000 Shkup,
tel: 076455428;
e-mail: d.todorovska@moepp.gov.mk

Република Македонија

Министерство за животна средина

Архивски бр. 11-5508/1

Дата: 14. 11. 2017

МКД СЕРТИФИКАТ
МКС EN ISO 9001:2009

[redacted]

Република Македонија
Министерство за животна средина и просторно планирање
Бул."Гоце Делчев" бр.18,

ДО : Министерство за транспорт и врски
ул. „Црвена Скопска Општина" бр.4
1000 Скопје

ПРЕДМЕТ: Доставување на решение

ВРСКА: Ваш бр. 02-2555/1 од 10.03.2017 година

Согласно Вашето известување за намера за изведување на проектот – Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка - Граница со Република Бугарија, за потребите на инвеститорот Министерство за за транспорт и врски, во прилог на овој допис Ви го доставуваме Решението со кое се утврдува потребата од оцена на влијанието на проектот - Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка - Граница со Република Бугарија, како и определениот обем на оцената на влијанието на проектот врз животната средина.

Со почит,

МИНИСТЕР
Sadulla Duraki

Изработил: Дејана Тодоровска
Контролирал: Александар Петковски
Согласен: Билјана Петкоска
Одобрил: в.д.Директор на Управа за животна средина
Билјана Зефиќ

Прилог: Решение со кое се утврдува потребата од оцена на влијанието на проектот - Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка - Граница со Република Бугарија, за потребите на инвеститорот Министерство за за транспорт и врски

МКД СЕРТИФИКАТ
МКС EN ISO 9001:2009

РЕПУБЛИКА МАКЕДОНИЈА
МИНИСТЕРСТВО ЗА ЖИВОТНА СРЕДИНА
И ПРОСТОРНО ПЛАНИРАЊЕ
Бр. 11- 5508/2 од 14. 11. 2017 година
Скопје

Врз основа на член 81 став 8 од Законот за животна средина (Службен весник на Република Македонија бр. 53/2005, 81/2005, 24/2007, 159/2008, 83/2009, 48/2010, 124/2010, 51/2011, 123/2012, 93/2013, 42/2014, 44/2015, 129/2015 и 39/2016), Министерот за животна средина и просторно планирање донесе

РЕШЕНИЕ

за утврдување на потреба од оцена на влијание врз животната средина

1. Се утврдува потребата од оцена на влијанието врз животната средина на проектот:Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка - Граница со Република Бугарија, за потребите на инвеститорот Министерство за за транспорт и врски.
2. Обемот на Студијата за оцена на влијанието на проектот врз животната средина е определен во Листата на проверка за определување на обемот на студијата за оцена на влијанието на проектот врз животната средина: прашања за карактеристиките на проектот, која е составен дел на ова решение.
3. Обемот на Студијата за оцена на влијанието на проектот врз животната средина покрај определената Листата на проверка за определување на обемот на студијата за оцена на влијанието на проектот врз животната средина, прашања за карактеристиките на проектот, треба ги опфати и прашањата кои се однесуваат на: геолошки и хидрогеолошки аспекти, влијанијата врз сите медиуми на животната средина, визуелни аспекти, биолошка разновидност, кумулативни влијанија и социо-економски аспекти.
4. Засегнатата држава, Република Бугарија е известена за намерата за изведување на проектот – Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка - Граница со Република Бугарија, која изрази интерес за учество во постапката за оцена на влијанието врз животната средина.

СЕРТИФИК
МКС EN ISO 9001:200

5. Инвеститорот Министерството за транспорт и врски е должен да ги сноси сите трошоци за вклучување на засегнатата држава во постапката за оцена на влијание врз животната средина (трошоците за превод на информациите за документацијата која се испраќа до засегнататадржава, известувањето, како и дополнителните информации се изготвуваат на официјалниот јазик на засегнатата држава, трошоците за превод на Студијата за ОВЖС која се доставува на официјалниот јазик на засегнатата држава и други трошоци утврдени со Законот за животна средина и подзаконските акти).

6. Ова Решение влегува во сила со денот на донесувањето, а ќе се објави во најмалку еден дневен весник достапен на целата територија на Република Македонија, на интернет страницата, како и на огласната табла во Министерството за животна средина и просторно планирање.

Образложение

На ден 13.03.2017 година од страна на инвеститорот Министерство за транспорт и врски со седиште на ул. „Црвена Скопска Општина“ бр.4 во Скопје,до Министерството за животна средина и просторно планирање достави известување за намера за изведување на проект - Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка - Граница со Република Бугарија.

Со реализација на проектот ќе се обезбеди поврзување на Медитеранската/Јадранската транспортна област со Црноморската трасннортна област, а ќе се олесни и потпомогне трговијата меѓу Бугарија, Македонија и Албанија преку железничкиот траспорт. Проектот ќе овозможи железничко поврзување на Македонија и Бугарија.

Трасата на оваа делница целосно ќе поминува на територијата на општина Крива Паланка, ќе започне од крајот на делницата 2 на катастарската парцела 65, во околината на село Длабочица и ќе се движи до граничниот премин Деве Баир на катастарска парцела 88,5. Оттука преку тунел бр.22, пругата преминува на територијата на Република Бугарија, кон селото Ѓушево. Должината на трасата изнесува 23,4 км.

Министерството за животна средина и просторно планирање, по добивање на известувањето пристапи кон разгледување на истата. Согласно член 81 од Законот за животна средина, постапката за утврдување на потребата од оцена на влијанијата на проектите врз животната средина се врши за проекти определени согласно член 77 од Законот за животната средина.

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МКС EN ISO 9001:2009

При утврдувањето на потребата од оцена на влијанието на проектот врз животната средина, заради изградба на пограничен тунел, се утврди дека проектот може да предизвика прекугранично влијание врз животната средина на територијата на Република Бугарија. Согласно законските обврски и Конвенцијата за оценка на влијанието врз животната средина во прекуграничен контекст (Еспо Конвенција), Министерството за животна средина и просторно планирање ја извести засегнатата држава. Република Бугарија пријави интерес и го потврди учеството во постапката за ОВЖС за проектот. Инвеститорот Министерство за транспорт и врски е должен да ги сноси сите трошоци за вклучување на засегнатата држава во постапката за оцена на вллијанието врз животната средина кои произлегиваат од Законот за животна средина (Службен весник на Република Македонија бр.53/2005, 81/2005, 24/2007, 159/2008, 83/2009, 48/2010, 124/2010, 51/2011, 123/2012, 93/2013, 42/2014, 44/2015, 129/2015 и 39/2016).

Согласно Уредбата за определување на проекти и за критериумите врз основа на кои се утврдува потребата за спроведување на постапката за оцена на влијанијата врз животната средина ("Службен весник на Република Македонија" бр. 74/05, 109/09, 164/2012 и 202/2016) предложениот проект се наоѓа во Прилог I – Проекти за кои задолжително се врши оцена на влијанијата врз животната средина, точка 7 – Изградбата на; а) железнички сообраќај на големи растојанија и на аеродроми со должина на основната писта од 2,100 м или повеќе и за истиот задолжително се спроведува постапка за оцена на влијанието врз животната средина.

За таа цел се пристапи кон пополнување на Листата на проверка за определување на обемот на студијата за оцена на влијанието на проектот врз животната средина: прашања за карактеристиките на проектот и се изврши определување на обемот на студијата за оцена на влијанието на проектот врз животната средина. Покрај прашањата опфатени во Листата на проверка за определување на обемот на студијата за оцена на влијанието на проектот врз животната средина, инвеститорот треба подетално да ги разработи следните прашања:

Геолошки и хидрогеолошки аспекти

Овие аспекти се важни во релација со животната средина во текот на фазата на изградба на овој вид на проекти. Од тие причини претставуваат важен сегмент која треба да ги опфати Студијата за ОВЖС.

Влијанијата врз сите медиуми на животната средина

Овие аспекти се важни за овој вид на проекти во релација со животната средина во текот на фазата на изградба, а особено во оперативната фаза. Од тие причини претставуваат важен сегмент која треба да ги опфати Студијата за ОВЖС

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МКС EN ISO 9001:2009

Визуелни аспекти

Овие аспекти се важни во релација со животната средина во текот на оперативната фаза и во фазата на искористување на овој вид на проекти. Од тие причини претставуваат важен сегмент на Студијата за ОВЖС, која треба да опфати ефекти врз пределот.

Биолошка разновидност

Студијата за ОВЖС треба да вклучи анализа на состојбите со билошката разновидност на подрачјето, евентуално присуство на заштитени и засегнати видови живеалишта, присуство на заштитени подрачја, евидентирани подрачја за заштита, присуство на еколошки мрежи, како и потенцијалните влијанија од спроведување на проектот.

Кумулативни влијанија

Овие аспекти се важни за овој вид на проекти во релација со животната средина во текот на фазата на изградба, а особено во оперативната фаза. Студијата за ОВЖС треба да вклучи анализа на кумулативните ефекти.

Социо-економски аспекти

Оцената на социо-економските аспекти ќе даде преглед на потенцијалните директни и индиректни ефекти од проектот врз економијата и социјалните состојби во подрачјето од спроведување на истиот.

Врз основа на горенаведеното се одлучи како во диспозитивот на ова Решение.

Правна поука: Против ова Решение инвеститорот, засегнатите правни или физички лица, како и здруженијата на граѓани формирани за заштита и за унапредување на животната средина, можат да поднесат жалба до Државна комисија за одлучување во управна постапка и постапка од работен однос во втор степен, во рок од осум дена од денот на последното направено објавување на решението согласно член 90 став (1) точка 2 од Законот за животна средина.

МИНИСТЕР

Sadulla Duraki

РЕПУБЛИКА МАКЕДОНИЈА
МИНИСТЕРСТВО ЗА ЖИВОТНА СРЕДИНА И ПРОСТОРНО ПЛАНИРАЊЕ
СКОПЈЕ

Изработил: Дејана Тодоровска

Контролирал: Александар Пековски

Согласен: Билјана Петкоска

Одобрил: в.д.Директор на Управа за животна средина

Билјана Зефиќ

Зефиќ

вечер сабота и недела, 25 и 26 ноември 2017

Република Македонија
Министерство за животна средина
и просторно планирање

[redacted]

Врз основа на член 81 став 8 од Законот за животна средина („Службен весник на Република Македонија„ бр. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 42/2014, 44/2015, 129/2015 и 39/2016), Министерот за животна средина и просторно планирање донесе

РЕШЕНИЕ

за утврдување на потреба од оцена на влијание врз животната средина

1. Се утврдува потребата од оцена на влијанието врз животната средина на проектот: Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка – Граница со Република Бугарија, за потребите на инвеститорот Министерство за транспорт и врски.

2.Обемот на Студијата за оцена на влијанието на проектот врз животната средина е определен во Листата на проверка за определување на обемот на студијата за оцена на влијанието на проектот врз животната средина, прашања за карактеристиките на проектот, која е составен дел на ова решение.

3.Обемот на Студијата за оцена на влијанието на проектот врз животната средина покрај определената Листата на проверка за определување на обемот на студијата за оцена на влијанието на проектот врз животната средина, прашања за карактеристиките на проектот, треба ги опфати и прашањата кои се однесуваат на: геолошки и хидрогеолошки аспекти, влијанијата врз сите медиуми на животната средина, визуелни аспекти, биолошка разновидност, кумулативни влијанија, водотеци и водостопански објекти и социо-економски аспекти.

4.Ова Решение влегува во сила со денот на донесувањето, а ќе се објави во најмалку еден дневен весник достапен на целата територија на Република Македонија, на интернет страницата, како и на огласната табла во Министерството за животна средина и просторно планирање.

Комплетното решение за утврдување на потребата од спроведување на постапка за оцена на влијание врз животната средина за проектот: Изградба на делница 3 од Железничкиот коридор VIII, Крива Паланка – Граница со Република Бугарија, за потребите на инвеститорот Министерство за транспорт и врски може да се види на интернет страната на Министерството за животна средина и просторно планирање.– www.moepp.gov.mk.

Правна поука: Против ова решение инвеститорот, засегнатите правни или физички лица, како и здруженијата на граѓани формирани за заштита и за унапредување на животната средина, можат да поднесат жалба до Државна комисија за одлучување во управна постапка и постапка од работен однос во втор степен, во рок од осум дена од денот на објавувањето на решението.

ЕЛЕМ
ЕЛЕКТРАНИ НА МАКЕДОНИЈА

АД ЕЛЕКТРАНИ НА МАКЕДОНИЈА - СКОПЈЕ, ДИРЕКЦИЈА
11 Октомври 9, 1000 Скопје, П.фах 16, Р. Македонија

3-553-101.01

Бр: 08 - 3753/1
Скопје, 22-06-2017

До: **„ТЕКТОН" ДООЕЛ - Скопје**
ул: „Народен фронт" бр. 5/12
1000 Скопје

Предмет: Известување за Барање податоци за постојни и планирани инсталациски водови и објекти сопственост на АД ЕЛЕМ

Почитувани,

Согласно Вашиот допис број 0302/18/4 од 21.06.2017 год., наш број 08 3744/1 од 21.06.2017 год., за изработка на EuropeAid/136050/IH/SER/MK, детален проект и тендерска документација за изградба на нова железничка делница Крива Паланка-граница со Република Бугарија, како дел од Коридорот VIII, Ве известуваме дека на предметниот проектен опфат АД ЕЛЕМ **нема** постојни и планирани инсталации и објекти, односно не располага со било какви податоци и информации за тој проектен опфат.

Со почит,

Изработил: Бранко Панчевски
Контролирал: Влатко Павлески
Одобрил: Невенка Јакимова Филиповска

ДИРЕКТОР
ЗА РАЗВОЈ И ИНВЕСТИЦИИ
м-р Александар Пауноски, дипл.ел.инж.

Ко:
- Архива
- Оддел за развој

тел.:+389 (0)2 31 49 278, факс: +389 (0)2 31 49 176; www.elem.com.mk, e-mail: contact@elem.com.mk

АЕК
РЕПУБЛИКА МАКЕДОНИЈА
АГЕНЦИЈА ЗА ЕЛЕКТРОНСКИ КОМУНИКАЦИИ

Наш број: 1404-1908/2
Скопје 04.07.2017 г.

До
ТЕКТОН-АРХИТЕКТУРА И УРБАНИЗАМ-ДООЕЛ - СКОПЈЕ
Ул.„Народен Фронт“, бр.5/12
1000 СКОПЈЕ

Предмет: Одговор за барање за податоци за ТК инсталации
Врска: Ваше барање 0302/18/5

Согласно вашето барање за доставување на податоци за изградени електронски комуникациски мрежи, а во врска со изработката на Проект за изградба на нова железничка делница К.Паланка-граница со Р.Бугарија, према доставената ситуација, во прилог ви доставуваме податоци со кои во моментов располага Агенцијата за електронски комуникации.

Прилог:
-Податоци на изградени јавни
електронски комуникациски мрежи -во електронска форма

Сектор за телекомуникации
Изработил: Ј.Србиновски
Раководител на сектор:Борис Арсов

ПО ОВЛАСТУВАЊЕ НА ДИРЕКТОРОТ:
Синиша Апостолоски

АЕК-751-801.03

www.aek.mk
ул.Кеј Димитар Влахов 21
1000 Скопје
Република Македонија
тел.: 02 32 89 200
факс: 02 32 24 611
е-пошта: contact@aec.mk

Република Македонија
Министерство за внатрешни работи

[redacted]

До:
ТЕКТОН ДООЕЛ-Скопје
ул. Народен фронт бр.5/12
1000 Скопје

Рег. бр. 11.2. 41964 / 2
Скопје 28. 06.2017 год.
07. 07. 2017

Министерство за внатрешни работи

Оддел за информатика и телекомуникации
Сектор за телекомуникации

Ул. „Димче Мирчев" 66
Скопје

Тел. (02) 3113 345
Факс:(02) 3142 434
www.mvr.gov.mk

Предмет: Одговор по барање податоци за постоечки инсталации, доставува.-
Врска: Ваш акт 0302/18/7 од 21.06. 2017 год.

Во врска со Вашето барање, Ве известуваме дека за посочената локација (железничка делница Крива Паланка-граница со Република Бугарија) немаме податоци за постоење на наши инсталации. Доколку во текот на изведување на градежните работи се појават телекомуникациони инсталации, задолжително да бидеме информирани.

Со почит,

Лице за контакт: Оливер Табаковски, тел: 070 33 66 66

Изработил: Оливер Табаковски
Контролирал: Дејан Костадинов
Одобрил: Јане Стојанов

Изработено во: 1 (еден) примерок
и 1 (една) копија и доставено до:
- Примател - примерок 1
- Архива на сектор – копија

Помошник на Министерот
Горан Трајановски

АКЦИОНЕРСКО ДРУШТВО
ГА-МА
Бр. 0308-819/2
13. 07. 2017 год.
СКОПЈЕ

"ТЕКТОН"
ул."Народен Фронт" бр.5/12
Скопје

Предмет: Потврда за подземни инсталации

По извршениот преглед на Вашата ситуација за изработка на Europe Aid/136050/IH/SER/MK детален проект и тендерска документација за изградба на железничка пруга делница Крива Паланка – граница со Република Бугарија, Ви доставуваме ситуации со дадени изведени гасоводи на предметниот локалитет. Постојат 4 пресеци на новопроектираната железничка пруга и изведените гасоводи од кои 3 со магистралниот гасовод Ф530мм и 1 со градската гасоводна мрежа за Крива Паланка Ф108мм. Ве информираме дека за два пресеци со магистралниот гасовод и еден со градската гасоводна мрежа беа изградени заштитни градби во 1996година според првата варијанта на траса за железничката пруга. Со новата траса на железничката пруга изградените заштитни градби ги избегнувате. При пресек на железничка пруга со гасоводи аголот на пресек треба да биде од 60 до 90 степени. При изградба на мостови на пресек столбовите треба да бидат на минимална оддалеченост од 5метри, а котата на стопите треба да биде пониска од котата на долниот дел на цевката на гасоводот. Доколку изведувате тунели на пресек со гасоводот потребно е да доставите ревидирани проекти за заштита на гасоводот. Ако пругата биде електрифицирана потребно е да доставите мислење за влијанието на лутачките струи на катодната заштита на гасоводот.

Ве молиме да ја проверите можноста за дислокација на трасата на железничката пруга со цел да се искористат изградените заштитни градби на гасоводот според првата варијанта на траса на пруга. Да ни доставите детални проекти на локациите на сите четири пресеци со гасовод. Да доставите ревидирани проекти за заштита на гасоводот на местата на пресек.

Ве молиме сериозно да пристапите кон проблематиката на пресеците со гасоводот бидејќи истиот е во функција и под висок притисок. Трошоците за проектната документација и изградба на евентуални заштитни граби на гасоводот се на терет на инвеститорот на железничката пруга.

Благодариме на соработката.

Со почит,
Изработил:
Сашко Петрески дипл.геод.инж.

Скопје, 13.07.2017год.

ГА-МА А.Д. - Скопје
Сектор за развој, инвестиции, проектирање, изградба и надзор
Раководител
д-р Владимир Талевски

ГА-МА

Република Македонија
Јавно претпријатие за државни патишта

Република Македонија
Јавно претпријатие за државни патишта

ЕМБС: 6839673
ул.Даме Груев бр.14
1000 Скопје,
Република Македонија

Тел. (02) 3-228-454
(02) 3-118-044
Факс: (02) 3-220-535

Бр. 10-6698/4

Дата: 14-07-2017

Скопје

До **ТЕКТОН ДООЕЛ**
ул.Народен Фронт бр.5/12
1000 Скопје

Предмет:Податоци и информации

Почитувани,

Врз основа на Вашето барање бр.0302/18/10 од 21.06.2017 год. за добивање информации за постојни и планирани наши инфраструктурни водови и градби кои се потребни за изработка на деталeн проект и тендерска документација за изградба на нова железничка делница Крива Паланка-граница со Република Бугарија, како дел од Коридорот VIII, Ве известуваме:

Стручната служба при Јавното претпријатие за државни патишта, ги разгледа пристигнатите прилози, заверени со евиденциски број на Јавното претпријатие 10-6698/3 од 10.07.2017година:

- Геореференцирана ажурирана геодетска подлога со проектен опфат и
- Прегледна карта со проектен опфат.

Од доставените и разгледани прилози констатирано е дека покрај предметниот опфат поминува планираниот автопат А2-коридор 8, делница:Романовце-ГП Деве Баир и трасата на истиот да биде земена во предвид. Дел од предметниот планскиот опфат поминува покрај магистралниот пат А2 (претходно означување М-2) за кој во плановите на Јавното претпријатие за државни патишта е предвидено негово проширување за уште една лента и истото треба да биде земено во предвид при изработка на предметниот Проект за инфраструктура.

Воедно Ве известуваме дека трасата на железничката пруга Крива Паланка-граница со Р.Бугарија на неколку места се

Република Македонија
Јавно претпријатие за државни патишта

врстува магистралниот пат А2 (М-4) и на едно место се вкрстува со регионалниот пат Р2250 (Р-207). За вкртувањата да се земат во предвид стандардите и законските нормативи за вкрстување на државен пат со железничка пруга.

Со почит,

Директор
Александар Стојанов

РЕПУБЛИКА МАКЕДОНИЈА ЈАВНО ПРЕТПРИЈАТИЕ ЗА ДРЖАВНИ ПАТИШТА СКОПЈЕ

Изготвил: Гашпарова Д.
/Советник во одделението за заштита на патишта/
Контролирал: Тевдовски Б.
/Раководител на Секторот за одржување и заштита/
Одобрил: Тошевски Р.
/Помошник Директор на Секторот за одржување и заштита/

Република Македонија
МИНИСТЕРСТВО ЗА КУЛТУРА
Управа за заштита на културното наследство
Бр. 17-2582/2
27.06.2017 год.
Скопје

ДО

ТЕКТОН ДООЕЛ СКОПЈЕ
ул. „Народен фронт" бр. 5/12
1000 Скопје

Предмет: Доставување на податоци и информации
Врска: Ваш допис бр. 0302/18/11 од 21.06.2017 година

Управата за заштита на културно наследство, орган во состав на Министерството за култура, го разгледа Вашето барање за доставување на податоци и информации за изработка на **EuropeAid/136050/IH/SER/MK Изработка на детален проект и тендерска документација за изградба на нова железничка делница Крива Паланка – граница со Република Бугарија како дел од Коридорот VIII.** Во согласност со доставената и постојната документација Управата за заштита на културно наследство констатира дека на подрачјето на планскиот опфат нема заштитени добра и добра за кои основано се претпоставува дека претставуваат културно наследство.

Потребните податоци од аспект на заштита на културното наследство во врска со член 65 од Законот за заштита на културно наследство („Сл. Весник на РМ" бр. 20/04, 71/04, 115/07, 18/11, 148/11, 23/13, 137/13, 164/13, 38/14, 44/14, 199/14, 104/15, 154/15, 192/15 и 39/16) е потребно да се вградат во планот.

Со почит,

ДИРЕКТОР
д-р Виктор Л. Адамс

Изработил: О. Зорова
Проверил: м-р С. Герасимова – Матеска
Одобрил: м-р Б. Јовановска

Адреса: „Павел Шатев" бр. 63; П. фах 220; 1000 Скопје, Р. Македонија; тел. 02/3289-700; факс 02/3289-777
contact@uzkn.gov.mk uzknrm@t-home.mk ordi@uzkn.gov.mk upkulnas@t-home.mk

Република Македонија
Влада на Република Македонија
Дирекција за заштита и спасување

[redacted]

Република Македонија
Влада на Република Македонија
Дирекција за заштита и спасување
(Подрачно одделение за заштита и спасување)
Бр: 10-7914
4.7 2017 год.
ул."Св.Јоаким Осоговски" бр.175
КриваПаланка,

Тел. (031) 376744
Факс. (031) 376744
e-mail:Krivapalanka@dzs.gov.mk

ДО ТЕКТОН ДООЕЛ
СКОПЈЕ

Предмет: Податоци и информации,
Доставува-.
Врска: Ваш акт број 0302/18/12 од 21.06.2017 година.

Врз основа на Вашето барање под горниот број и дата Ве известуваме дека Дирекцијата за заштита и спасување нема постојани и планирани инфраструктурни водови и градби на новата железничка делница Крива Паланка – граница со Република Бугарија, како дел од Коридор VIII.

ПО ОВЛАСТУВАЊЕ НА ДИРЕКТОРОТ НА ДИРЕКЦИЈАТА ЗА ЗАШТИТА И СПАСУВАЊЕ
Соработник – координатор
Зоки Павловски

Страна 2

ЈАВНО ПРЕТПРИЈАТИЕ
МАКЕДОНСКИ ЖЕЛЕЗНИЦИ
ИНФРАСТРУКТУРА

NDËRMARRJA PUBLIKE
HEKURUDHAT E MAQEDONISË
INFRASTRUKTURA

Јавно претпријатие за железничка инфраструктура
МАКЕДОНСКИ ЖЕЛЕЗНИЦИ
Бр. 2001-3368/1
10-07-2017 год.
СКОПЈЕ

До

ТЕКТОН ДООЕЛ-Скопје
Ул. Народен фронт бр.5/12-Скопје

Предмет: Податоци за постојна и планирана инфраструктура

Во врска со Вашето барање бр.0302/18/13 од 21.06.2017 год. со кое барате податоци за постојна и планирана инфраструктура на ЈП МЖ Инфраструктура, а поради изработка на EuropeAid/136050/IH/SER/MK Изработка на детален проект и тендерска документација за изградба на нова железничка делница Крива Паланка-граница со Република Бугарија како дел од коридорот VIII, Ве информираме следно:

Во посочениот проектен опфат во кој е предвидена изградба на нова железничка делница Крива Паланка-граница со Република Бугарија како дел од коридорот VIII, нема постојни инфраструктурни водови и градби сопственост на ЈП МЖ Инфраструктура-Скопје.

Со почит

Пом. Директор за пруги

Владимир Трајковски

Изработил: Љ. Арсов, дипл.гр.инж

Контролирал-одобрил: М.Тилиќ, дипл.гр.инж

Ул. „Јордан Мијалков" Бр. 50б 1000 Скопје | Rr. "Jordan Mijalkov" Nr. 50b 1000 Shkup | П. Фах. | Fahu Postal: 543
Централа | Centrali: +389 2 3 227 903 • Факс | Faks: +389 2 2 462 330 | www.mzi.mk • e-mail: info@mzi.mk

Република Македонија
Министерство за земјоделство, шумарство и водостопанство

Влада на Република Македонија
Министерство за земјоделство, шумарство и водостопанство
Управа за водостопанство
Бр.24-4524/2
28.06.2017 год.
Аминта Трети 2,
1000 Скопје,
Република Македонија
Тел: (02) 3134477
Факс: (02) 3211 997
Е-пошта: info@mzsv.gov.mk
Сајт: www.mzsv.gov.mk

"ТЕКТОН" ДООЕЛ
Ул.Народен Фронт бр.5/12
Скопје
Република Македонија

Предмет: Известување за податоци
Врска: Ваш број 0302/18/14 од 21.06.2017 година

Почитувани,

Во врска со Вашето барање податоци за постојни и планирани инфраструктурни водови и градби, а по однос на изработка на детален проект и тендерска документација за изградба на нова железничка делница Крива Паланка – граница со Република Бугарија, како дел од коридор VIII, Ве известуваме дека Управата за водостопанство е надлежна само за водостопанската инфраструктура за наводнување и одводнување, преку АД Водостопанство на Република Македонија, кое, согласно Законот за водостопанство, е надлежно за одржување и стопанисување со системите за наводнување и сдводнување.

Од овие причини, при изработка на проектот за инфраструктура треба да се добие мислење и податоци од АД Водостопанство на Република Македонија, дали во рамките на проектниот опфат постојат или се планирани водостопански објекти и инфраструктура за наводнување и одводнување. Доколку постојат или е планирана изградба на вакви водостопански објекти, при изработка на проектната документација, потребно е да се води сметка да не се наруши функционалноста на водостопанските објекти и инфраструктура за наводнување и одводнување.

Со почит,

Кадир Салих
Директор
Управа за водостопанство

Акционерско друштво за вршење на енергетски дејности
МАКЕДОНСКИ ЕНЕРГЕТСКИ РЕСУРСИ
во државна сопственост
Бр. 03-1367/2
29 06. 2017 год.
СКОПЈЕ

Акционерско друштво за вршење на енергетски дејности
МАКЕДОНСКИ ЕНЕРГЕТСКИ РЕСУРСИ Скопје во државна сопственост

ул. Максим Горки бр. 11/1-3, Скопје
тел. 02 6090-137
факс 02 6090-437
contact@mer.com.mk
www.mer.com.mk
ЕМБС: 6664903

Скопје, 29.06.2017 год.

До: **ТЕКТОН ДООЕЛ-Скопје**
Ул.Народен фронт бр5/12
1000 Скопје

Предмет: **Одговор на барање**

Врска: **Барање за постојни** и **планирани инфрактурни водови и градби, ваш бр.0302/18/15 од 21.06.2017 година.**

Почитувани,

Согласно вашето барање за постојни и планирани инфрактурни водови и градби, ваш бр.0302/18/15 од 21.06.2017 година и наш бр.03-1367/1 од 21.06.2017 година, во врска со изработка на детален проект и тендерска документација за изградба на нова железничка делница Крива Паланка-граница со Република Бугарија, како дел од Коридорот VIII.

МЕР АД Скопје, Ве известува дека на наведениот проектен опфат, нема изградено и не е планирано изградба на гасоводна мрежа.

Со почит,

Изработил:
Сашо Јовчески

Одобрил:
Оливера Костачева

Акционерско друштво за вршење на енергетски дејности МАКЕДОНСКИ ЕНЕРГЕТСКИ РЕСУРСИ во државна сопственост СКОПЈЕ

МЕР АД Скопје
Извршен директор,
Кросте Миладинов

TELEKS

ТЕЛЕКС ДООЕЛ Скопје
ЕДБ: МК4030993237796
Жиро с/ка: 300000001410319
Комерцијална Банка АД Скопје

ТЦ Буњаковец к2 л4, 1000 Скопје
Т/Ф: +3892-3118138,-3116400
info@teleks.mk http://teleks.mk

До: **ТЕКТОН ДООЕЛ Скопје**
ул.„Народен фронт“ бр.5/12
1000 Скопје, Р.Македонија

Од: ТЕЛЕКС ДООЕЛ Скопје
Дата: 23.06.2017
Допис бр: 0302-428-17

Предмет: Одговор на барање

Почитувани,

Во врска со Вашето барање број 0302/18/16 од 21.06.2017 г., доставено до нас на ден 22.06.2017 г., за информации во однос на постојни и планирани инсталации за:

- **Изработка на детален проект за изградба на нова железничка делница Крива Паланка - граница со Република Бугарија, како дел од Коридорот VIII,**

Ве известуваме дека Телекс ДООЕЛ Скопје **ИМА** подземна кабелска инфраструктура на локацијата која ја имате предвидено со овој допис и приложената ситуација, и истата е обележана со жолта боја.

Во прилог на овој допис Ви доставуваме:

- CD со подземна инсталација;

За дополнителни информации Ви стоиме на располагање.

Со почит,

Александра Лозаноска
Оддел за инфраструктура
ТЕЛЕКС ДООЕЛ Скопје

ТЕЛЕКС ДООЕЛ Друштво за изградба и комуникациски ... Увоз-извоз Скопје

СПОДЕЛИ ДОЖИВУВАЊА

МАКЕДОНСКИ ТЕЛЕКОМ АД - СКОПЈЕ
Адреса: „Кеј 13-ти Ноември" број 6, 1000 Скопје, Р. Македонија

арх.бр: 07-208675/2
дата: 13-07-2017

ТЕКТОН ДООЕЛ Скопје
Ул.Народен фронт бр.5/12, Скопје

Ваше упатување	Постојна-Планирана тк инфрастуктура проектирање
Наше контакт лице и телефон	Перо Ѓорѓевски 070 200 736 Јордан Шијаков 071 200 243
Датум	10.7.2017
Во врска со	Ваше барање бр.0302/18/16 од 21.6.2017

Почитувани,

Согласно вашето барање: со МКТ архивски број 07-208675/1 од 21.6.2017, со кое барате информации за тк инфраструктура потребни за изградба/изработка на

Вид на објект/проект: Нова железничка
Локација: Крива Паланка со Република Бугарија

Ве информираме следново :

1.На предметното подрачје има постојна тк инфраструктура

2.Планерот треба да предвиди коридор за кабелска комуникациска инфраструктура за поврзување на новопланираните објекти во согласност со Правилникот за начин и изградба на јавни електронски комуникациски мрежи и придружни средства(с.в. 106/2014, 170/2016), а притоа имајќи ја во предвид постојната кабелска комуникациска мрежа.

Истотака за делот од постојната МКТ инфраструктура која е во колизија со жел.пруга или објектите, планерот да предвиди коридор за дислокација на кабелската комуникациска инфраструктура

Прилог: Информации во електронска форма

Напомена: Информациите содржани во овој документ се доверливи и тие се наменети за користење само од страна на примателот. Примателот е обврзан да превземе разумно ниво на грижа заради заштита на доверливите информации содржани во документот. Воедно, примателот е обврзан документот или било кој дел од неговата содржина да не го открива или дистрибуира на трети лица кои не се засегнати со актуелниот предмет, а заради спречување на можни злоупотреби

Со почит,

Служба за управување со документација и телекомуникациска инфраструктура
Раководител
Николче Тасевски

Служба за планирање и инженеринг на пристапни мрежи
Раководител
Горан Јордановски
12.07.2017

Сектор за развој на мрежи и сервисни платформи
Директор
Лазар Динов
12.07.2017

МАКЕДОНСКИ ТЕЛЕКОМ
Акционерско друштво за електронски комуникации-Скопје
Кеј 13-ти Ноември 6
1000 Скопје

МАКЕДОНСКИ ТЕЛЕКОМ АД - СКОПЈЕ
Адреса: „Кеј 13-ти Ноември" број 6, 1000 Скопје, Р. Македонија
Телефон: +389 2 3100 200 | Факс +389 2 3100 300 | Контакт центар +389 2 122
E-Mail: kontakt@telekom.mk | Internet: www.telekom.mk
ЕМБС 5168660 | Основна главнина МКД 9.583.887.733,00
ISO 9001, ISO 14001 и ISO 27001 сертифицирана компанија

Annex 3 Transboundary communication within the framework of Espoo Convention

Република Македонија
Министерство за животна средина
и просторно планирање

МКД СЕРТИФИКАТ
МКС EN ISO 9001:2009

[redacted]

Република Македонија
Министерство за животна средина и просторно планирање

Бул."Гоце Делчев" бр.18,
1000 Скопје,
Република Македонија
Тел. (02) 3251 400
Факс. (02) 3220 165
Е-пошта: infoeko@moepp.gov.mk
Сајт: www. moepp.gov.mk

Архивски број: M-2504/3
Дата: 01.08. 2017

Mr Neno Dimov, minister
Ministry of Enviorment and Water
Bld. Maria Luiza n. 22, Sofia
Republic of Bulgaria

nofficial translation

Your Excellency,

According to Article 3, paragraph 1 of the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention), please find attached Notification on the intention for realization of the Project: "Construction of section 3 of rail corridor VII: Kriva Palanka- Border with the Republic of Bulgaria" on Bulgarian language.

Please inform us about you intention for participation in the environmental impact assessment procedure for realization of the Project: "Construction of section 3 of rail corridor VII: Kriva Palanka-Border with the Republic of Bulgaria", within 30 days after receipt of this notification.

Contact persons:
Daniela Rendevska, national focal point for Espoo Convention
Tel: 00 389 2 3251 438
Fax: 00 389 2 3220 165
Cell: 00 389 76 44 69 14
e-mail: danielarendevska@gmail.com

Biljana Petkoska, Head of Department for Environment
Tel: 00 389 2 3251 400
Fax: 00 389 2 3220 165
Cell: 00 389 76 45 54 27
e-mail: bspiroska@gmail.com

Sincerely yours,

MINISTER
SADULA DURAKI

РЕПУБЛИКА МАКЕДОНИЈА МИНИСТЕРСТВО ЗА ЖИВОТНА СРЕДИНА И ПРОСТОРНО ПЛАНИРАЊЕ СКОПЈЕ

Република Македонија
Министерство за животна средина
и просторно планирање

МКД СЕРТИФИКАТ
МКС EN ISO 9001:2009

[redacted]

Република Македонија
Министерство за животна средина и просторно планирање

Бул."Гоце Делчев" бр.18,
1000 Скопје,
Република Македонија
Тел. (02) 3251 400
Факс. (02) 3220 165
Е-пошта: infoeko@moepp.gov.mk
Сајт: www. moepp.gov.mk

Архивски број: 11-2504/2
Дата: ~~03. 07.~~ 2017 01. 08. 2017

До: Министерство за надворешни работи
бул. "Филип Втори Македонски" бр.7
1000 Скопје

Предмет: Барање за достава на Известување по дипломатски пат

Почитувани,

Согласно, член 93 од Законот за животна средина (Службен весник на Република Македонија бр.53/2005, 81/2005, 24/2007, 159/2008, 83/2009, 48/2010, 124/2010, 51/2011, 123/2012, 93/2013, 42/2014, 44/2015 129/2015 и 39/2016), во прилог на дописот Ви го доставуваме Известувањето за намерата за реализација на Проектот: "Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија" упатено од министерот за животна средина и просторно планирање на Република Македонија, до министерот за животна средина и води на Република Бугарија, со цел истото да го доставите по дипломатски пат.

Благодариме за соработката,

РЕПУБЛИКА МАКЕДОНИЈА МИНИСТЕРСТВО ЗА ЖИВОТНА СРЕДИНА И ПРОСТОРНО ПЛАНИРАЊЕ СКОПЈЕ

МИНИСТЕР
SADULA DURAKI

Прилог: Известување за намерата за реализација на Проектот:"Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија" во еклектонска форма (CD)

Република Македонија
Министерство за животна средина
и просторно планирање

МКД СЕРТИФИКАТ
МКС EN ISO 9001:2009

[redacted]

Република Македонија
Министерство за животна средина и просторно планирање

Бул."Гоце Делчев" бр.18,
1000 Скопје,
Република Македонија
Тел. (02) 3251 400
Факс. (02) 3220 165
Е-пошта: infoeko@moepp.gov.mk
Сајт: www. moepp.gov.mk

Архивски број: М-2504/3
Дата: 01. 08. 2017

г-дин. Нено Димов, министер
Министерство за животна средина и води
бул. Марија Луиза бр. 22, Софија
Република Бугарија

Ваша Екселенцијо,

Согласно, член 3 став 1 од Конвенцијата за оценка на влијанието врз животната средина во прекуграничен контекст (Еспо Конвенција), во прилог на дописов Ви доставуваме Известување за намерата за реализација на Проектот: "Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија", на бугарски јазик.

Ве молиме да не информирате за Вашата намера за учество во постапката за оценка на влијанието врз животната средина од реализацијата на Проектот: "Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија" за производство на електрична енергија ", во рок од 30 дена од добивањето на известувањето.

Контакт лица:

Даниела Рендевска, национално контакт лице за Еспо Конвенција
Тел: 00 389 2 3251 438
Fax: 00 389 2 3220 165
Cell: 00 389 76 44 69 14
e-mail: danielarendevska@gmail.com

Билјана Петкоска, раководител на сектор за животна средина
Тел: 00 389 2 3251 400
Fax: 00 389 2 3220 165
Cell: 00 389 76 45 54 27
e-mail: bspiroska@gmail.com

Искрено Ваш,

МИНИСТЕР
SADULA DURAKI

РЕПУБЛИКА МАКЕДОНИЈА
МИНИСТЕРСТВО ЗА ЖИВОТНА СРЕДИНА И ПРОСТОРНО ПЛАНИРАЊЕ

Примено: 18. 10. 2017

Орг. Един.	Број	Прилог	Вредност
11	5131/1		

20 год.
Потпис,

REPUBLIC OF BULGARIA

Ministry of Environment and Water

04-00-1504
05, October 2017

Subject: *Investment proposal "Construction of section 3 of rail corridor VII: Kriva Palanka-Border with the Republic of Bulgaria"*

Dear Mr Duraki,

I would like to refer to your letter № 11-2504/3/01.08.2017 received through the Embassy of the Republic of Macedonia to Sofia, notifying us about the Investment proposal "Construction of section 3 of rail corridor VII: Kriva Palanka-Border with the Republic of Bulgaria". I would like to inform you as follows:

After considering the information in the Notification of the Investment proposal "Construction of section 3 of rail corridor VII: Kriva Palanka-Border with the Republic of Bulgaria" it was found that the subject of the proposal is construction of single electrified railway on the territory of the Republic of Macedonia in the section from Kriva Palanka to the border with the Republic of Bulgaria, which is part of one of the Pan-European corridors, connecting the Adriatic Sea and the Black Sea (Corridor VIII). The railway through common tunnel № 22 close to border checkpoint Deve Bair passes over the territory of the Republic of Bulgaria to the village of Gyueshevo. Tunnel № 22 (from km 87+280 to km 89+560) is part of the proposed base and the proposed alternative route of section 3, with a length of 23.4 and 19.9 km respectively. It is envisaged that 64 trains per day with a speed of up to 100-160 km/h will pass the railway.

H. E. Mr. Sadula Duraki
Minister of Environment and Physical Planning
18 Goce Delcev Blvd.
1000 Skopje
Republic of Macedonia

Sofia 1000, 22 Maria-Luisa Blvd

Phone: +359 2 940 61 94, Fax:+359 2 986 25 33

In the documentation there is no clarity for the method of construction of the tunnel. After the consultations made the interested institutions in the Republic of Bulgaria expressed their position that implementation of the investment proposal regarding the activities on construction of the common border tunnel (tunnel № 22) may have an impact on the following groundwater bodies in West Aegean Region of River Basin Management: Porous-Fissured groundwater in Osogovo Paleogenic volcano-sedimentary complex with unique code BG4G00001Pg039 and Fissured grounwater in Vlahina-Ograzhden-Maleshevo-Osogovo metamorphic rocks with unique code BG4G001PtPz125.

In relation to the participation of the Republic of Bulgaria in the EIA procedure in a transboundary context it was pointed out that it is necessary only regarding the construction of the common border tunnel and the territory directly adjacent to it on which the construction and operation of the tunnel may have an impact.

Based on the above and in compliance with Article 3 of the Convention on EIA in a Transboundary Context I would like to notify you that we express the willingness of the Republic of Bulgaria to participate in the EIA procedure in a transboundary context for the above proposal.

I would like to take the opportunity to express my highest consideration and my willingness for fruitful cooperation.

Yours sincerely,

Neno Dimov
Minister of Environment and Water

Заместник-министър: Красимир Живков
Заповед за заместване: РД-631/27.09.2017 г.

From: **Daniela Rendevska** <danielarendevska@gmail.com>
Date: Wed, Nov 22, 2017 at 11:20 AM

Subject: Re: Re: Transboundary EIA procedure_ Project Construction of Section 3 of rail Corridor VIII: Kriva Palanka-Border with the Republic of Bulgaria
To: Silvia Dimitrova <sdimitrova@moew.government.bg>
Cc: Dejana Todorovska <naumcevska@gmail.com>, Biljana Spiroska <bspiroska@gmail.com>

Dear Ms. Dimitrova,

According to your letter from 5th of October 2017 and our email communication, we are sending to you all required documents on Bulgarian and English language. Also, we are sending to you Decision to determinate the need for EIA. All this documents you can put on your ministry internet page for informing the Bulgarian public.

Also, all this document will be send to you officially through diplomatic channels.

For all additional questions

wetransfer-6e5a41.zip

you can contact me or my colleagues, who are in cc.

Best regards,
Daniela Rendevska
Espoo focal point

On Thu, Nov 9, 2017 at 10:25 AM, Silvia Dimitrova <sdimitrova@moew.government.bg> wrote:

-------- Original Message --------

Subject: Re: Transboundary EIA procedure_ Project Construction of Section 3 of rail Corridor VIII: Kriva Palanka-Border with the Republic of Bulgaria
Date: Thu, 09 Nov 2017 11:23:53 +0200
From: Silvia Dimitrova <sdimitrova@moew.government.bg>
To: Daniela Rendevska <danielarendevska@gmail.com>
CC: Dejana Todorovska <naumcevska@gmail.com>, Biljana Spiroska <bspiroska@gmail.com>, d.todorovska@moepp.gov.mk, b.petkoska@moepp.gov.mk

Dear Ms. Rendevska,

According to your suggestion we appreciate to establish direct communication.
In relation with your questions:
1. We want to receive the Non Technical Summary and the transboundary impact chapter from the EIA report.
Please this documentation to be on English and Bulgarian language because we have to put it for 30 days on the ministry internet page for informing on the Bulgarian public.
2. After 30 days than informing Bulgarian public we may send our comments.
3. In this stage on the procedure we do not know if will have to organizing of a public hearing and where. This information we will send you with our comments to EIA documentation.
4. In our ministry does not have notification for EIA procedure for the project on our side, yet.

Best regards,

Silviya Dimitrova

```
On 27.10.2017 г. 13:24 ч., Daniela Rendevska wrote:
> Dear Ms. Dimitrova,
>
> In my capacity as a national focal point of the Espoo Convention of
> the Republic of Macedonia, I would like to confirm that we received
> your letter (your No. 04-00-1504 from 5th of October 2017) by which
> you notify us that the Republic of Bulgaria express the willingness to
> participate in the EIA procedure in a transboundary context (under
> article 3, point 3 of the Convention) for the Project: Construction of
> Section 3 of rail Corridor VIII: Kriva Palanka-Border with the
> Republic of Bulgaria, due to the possible impact of the project on the
> groundwater in Osogovo Paleogenic volcano-sedimentary complex with
> unique code BG4G0001Pg039 and Fissured ground water in
> Vlahina-Ograzhden-Maleshevo-Osogovo metamorphic rocks with unique code
> BG4G001PtPz125.
>
> In order to start with the transboundary procedure and be on time with
> the project realization, we would like to establish direct comunication.
> In this phase we would like to ask you following:
>
> 1. What is the documentation/documents you expect to receive? The
> entire EIA Report or only the Non Technical Summary (NTS) with
> transboundary impact highlighted as a separate chapter? and the
> language of the documentation (can we sent you on English or should be
> all translated on Bulgarian language)?
> 2. Deadline for comments?
> 3. Public participation (would you like to organize a public hearing
> on your territory, if yes, where? and we will need practical logistic?
> 4.Knowing that your Country is planning to invest in construction of
> the railway section Radomir-Gyueshevo-Macedonia (2017-2020) I would
> like also to ask you for the status of project preparation on BG side
> and also the status of the EIA procedure developed for the mentioned
> project. Did you make some investigation on your side and assessed the
> possible impacts?
> Looking forward to your answer,
>
> I wish you a pleasant weekend,
>
> Best regards,
>
> Daniela Rendevska
> NFP of the Espoo Convention
> Head of Unit for Multilateral Cooperation
> Ministry of Environment and Physical Planning
> Republic of Macedonia
>
```

4 Attachments

Архивски број:

Дата: ____________________

До: **г-дин. Нено Димов, министер**
Министерство за животна средина и води
бул. Марија Луиза бр. 22, Софија
Република Бугарија

Предмет: Достава на документација по однос на Студијата за оценка на влијанието врз животната средина за проект:"Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија"

Почитуван г-н Димов,

Согласно Вашиот допис со број 04-00-1504 од 05.10.2017 година, кој се однесува по Известувањето за намера за спроведување на проектот:"Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија", со кој не известувате дека ќе земете учество во постапката за оценка на влијанието врз животната средина во прекуграничен контекст, согласно Законот за животна средина (Службен весник на Република Македонија бр.53/2005, 81/2005, 24/2007, 159/2008, 83/2009, 48/2010, 124/2010, 51/2011, 123/2012 93/2013, 42/2014, 44/2015, 129/2015 и 39/2016) и ЕСПО Конвенцијата за прекуграничен контекст, во прилог на овој допис ви ги доставуваме следниве документи:

- решение за утврдување на потреба од оцена на влијание врз животната средина за проектот: "Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија";
- нетехничко резиме од Студијата за оценка на влијанието врз животната средина за горенаведениот проект на англиски јазик;
- методологијата за пробивање на заедничкиот граничен тунел бр 22, како и хидролошките аспекти на овој регион.

За сите дополнителни прашања лица за контакт од Министерството за животна средина и просторно планирање се:

Даниела Рендевска, национално контакт лице за Еспо Конвенција

Тел: 00 389 2 3251 438

Fax: 00 389 2 3220 165

Cell: 00 389 76 44 69 14

e-mail: danielarendevska@gmail.com

Билјана Петкоска, раководител на сектор за животна средина

Тел: 00 389 2 3251 400

Fax: 00 389 2 3220 165
Cell: 00 389 76 45 54 27
e-mail: bspiroska@gmail.com

Искрено Ваш,

МИНИСТЕР
SADULLA DURAKI

Прилог: Потребни документи за постапката за оценка на влијанието врз животната средина во прекуграничен контекст за проект: “Изградба на делница 3 од Железничкиот Коридор VIII, Крива Паланка - Граница со Република Бугарија“ во еклектонска форма (CD).

Annex 4 Legal framework

A) NATIONAL LEGAL FRAMEWORK

1. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCEDURE

In the context of the EIA procedure, and in accordance with the Law on environment, a *Project is a developmental document that analyses and defines the final decisions for the use of natural resources and goods, including projects aiming to use mineral resources, and it also regulates the construction of objects and installations, and analyses the implementation of other activities that have environmental, landscape and human health impact* (definition), while *"Developer/Requester" is a legal or physical person that submits a request for approval of a private project or the state authority that initiates a project.*

The types of projects and the criteria pursuant to whom the requirement for the enforcement of an EIA procedure is laid down are defined in accordance with the Chapter XI of the Law on environment and the Regulation on determination of the projects and criteria pursuant to whom the requirement for the enforcement of an EIA procedure is laid down ("Official Gazette of the Republic of Macedonia" no. 74/05, 109/09, 164/12 and 202/16). This Regulation defines two types of projects:

- Projects that are mandatory subject to an EIA procedure, which is enforced prior the publishing of the Decision on project implementation;
- Generally defined projects that may have significant environmental impact; hence the EIA procedure requirement is determined prior the publishing of the Decision on project implementation.

As it is already described in Chapter 2.2, the project for the construction of a new railway at the Section Kriva Palanka-border with the Republic of Bulgaria (Eastern branch) fits into Annex I-Projects that are mandatory subject to an impact assessment, **item 7. Construction of: (a) lines for long-distance railway traffic and of airports with a basic runway length of 2 100 m or more**, in accordance with the Regulation on determination of the projects and criteria pursuant to whom the requirement for the enforcement of an EIA procedure is laid down ("Official Gazette of the Republic of Macedonia" no. 74/05, 109/09, 164/12 and 202/16).

The list of relevant national legislation regulating the EIA procedure as well as the relevant EU policies and experience are summarized in the table below.

Relevant national legislation
• Law on environment ("Official Gazette of the Republic of Macedonia" no. 53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12, 93/13, 187/13, 42/14, 44/15, 129/15, 192/15, 39/16)
• Regulation on determination of the projects and criteria pursuant to whom the requirement for the enforcement of an EIA procedure is laid down ("Official Gazette of the Republic of Macedonia" no. 74/05, 109/09, 164/12 and 202/16)
• Rulebook on the information that the Letter of Intent for Project Implementation and the EIA procedure should contain ("Official Gazette of the Republic of Macedonia" no. 33/06)
• Rulebook on the contents of the publication of the Letter of Intent for Project Implementation, the Decision on the requirement for enforcing an EIA procedure, the Appropriateness Report on the EIA Study and the Decision on consent or rejection of the project implementation, as well as the manner of public consultation ("Official Gazette of the Republic of Macedonia" no. 33/06)
• Rulebook on the contents of the requirements that the EIA Study for the project should fulfill ("Official Gazette of the Republic of Macedonia" no. 33/06)
• Rulebook on the form, contents, procedure and way of preparing the Appropriateness Report on the EIA Study, as well as on the procedure of authorization of the persons from the List of EIA Experts that will prepare the Report ("Official Gazette of the Republic of Macedonia" no. 33/06)

• Rulebook on the amount of costs for enforcing the EIA procedure that are reimbursed by the Investor (“Official Gazette of the Republic of Macedonia” no. 116/09)
Relevant EU legislation/policies/experiences
• The EIA procedure is regulated by the EIA Directive (85/337/EEC) that came into force in 1985 and is enforced on defined public and private projects from Annex 1 (mandatory EIA procedure) and Annex 2 (discretionary power of the member states). This directive is amended three times, in 1997, 2003, and 2009, and it is transposed in the legislation of the Republic of Macedonia in Chapter XI of the Law on environment and the appropriate bylaws. In 2011 a codified version was adopted, i.e. Directive 2011/92/EU, and was amended for the last time in 2014 – Directive 2014/52/EU
• EU guidelines for EIA
• Experiences and recommendations of other countries regarding the enforcement of the EIA

The EIA procedure is enforced in several steps:

1. ***Letter of Intent for Project Implementation*** (Article 80 of the LE);

The procedure begins when the developer, intending to implement the project, submits a Letter of Intent for Project Implementation in written and electronic format to the Ministry of Environment and Physical Planning (MoEPP), which is the authority responsible for the procedure at large. MoEPP is obliged to publish the Letter of Intent in at least one daily newspaper available at the whole territory of the Republic of Macedonia and on the website of MoEPP.

2. ***Determining the necessity for enforcing an EIA*** (Articles 80 and 81 of the LE);

In this step of the procedure the MOEPP decides whether an EIA procedure should be enforced for a project. The Decision laid down by the MoEPP is published in at least one daily newspaper available at the whole territory of the Republic of Macedonia and on the website and bulletin board of MOEPP. The developer, the affected legal or physical persons, as well as the non-governmental environmental organisations may appeal against the Decision to the State Commission for deciding in administrative procedure and working relations procedure-second degree, within eight days from the date of publication of the Decision.

Simultaneously, MOEPP informs the Investor about the Decision laid down for the (non)implementation of the EIA. Based on these information, the Investor submits a request for determining the scope of the EIA.

3. ***Determining the scope of the EIA Study*** (Article 82 of the LE);

The determination of the scope is a step when MOEPP determines the contents and scope of the activities that should be covered with the EIA Study. During the preparation of the Opinion on the scope of the Study, MOEPP should consider the opinions of the Investor and the ones acquired after the publishing of the Decision for the enforcement of EIA. MOEPP notifies the Investor regarding the Decision, and a summary of it is published within five days from the day of its publishing in at least one daily newspaper available at the whole territory of the Republic of Macedonia and on the website and bulletin board of MOEPP.

4. ***Development of EIA Study*** (Article 83-84 of the LE);

After the scope has been determined, the development of the EIA Study may commence. The developer is obliged to prepare the Study and it should submit it to the MOEPP in written and electronic format. The developer engages at least one responsible person for the quality of the Study.

5. ***Public hearing and consultations with the public*** (Article 90-91 of the LE);

For the EIA Study, MOEPP should provide public hearing at least five working days before the deadline prescribed in the Article 86, paragraph (5) of the LE has expired, as well as to provide availability of the information necessary for public participation in the public hearing, in accordance with the Article 90 of the same law, and to inform the civic associations for environmental protection and improvement that originate from the place where the project will be implemented.

MOEPP keeps minutes from the public hearing and is obliged to send a copy of the minutes (together with the annexes) to the Investor, the state authorities affected by the project and the municipality, the City of Skopje and the municipalities within the City of Skopje, the territory where the project is meant to be implemented and to publish the minutes on its website.

6. ***Appropriateness Report on the EIA Study*** (Article 86 of the LE);

After the environmental impacts have been identified and assessed within the already prepared EIA Study, the procedure continues with the preparation of Appropriateness Report on the EIA Study. In this phase the focus is set on identifying and selecting the shortcomings with greater or lesser importance that may directly influence the process of decision making in relation to the quality of the Study. The Appropriateness Report on the EIA Study is prepared by the MOEPP or authorized persons identified within the List of Experts, within maximum of 60 days from the submission of the EIA Study (together with the opinions on the Study acquired from the public hearing). The Report should determine whether the EIA Study fulfills the requirements prescribed in the LE and proposes conditions that have to be determined with the permit for project implementation, as well as prevention and mitigation measures for the harmful impacts. If during the “check” of the Study some shortcomings are evident, it is returned to the Investor, which then should supplement/finalize within a maximum of 30 days.

Within 5 working days from the day of preparation of the EIA Study, the MOEPP submits the Study to the authorities responsible for the activities that the project includes and to the municipal or the City of Skopje authorities where the project is meant to be implemented and publishes the report on its website and at least in one daily newspaper available at the whole territory of the Republic of Macedonia.

7. ***Consent or rejection of the request for Project implementation*** (Art 87 of LE).

Based on the EIA Study, the Appropriateness Report on the EIA Study, the public hearing and the received opinions, the MoEPP, within a period of 40 days from the date of submission of the compliance report, lays down a decision with which it grants consent or rejects the request for implementation of the Project.

The decision contains an assessment of whether the EIA study satisfies the requirements prescribed by the Law on Environment and the conditions for issuing the permit for the implementation of the project, as well as measures for preventing and mitigating the harmful effects.

Within a period of five working days from the date of adoption of this decision, the MoEPP shall submit it to the developer, to the body of the state administration responsible for issuing the permit, ie the decision for the implementation of the project and to the municipality or the City of Skopje on whose territory the project should be Implemented. The same should be published by the MoEPP on its website and in at least one daily newspaper available on the entire territory of the Republic of Macedonia.

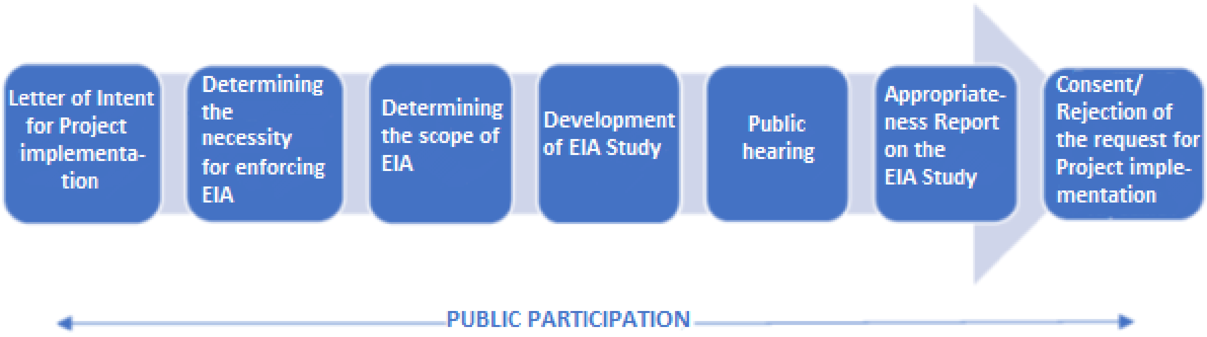


Figure 224 Flow-chart of the EIA procedure in Macedonia

***Transboundary environmental impact assessment for the project that is implemented on the territory of the Republic of Macedonia**

It has already been mentioned that due to the construction of a border tunnel, within the framework of the national procedure for environmental impact assessment, cross-border cooperation / consultation between the competent ministries of both countries (Republic of Macedonia and the Republic of Bulgaria) will be carried out in accordance with the requirements of the national legislation and the Espoo Convention (ratified by Law: "Official Gazette of the Republic of Macedonia" No. 49/1999).

Namely, the MoEPP should send a notification to the competent authority in the Republic of Bulgaria (concerned country) with information on the Project and the possible impact of the project on the environment of the neighboring country, information on the type of decision that may be taken in relation to the EIA procedure and a time limit for responding to the notification that can not be shorter than the time limit for the public to deliver opinions on the decision for determining the necessity for environmental impact assessment of the project.

If the concerned country responds that it will not participate in the EIA procedure or does not respond to the notification within the given time frame, the MoEPP shall implement the EIA procedure in accordance with the Law on Environment. If the concerned country is interested in participating in the EIA procedure, the MoEPP shall be obliged to send information on the EIA to the party concerned, including the time schedule for the submission of information and the places where the information is available to the public and information on the proposed project and possible transboundary impact.

The MoEPP is responsible for creating conditions for informing the public and for obtaining opinions and comments from the affected public of the affected country, as well as for the domestic public, in accordance with the laws of the Republic of Macedonia.

Additionally, if the affected party decides to participate in the EIA procedure, after receiving the EIA study, the MEPP must submit it to the concerned country, in the country's official language, and the procedures defined in the Espoo Convention will continue to apply.

2. SPATIAL AND URBANISTIC PLANNING

The Spatial Plan of the Republic of Macedonia ("Official Gazette of the Republic of Macedonia" No. 39/04) is a management document in the form of an integral development document that defines the spatial organization of the country and the objectives and concepts of spatial development of certain areas, as well as the conditions for their realization. The basic strategic determination is to achieve a higher level of overall functional integration of the country's space, as well as to provide conditions for significantly greater infrastructure and economic integration with the neighboring and other European countries.

From the aspect of the railway traffic in the country and the protection of the environment, part of the goals set by the Spatial Plan are:

- Construction of a transport system that will minimize the harmful effects of traffic on the environment and will help to raise the quality of life in the urban and rural areas of the country;
- Formation of transport intermodal centers as the basic points of contact between different types of transport, and as a prerequisite for building an efficient, flexible and cost-effective transport system;
- Reconstruction and construction of transport and communication networks and provision of vehicles with the use of state-of-the-art technology in the investment development, design, construction, maintenance and exploitation;
- Planning a transport system that will support and encourage the economic development and the international integration of the Republic of Macedonia;
- Continuous control for high traffic safety and protection of the environment;
- Connecting the Republic of Macedonia with all neighboring countries and the like.

In the system of European and Balkan communications, due to its location in the central part of the Balkan Peninsula, the Republic of Macedonia represents a crossroads of important communication corridors in the North-South direction (Corridor X) and in the East-West direction (Corridor VIII). The concept for the development of the railway system is based on international railway lines of international character (where the railway Kumanovo-Kriva Palanka-border with the Republic of Bulgaria is listed), regional and local lines.

3. WATER MANAGEMENT

The Law on Waters ("Official Gazette of the Republic of Macedonia" No. 87/08, 6/09, 161/09, 83/10, 51/11, 44/12, 23/13, 163/13, 180/14, 146/15, 52/16) regulates issues regarding the surface waters, including permanent or intermittent watercourses, lakes, reservoirs and springs, groundwater, riparian areas/shorelines and water habitats and their management, including the distribution of waters, protection and preservation of waters, as well as protection against the harmful effects of waters; water management facilities and services; organizational setup and financing of water management, as well as the conditions, manner and procedures under which water can be used or discharged. The objectives of this law are to provide:

- Availability of sufficient quantity of quality water;
- Protection, conservation and continuous improvement of the available water resources and progressive reduction of harmful discharges and gradual elimination of emissions of hazardous substances and materials in waters;
- Mitigation of the consequences of the harmful effects of water and the lack of water and
- Protection and promotion of the environment and nature, aquatic ecosystems and biodiversity and protection of human health.

Any action or activity that pollutes the waters or results in discharge of waste waters or failure to take action that disables water pollution or waste water discharge, is prohibited, except in cases, under conditions and in a manner determined by this Law. Any discharge into waters, riparian area/shore and wetlands shall be carried out on the basis of a permit in accordance with the criteria for water quality and environmental objectives laid down in this Law and another regulation.

Release of an effluent from industrial and agricultural liquid waste and urban wastewater, as well as waste oils in sewage or in a drainage system, in surface or underground water bodies, as well as in riparian areas and water habitats, shall be prohibited, except on the basis of the permit for discharge.

Hazardous and harmful materials and substances and their emission standards that can be discharged are prescribed by the Rulebook on hazardous and harmful materials and substances and their emission standards that can be discharged into the sewage system or in a drainage system, in surface or groundwater bodies, as well as in riparian areas and water habitats. Emission standards are particularly expressed in emission limit values as maximum concentrations of hazardous and harmful materials and substances for each industrial sector separately, for urban and industrial waste waters, the dilution factor, the method of determining emissions, the method of determining the emissions in permits and the relationship with the integrated environmental permits, indicators and standards for pollution and the level of hazard / harm, as well as the maximum quantity of materials and substances that can be released, and the time period in which they can be discharged.

In accordance with Article 112 of the Law on Waters, waste water disposal means the collection, removal, purification and discharge of wastewater from domestic and industrial effluents, as well as collected torrential waters from atmospheric precipitation in urban areas. The removal includes groundwater infiltration or irrigation of land with wastewater, as well as the removal of sludge obtained by purification of wastewater.

Water management is regulated by numerous laws and by-laws. Some of them are presented in the table below.

Relevant national legislation
• Law on Waters ("Official Gazette of the Republic of Macedonia" No. 87/08, 6/09, 161/09, 83/10, 51/11, 44/12, 23/13, 163/13, 180/14, 146/15, 52/16); • Law on drinking water supply and drainage of urban waste water ("Official Gazette of the Republic of Macedonia" No. 68/04, 28/06, 103/08, 17/11, 18/11, 54/11, 163 / 13, 10/15, 147/15, 31/16); • Decree on classification of waters ("Official Gazette of the Republic of Macedonia" No. 18/99); • Decree on the categorization of watercourses, lakes, accumulations and groundwaters ("Official Gazette of the Republic of Macedonia" No. 18/99, 71/99); • Rulebook on the detailed conditions, manner and maximum permissible values and concentrations of the parameters of purified waste waters for their reuse (*) ("Official Gazette of the Republic of Macedonia" No. 73/11); • Rulebook on the conditions, manner and emission limit values for the discharge of wastewater after its purification, the manner of their calculation, taking into account the special requirements for protection of the protection zones (*) ("Official Gazette of the Republic of Macedonia" No. 81 / 11); • Rulebook on the methodology, reference measurement methods, method and parameters of waste water monitoring, including sludge from urban wastewater treatment (*) ("Official Gazette of the Republic of Macedonia" No. 108/11); • Rulebook on hazardous and harmful materials and substances and their emission standards that can be released into the sewage system or drainage system, in surface or groundwater bodies, as well as in riparian areas/shorelines and aquatic habitats (*) (*) ("Official Journal of the Republic of Macedonia "No. 108/11); • Rulebook on the form and content of the request for non-issuance of a license ie failure to submit a decision for refusal of the application for issuing a permit for discharge ("Official Gazette of the Republic of Macedonia" No. 129/11); • Rulebook on the criteria for determining the zones sensitive to the discharge of urban wastewater (*) ("Official Gazette of the Republic of Macedonia" No. 131/11).
Relevant EU legislation/policies/experience
• Water Framework Directive (2001/60 / EC); • Directive on the treatment of urban wastewater (91/271 / EEC);

- Nitrates Directive (91/676 / EEC);
- Directive 2008/105 / EC on environmental quality standards in the field of water policy;
- Directive 2006/11 / EC on pollution caused by certain dangerous substances discharged into the aquatic environment in the Community;
- Directive 80/68 / EEC on the protection of groundwater against pollution caused by certain hazardous substances.

In the water sector, the basic planning document is the Strategy for Waters ("Official Gazette of the Republic of Macedonia" No. 122/12). The Strategy presents conclusions on the status of water with a special exploration of the general characteristics of the river basin, the status of water use, the condition of river training and protection against the harmful effects of water and the condition of water protection. Determining the status of water is the starting point for defining water management and economic goals, and consequently a program of measures that are upgraded with economic issues.

The Strategy points out that by increasing the density of road and rail traffic, the risk of incidents and environmental damage on surface and groundwater increases. For this reason, it is necessary to undertake appropriate preventive measures to reduce or prevent the risks and adverse effects.

4. WASTE MANAGEMENT

Framework law in the waste sector is the Law on Waste Management that regulates waste management; principles and objectives for waste management; plans and programs for waste management; rights and obligations of legal entities and natural persons in relation to waste management; requirements and obligations of legal entities and natural persons that produce products and packaging and which at the end of the life cycle burden the environment; the manner and conditions under which the collection, transport, treatment, storage, processing and disposal of waste can be carried out; import, export and transit of waste; monitoring; the information system; financing and supervision of waste management.

When managing the waste that will be generated during the implementation of the project for construction of a new railway line on the section Kriva Palanka-Border with the Republic of Macedonia, as part of Corridor VIII, the provisions of this Law and the relevant bylaws shall apply. Some of them are presented in the table below.

Relevant national legislation
• Law on Waste Management ("Official Gazette of the Republic of Macedonia" No. 68/04, 71/04, 107/07, 102/08, 134/08, 124/10, 51/11, 123/12, 147 / 13, 163/13, 27/14, 51/15, 146/15, 192/15, 39/16); • The Law on Ratification of the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and its Elimination ("Official Gazette of the Republic of Macedonia" No. 48/97); • Law on Management of Electrical and Electronic Equipment and Waste from Electrical and Electronic Equipment ("Official Gazette of the Republic of Macedonia" No. 6/12, 163/13, 146/15, 39/16); • Law on Management of Batteries and Accumulators and Waste Batteries and Accumulators ("Official Gazette of the Republic of Macedonia" No. 140/10, 47/11, 148/11, 39/12, 163/13, 146/15, 39/16); • Law on Packaging and Packaging Waste Management ("Official Gazette of the Republic of Macedonia" No. 161/09, 17/11, 47/11, 136/11, 6/12, 39/12, 163/13, 146 / 15, 39/16); • List of types of waste ("Official Gazette of the Republic of Macedonia" No. 100/05); • Rulebook on the procedures and manner of collection, transportation, processing, storage,

treatment and disposal of waste oils, the manner of keeping records and submission of data ("Official Gazette of the Republic of Macedonia" No. 156/07, 109/14);
- Rulebook on the general rules for dealing with municipal and other types of non-hazardous waste ("Official Gazette of the Republic of Macedonia" No. 147/07);
- Rulebook on detailed conditions for handling hazardous waste and the manner of packaging and labeling of hazardous waste ("Official Gazette of the Republic of Macedonia" No. 15/08);
- Rulebook on the form and content of the request due to non-issuance of a permit or non-submission of a decision for refusing the application for issuing a permit for collection and transportation of municipal and other types of non-hazardous waste ("Official Gazette of the Republic of Macedonia" No. 146 / 11);
- Rulebook on the form and content of the permit for collection and transportation of hazardous waste ("Official Gazette of the Republic of Macedonia" No. 118/10);
- Rulebook on the form and content of the application for obtaining a permit for processing, treatment and / or for the storage of waste, the form and content of the permit as well as the minimum technical conditions for performing the activity of processing, treatment and / or storage of waste (" Journal of the Republic of Macedonia "No. 76/07, 122/08, 126/12 and 9/13);
- Rulebook on the form and content of the permit, the application and the register for issued permits for trade with non-hazardous waste, the manner and procedure for issuing the license, the manner of keeping the records, as well as the conditions for the manner of performing the activity trade with non-hazardous waste (" Journal of the Republic of Macedonia "No. 115/07, 55/12 and 41/13);
- Rulebook on the procedures and manner of collection, transportation, processing, storage, treatment and disposal of waste oils, the manner of keeping records and submission of data ("Official Gazette of the Republic of Macedonia" No. 156/07 and 109/14);
- Rulebook on the content and manner of keeping and maintaining records in the waste register ("Official Gazette of the Republic of Macedonia" No. 39/09);
- Rulebook on the manner and conditions for functioning of the integrated network for waste disposal ("Official Gazette of the Republic of Macedonia" No. 7/06);
- Rulebook on the form and content of the application form and the required documentation, the form and content of the permit for collection and transportation of communal and other types of non-hazardous waste, as well as the minimum technical conditions for performing the activity collection and transportation of municipal and other types of non-hazardous waste ("Official Gazette of the Republic of Macedonia" No. 87/15);
- Rulebook on the quantity of biodegradable ingredients in the waste that can be deposited ("Official Gazette of the Republic of Macedonia" No. 108/09, 142/09).

Relevant EU legislation/policies/experience

- Waste Framework Directive (2006/12 / EC);
- Hazardous Waste Directive (91/689 / EEC);
- Directive on waste oils (75/439 / EEC);
- Decision 2000/532 / EC on establishing a list of waste types.

5. AIR QUALITY

The legal framework in the air sector in the country consists of the Law on Protection of ambient air and relevant bylaws.

The Law on Ambient Air Protection regulates measures to avoid, prevent or reduce harmful effects of ambient air pollution on human health and the environment as a whole by setting limits and target values for ambient air quality and alarming thresholds and information, limit and target values for emissions, forming a single system for monitoring and control of air quality and monitoring of sources of emissions, a comprehensive system for managing the quality of ambient air and emission sources, information system, as well as other measures for protection against certain activities of legal entities and natural persons that have a direct or indirect impact on the quality of ambient air.

The sources of ambient air pollution may be:

- Installations in which technological processes take place, waste incineration, energy production (stationary sources);
- internal combustion engines built into nepatni mobile machinery, locomotives, ships and aircraft (nepatni mobile sources);
- internal combustion engines incorporated in vehicles (mobile sources);
- combustion of all types of fuels and
- natural phenomena.

Relevant national legislation
• Law on Ambient Air Quality ("Official Gazette of the Republic of Macedonia" No. 67/04, 92/07, 35/10, 47/11, 59/12, 100/12, 163/13, 10/15, 146 / 15);
• Law on Ratification of the United Nations Framework Convention on Climate Change ("Official Gazette of the Republic of Macedonia" No. 61/97);
• Law on Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change ("Official Gazette of the Republic of Macedonia" No. 49/04);
• Decree on limit values for levels and types of pollutants in ambient air and alert thresholds, deadlines for achieving limit values, margins of tolerance for limit value, target values and long-term goals (Official Gazette of the Republic of Macedonia No. 50 / 05, 4/13);
• Rulebook on the quantities of the upper limits - the ceilings of the emission of polluting substances for the purpose of determining projections for a certain period of time that refer to the reduction of the quantities of pollutant emissions on an annual basis ("Official Gazette of the Republic of Macedonia" No. 2 / 10, 156/11, 111/14);
• Rulebook on the methodology, modes, procedures, methods and means for measuring emissions from stationary sources (*) ("Official Gazette of the Republic of Macedonia" No. 11/12);
• Rulebook on the limit values for the permitted levels of emissions and types of pollutants in the waste gases and vapors emitted from stationary sources in the air (*) ("Official Gazette of the Republic of Macedonia" No. 141/10);
• Rulebook on the methodology for inventory and determination of the level of emissions of pollutants in the atmosphere in tons per year for all types of activities, as well as other data for the submission of the air monitoring program of Europe (EMEP) ("Official Gazette of the Republic of Macedonia" No. 142/07);
• List of zones and agglomerations for ambient air quality ("Official Gazette of the Republic of Macedonia" No. 23/09);
• Rulebook on the quantities of the upper limits for the emission of pollutants for the purpose of determining projections for a certain period of time that refer to the reduction of the quantities of pollutant emissions on an annual basis ("Official Gazette of the Republic of Macedonia" No. 2/10, 156/11 and 111/14);
• Rulebook on the quality of liquid fuels (Official Gazette of the Republic of Macedonia No. 88/07,

91/07, 97/07, 105/07, 15/08, 78/08, 156/08 and 81/09); • Rulebook on the content and manner of transmission of data and information on the conditions in the ambient air quality management ("Official Gazette of the Republic of Macedonia" No. 138/09); During the implementation of the project, the findings of the National Plan for Ambient Air Protection in the Republic of Macedonia for the period 2013-2018 ("Official Gazette of the Republic of Macedonia" No. 170/12) should also be taken into account.
Relevant EU legislation/policies/experience
• Ambient Air Quality Framework Directive (2008/50 / EC); • Directive 2000/69 / EC on limit values for benzene and carbon monoxide in ambient air; • Directive 2002/3 / EC on ozone in ambient air; • Directive 1999/30 / EC on limit values for sulfur dioxide, nitrogen dioxide and nitrogen oxides, suspended particulates and lead in ambient air; • Directive 2004/107 / EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

6. NOISE

The provisions of the Law on protection against noise in the environment refer to:

- noise in the environment where people are exposed to: agglomeration, zone, quiet areas in agglomeration, quiet area in nature, as well as in the environment of specific educational, health and recreational facilities and / or areas of special interest,
- assessment, management and control of noise caused by road, rail, air and water transport vehicles, noise generated in the neighborhood and open space, as well as noise in the open space caused by installations and industrial plants, including the categories Of economic activities,
- Determination of the level of noise exposure through noise recording with assessment methods and development of strategic noise maps,
- Preparation of action plans for noise and acoustic planning based on the results of the noise monitoring, in order to prevent and reduce noise where possible, and especially in cases when exceeding the noise limit values can cause anxiety and harmfulness Impacts on human health or to maintain the value of the noise indicator in areas in which the highest limit values are not exceeded,
- the right to provide access and provide information to the public on the state of the noise and
- Realizing the rights and obligations of: state bodies and units of local self-government, legal and natural persons and citizens for the assessment, management and control of environmental noise.

Relevant national legislation
• Law on Protection against Environmental Noise ("Official Gazette of the Republic of Macedonia" No. 79/07, 124/10, 47/11, 163/13, 146/15); • Rulebook on the use of noise indicators, additional noise indicators, the method of noise measurement and assessment methods with the environmental noise indicators ("Official Gazette of the Republic of Macedonia" No. 107/08); • Rulebook on limit values for the level of noise in the environment ("Official Gazette of the Republic of Macedonia" No. 147/08); • Rulebook on the detailed conditions for the necessary equipment that should be possessed by

authorized scientific professional organizations and institutions, as well as other legal and natural persons, for carrying out certain expert works for noise monitoring ("Official Gazette of the Republic of Macedonia" No. 152 / 08);

- Rulebook on the closer types of special noise sources, as well as the conditions that need to be fulfilled by facilities, equipment, installations and devices used in the open space in terms of noise emitted and noise protection standards (1) ("Official Gazette of the Republic of Macedonia" Republic of Macedonia "No. 142/13);
- Rulebook on the locations of measuring stations and measuring points ("Official Gazette of the Republic of Macedonia" No. 120/08);
- Decision on determining in which cases and under what conditions the peace of the citizens against harmful noise is disturbed ("Official Gazette of the Republic of Macedonia" No. 1/09, 38/13).

Relevant EU legislation/Policies/Experience

- Directive 2002/49 / EC on the assessment and management of environmental noise;
- Directive 2000/14 / EC on noise emissions from external equipment.

7. NATURE PROTECTION

In 2004, the Law on Nature Protection was adopted, which regulates the protection of biological and landscape diversity and protection of natural heritage, in protected areas and outside protected areas. The Republic of Macedonia has also ratified numerous international agreements that are part of the legal system for nature protection in the country.

In addition, the Emerald Network is a network of areas of special interest for conservation designated for the purpose of preserving the natural habitat network and is developed in the territory of the Member States of the Berne Convention. The main motive for the development of this network is to contribute to the Natura 2000 ecological network in non-EU countries using the most appropriate and most similar methodological approach. The activities for development of the national Emerald network in the Republic of Macedonia were carried out in the period 2002-2008. A total of 35 areas are included in the national Emerald Network, representing about 29% of the territory of the Republic of Macedonia (MEPP, 2008).

Relevant national legislation

- Law on Nature Protection ("Official Gazette of the Republic of Macedonia" No. 67/06, 14/06, 84/07, 35/10, 47/11, 148/11, 59/12, 13/13, 163 / 13, 27/14, 41/14, 146/15, 39/16, 63/16);
- Legal acts for proclamation of protected areas in accordance with the Law on Nature Protection;
- Law on Ratification of the Bonn Convention on the Protection of Migratory Species of Wild Animals ("Official Gazette of the Republic of Macedonia" No. 38/99);
- Law on Ratification of the Berne Convention for the Protection of Wildlife and Natural Habitats in Europe ("Official Gazette of the Republic of Macedonia" No. 49/97);
- Law on Ratification of the Convention on International Trade in Endangered Species of Wild Fauna and Flora-CITES Convention ("Official Gazette of the Republic of Macedonia" No. 82/99);
- Law on Ratification of the London Agreement for the Protection of Bats in Europe ("Official Gazette of the Republic of Macedonia" No. 38/99);
- Decree on the ratification of the Convention for the Protection of Wetlands with International Importance for the Protection of Aquatic Birds (RAMSAR) ("Official Gazette of the Republic of Macedonia" No. 9/77).

Relevant EU legislation/Policies/Experience

- Directive 92/43 / EEC on the conservation of natural habitats of wild fauna and flora;
- Directive 2009/147 / EC on the conservation of wild birds;
- European Convention on the Landscape (Florence), 2003;
- Convention on Biological Diversity (Rio de Janeiro), 1992;
- Convention on the Protection of Migratory Species of Wild Animals (Bonn), 1979;
- Convention on Wetlands of International Importance, Particularly as Aquatic Habitats (Ramsar), 1971;
- Convention on the Conservation of Wild Fauna and Flora in Europe and Natural Habitats (Bern), 1972;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, DC - CITES Convention), 1973;
- Agreement for the Protection of Bats in Europe (London), 1991.

8. SOIL PROTECTION

Soil represents a very important natural and economic resource, especially for the agriculture and forestry sectors. The impacts on soil caused by human activities are constantly increasing and lead to serious problems in soil management. In the Second National Environmental Action Plan, the following are prominent: soil degradation, absence of permanent monitoring, partial policy for soil protection, low level of education and public awareness in the area of soil protection, illegal exploitation of forests and forest fires, and the like.

Soil protection in the Republic of Macedonia is covered by several laws, including those relating to the environment, nature, water, forests and waste management. However, in the Republic of Macedonia, the need for adopting a special law that will treat the soil from several aspects as an environmental medium is increasingly imposed.

9. PROTECTION OF CULTURAL HERITAGE

The cultural heritage and its protection is regulated by the Law on Protection of Cultural Heritage. This law specifies the types, categories, identification, methods of protection and other instruments for protection of cultural heritage, the regime of protection and use of cultural heritage, the rights and duties of the holders and the restrictions on the right to ownership of cultural heritage in public interest, organization, coordination and supervision, professional titles and other issues that are of importance for the unity and functioning of the system for protection of cultural heritage in the Republic of Macedonia.

Relevant national legislation

- Law on Protection of Cultural Heritage (Official Gazette of the Republic of Macedonia No. 20/04, 71/04, 115/07, 18/11, 148/11, 23/13, 137/13, 164/13, 38 / 14, 44/14, 199/14, 104/15, 154/15, 192/15, 39/16);
- Law on Ratification of the Council of Europe Framework Convention on the Importance of Cultural Heritage in the Society ("Official Gazette of the Republic of Macedonia" No. 25/11);
    - Law on Ratification of the Convention for the Protection of the Intangible Cultural Heritage ("Official Gazette of the Republic of Macedonia" No. 59/06);
  - Manual for the National Register of Cultural Heritage (("Official Gazette of the Republic of Macedonia" No. 25/05);
  - Law on Monuments ("Official Gazette of the Republic of Macedonia No. 66/04, 89/08 and 152/15);
  - Law on Museums ("Official Gazette of the Republic of Macedonia" No. 66/04, 89/08, 116/10, 51/11, 88/15 and 152/15).

Relevant international legislation/Policies/Experience
• Convention on the Protection of World Cultural and Natural Heritage, UNESCO, 1972

10. LEGAL AND POLITICAL FRAMEWORK ON THE SOCIAL ASPECTS

The Republic of Macedonia is a signatory of numerous international human rights conventions-the United Nations and the Council of Europe. The legislation of the Republic of Macedonia is moving towards full harmonization with the existing EU directives. Several areas of the project are fully covered.

The area of community safety and health is covered in the Macedonian legislation with the following legal acts: Law on Construction, Law on Road Safety, Public Health Law, Law on Transport of Dangerous Materials, Law on Prevention of Diseases etc. The issues of community safety and health are covered by other issues such as noise and vibration, work and working conditions, air quality, climate and hydrology, the Law on Protection and Rescue, the Law on Crisis Management, the Law on Social Security, the Law on Dwelling, the Law on Equal Opportunities for Women and Men, the Law on Traffic and Road Safety.

The Macedonian Law on Occupational Health and Safety (LOHS) and the associated legislation requires employers to take all necessary measures and maintain acceptable working conditions. The Law on Labor Relations regulates relations with regard to the workforce and employees. Employees must adhere to and comply with all prescribed occupational health and safety measures, while the employers:

- must inform employees of the occupational risks and the preventive measures that must be taken to prevent those risks;
- must inform employees of their legal rights and obligations and to provide them with training in health protection at work;
- are responsible for creating a safe working environment and must supply all employees with the necessary protective equipment;
- must regularly check the same and other safety equipment at work, and ensure that it is in good working order;
- must take the necessary measures to protect against occupational diseases;
- must prepare a plan for protecting the health and safety of workers before the start of construction work.

Other issues covered by the Macedonian legislation are trade unions, working hours, pension and disability insurance, labor inspection, fees and minimum wages, health care, protection against all types of discrimination at the workplace and other issues.

The Expropriation Law regulates procedures for expropriation of properties for projects of public interest and related property rights (of the land). Other legal documents covering the regulation of land ownership rights include: the Law on privatization and the lease of construction land, the Law on construction land, the Law on agricultural land, the Law on property and other material and other rights.

The implementation of the project will follow the framework laws and regulations of the Republic of Macedonia (RM) and the applicable policies and standards of the involved international financial institutions.

A) LABOR AND WORKING CONDITIONS LEGAL FRAMEWORK

Labor and working conditions are considered one of the most important social issues in the Republic of Macedonia. Since its independence, the Republic of Macedonia has signed 75 of the 77 conventions with the ILO (one is withdrawn and the other is not applicable because the Republic of Macedonia is a landlocked country).

Most of the conventions were integrated either within the Law on Labor Relations or within the Law on Occupational Safety and Health. Other laws regulating labor relations are the following: Labor Inspection Law, Employment and Unemployment Insurance Act, Law on Employment of Disabled Persons, Law on Social Protection.

There is a series of by-laws and regulations covering the issues identified in these two laws. The basic legislation covering labor and working conditions is shown in the table below.

The Law on Labor Relations, as a pillar of labor relations legislation, determines the working relationship between the employee and the employer, based on the employment contract. In detail, the Law regulates all specific rights and obligations of each of them, the employee and the employer, when concluding the employment contract and during its implementation, and in particular those relating to the performance of the work.

The main points considered by the Law on Labor Relations are the following:

- The right of trade unions and their associations to strike for the protection of economic and social rights of their members;
- Issues related to trade unions and employers' associations;
- The right of workers to freely establish trade unions and become members under the conditions laid down in the rulebook of the given trade union;
- Rights and obligations in the course of the strike;
- Collective agreements;
- peaceful resolution of individual and collective disputes in the field of labor relations;
- Special protection for older workers;
- Protection of workers under the age of 18, protection of persons with disabilities and the right of their professional rehabilitation;
- Prohibition of performing work during pregnancy and after delivery;
- Special protection during pregnancy, right of paid leave during pregnancy, during childbirth and parental care;
- The right of women workers to return to work after the absence due to pregnancy, childbirth and parental care;
- The right to use parental leave for fathers or absence due to custody of a child;
- Right of part-time work for a parent of a child with developmental disabilities and special educational needs.

The basic relevant legal framework in the area of labor and working conditions is presented in the following table.

Relevant national legislation
• Law on Health Care ("Official Gazette of the Republic of Macedonia" No. 43/12, 145/12, 87/13, 164/13, 39/14, 43/14, 132/14, 188/14, 10/15 , 61/15, 154/15, 192/15, 17/16, 37/16);
• Law on Occupational Health and Safety ("Official Gazette of the Republic of Macedonia" No. 92/07, 136/11, 23/13, 25/13, 137/13, 164/13, 158/14, 15/15, 129/15, 192/15, 30/16);
• Law on Protection and Rescue ("Official Gazette of the Republic of Macedonia" No. 36/04, 49/04, 86/08, 124/10, 18/11, 41/14, 129/15, 71/16);
• Law on Labor Relations ("Official Gazette of the Republic of Macedonia" No. 92/07, 163/11, 53/13, 137/13, 23/13, 25/13, 164/13, 158/14, 15/15 , 72/15, 74/15, 129/15, 167/15, 27/16);
• Law on Labor Inspection ("Official Gazette of the Republic of Macedonia" No. 35/1997, 25/2002, 29/11, 164/13, 147/15);

- Law on Employment and Insurance against Unemployment ("Official Gazette of the Republic of Macedonia" No. 112/14 and 154/15);
- Law on Protection from Harassment at the Workplace ("Official Gazette of the Republic of Macedonia" No. 79/13, 147/15);
- Law on salaries ("Official Gazette of the Republic of Macedonia" No. 26/13, 170/13, 139/14, 147/15);
- Law on Employment and Work of Foreigners ("Official Gazette of the Republic of Macedonia" No. 70/07, 5/09, 35/10, 148/11, 84/12, 38/14)
- Decree on the type, manner, scope and price list of the health examinations of the employees ("Official Gazette of the Republic of Macedonia" No. 60/13, 168/14);
- Rulebook on the minimum requirements for occupational safety and health at temporary and mobile construction sites ("Official Gazette of the Republic of Macedonia" No. 108/08);
- Rulebook on the minimum requirements for the safety and health of employees potentially exposed to the risk of explosive atmospheres ("Official Gazette of the Republic of Macedonia" No. 116/07);
- Rulebook on the minimum requirements for safety and health of the employees in the working space ("Official Gazette of the Republic of Macedonia" No. 154/08);
- Rulebook on personal protective equipment used by employees during their work ("Official Gazette of the Republic of Macedonia" No. 116/07);
- Rulebook on occupatinal safety and health during the operation of the working equipment ("Official Gazette of the Republic of Macedonia" No. 116/07);
- Rulebook on signs for occupational safety and health ("Official Gazette of the Republic of Macedonia" No. 127/07);
- Rulebook on the minimum requirements for the safety and health of employees from the risks related to exposure to asbestos at work ("Official Gazette of the Republic of Macedonia" No. 50/09);
- Rulebook on occupational safety and health for employees at risk of mechanical vibration ("Official Gazette of the Republic of Macedonia" No. 26/08);
- Rulebook on occupational safety and health for employees at risk of noise ("Official Gazette of the Republic of Macedonia" No. 21/08), etc.

Relevant EU legislation/Policies/Experience

- Framework directive on occupational safety and health (89/391 / EEC);
- Directive 89/654 / EEC on minimum occupational safety and health requirements;
- Directive 2009/104 / EC on minimum occupational safety and health requirements for use of work equipment;
- Directive 89/656 / EEC on minimum occupational safety and health requirements for use of personal protective equipment etc.

B) FRAMEWORK ON SOCIAL ISSUES

Social care and protection in the Republic of Macedonia consists of services and benefits of the system of social protection, financed by taxes (Social Prevention, which according to the Law on Social Protection includes educational and advisory activity, development of forms of self-help, volunteer work and so on. , institutional care, and financial assistance) and a system based on social insurance (pensions and disability, health and unemployment insurance).

The Law on Pension and Disability Insurance defines the mandatory pension insurance of the employees with a working contract, as well as other persons performing an activity, the fundamentals of the pension insurance based on capital, as well as the special conditions for certain categories of insured persons to implement the right to a pension, as well as to receive a disability allowance. The rights arising from retirement and disability insurance are the following: the right to old age pension, the right to disability pension, the right to transfer to other more appropriate jobs, the right to adequate employment, the right to retrain or increase the qualification and the right to adequate financial compensation, the right of family pension, the right to monthly compensation for physical damage, and the right to a minimum pension.

The key point, from a social point of view, relevant to this project in the Housing Law (Law on Dwelling) is that it provides for the possibility of renting state-owned housing for socially endangered and homeless persons, in accordance with the Law on Social Protection. Among other things, the Law addresses the issue of social housing and housing of vulnerable groups (children without parents or parental care, beneficiaries of social and permanent assistance, persons affected by natural disasters, disabled people and persons in need of care of another person, socially vulnerable persons from the Roma community, single parents with minor children).

The Law on Equal Opportunities for Women and Men defines the basic and special measures for establishing equal opportunities for women and men, the competencies, tasks and responsibilities of the responsible actors for securing equal opportunities, the procedures for determining the unequal treatment of women and men, and Related issues. It aims to promote the principles of establishing equal opportunities for women and men in the political, economic, social and educational spheres, as well as in other areas of social life.

Relevant national legislation
• Law on Social Protection ("Official Gazette of the Republic of Macedonia" No. 79/09, 148/13, 164/13, 187/13, 38/14, 44/14, 116/14, 180/14, 33/15 , 72/15, 104/15, 150/15, 173/15, 192/18 and 30/16); • Law on Pension and Disability Insurance ("Official Gazette of the Republic of Macedonia" No. 53/13, 170/13, 43/14, 44/14, 97/14, 113/14, 160/14, 188/14, 20 / 15, 61/15, 97/15, 129/15, 147/15, 154/15, 173/15, 217/15, 27/16, 120/16, 132/16); • Law on Housing ("Official Gazette of the Republic of Macedonia" No. 99/09, 57/10, 36/11, 54/11, 13/12, 55/13, 163/13, 42/14, 199/14, 146/15, 31/16); • Law on Health Care ("Official Gazette of the Republic of Macedonia" No. 43/12, 145/12, 87/13, 164/13, 39/14, 43/14, 132/14, 188/14, 10/15 , 61/15, 132/15, 154/15, 192/15, 37/16); • Law on Public Health ("Official Gazette of the Republic of Macedonia" No. 22/10, 136/11, 144/14, 149/15, 37/16); • Law on Sanitary and Health Inspection ("Official Gazette of the Republic of Macedonia" No. 71/06, 139/08, 88/10, 18/11, 53/11, 164/13, 43/14, 144/14, 51 / 15, 150/15, 37/16); • Law on Equal Opportunities for Women and Men ("Official Gazette of the Republic of Macedonia" No. 06/12, 166/14, 150/15, 201/15), etc.

B) LEGAL FRAMEWORK ON LAND EXPROPRIATION AND ACQUISITION

In the Republic of Macedonia, the following legal acts regulate the issues for the acquisition of land parcels privately owned by the state, on the basis of public interest and need:

Relevant national legislation
• Law on Expropriation ("Official Gazette of the Republic of Macedonia" No. 95/12, 131/12, 24/13, 27/14, 104/15, 192/15, 23/16, 178/16); • Law on Privatization and Hire of Construction Land (Official Gazette of the Republic of Macedonia No. 4/05, 13/07, 165/08, 146/09, 18/11, 51/11, 27/14, 144/14 , 72/15, 104/15, 153/15, 23/16, 178/16); • The Law on Construction (Official Gazette of the Republic of Macedonia No. 130/09, 124/10, 18/11, 36/11, 54/11, 13/12, 144/12, 25/13, 70/13, 79/13, 137/13, 150/13, 163/13, 27/14, 28/14, 42/14, 115/14, 149/14, 187/14, 44/15, 129/15, 217 / 15, 226/15, 30/16, 31/16, 39/16, 71/16, 132/16); • Methodology for estimating the market value of the land ("Official Gazette of the Republic of Macedonia" no.54 / 12); • Manual on the method of cadastral classification and determination, and registration of changes in cadastral cultures and type of land ("Official Gazette of the Republic of Macedonia" No. 144/13); • Law against illegal buildings ("Official Gazette of the Republic of Macedonia" No. 54/11, 155/12, 53/13,

72/13, 44/14 and 115/14); • Law on Property and Other Property Rights ("Official Gazette of the Republic of Macedonia" No. 18/01, 99/08, 139/09, 35/10); • Law on appeals procedures and proposals ("Official Gazette of the Republic of Macedonia" No. 82/2008, 13/13); • Manual on the manner of handling complaints and proposals ("Official Gazette of the Republic of Macedonia" No. 2/09); • Law on Cadastre of Properties ("Official Gazette of the Republic of Macedonia" No. 40/08, 158/10, 51/11).

11. OTHER RELEVANT LEGISLATION

In addition to the aforementioned, the table below also presents laws in other areas that may be relevant in the development of the ESIA Study.

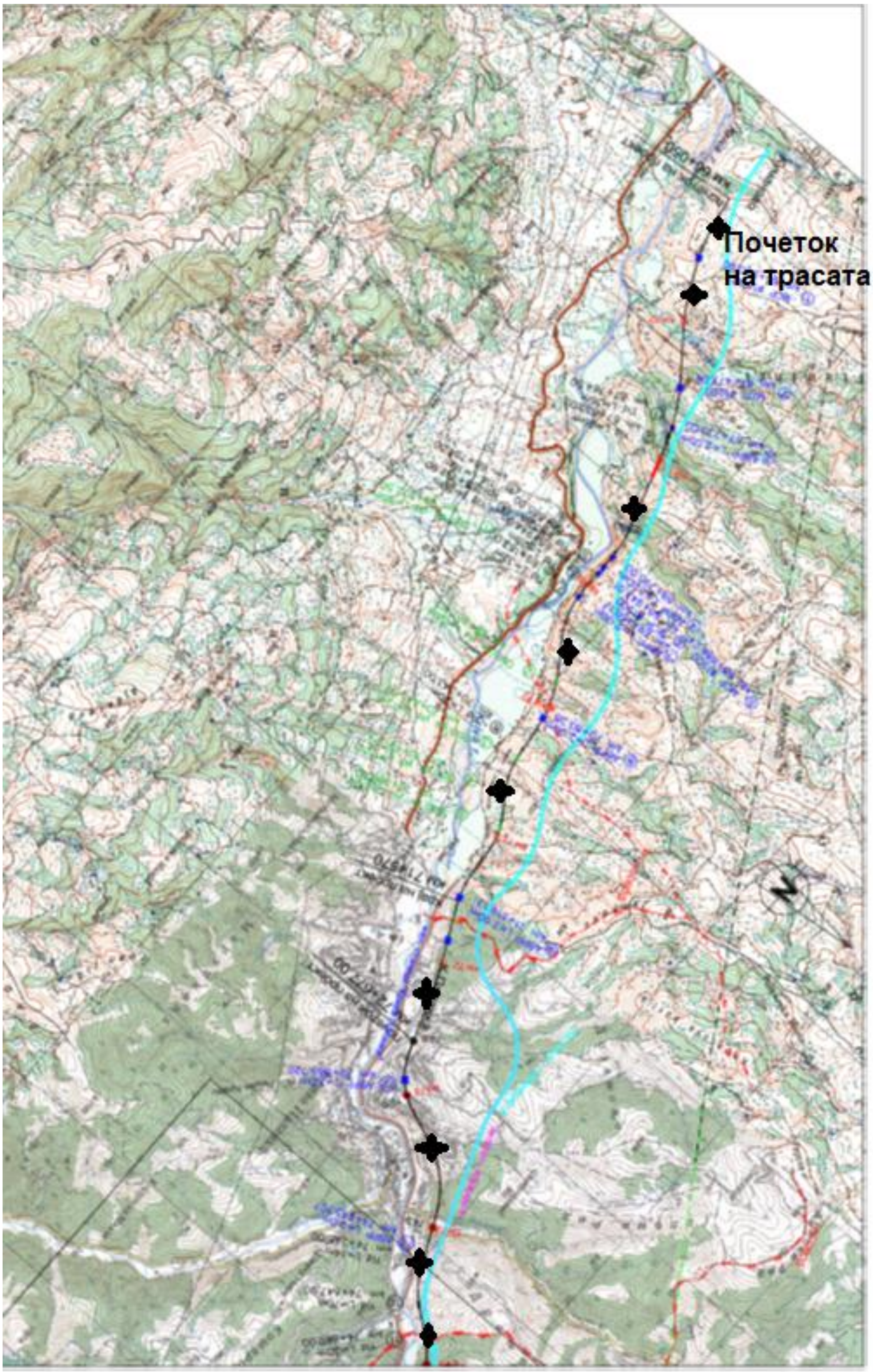
Relevant national legislation
• Law on the railway system ("Official Gazette of the Republic of Macedonia" No. 48/10, 23/11, 80/12, 155/12, 163/13, 42/14, 130/14, 152/15, 31/16 , 178/16); • Law on interoperability in the railway system ("Official Gazette of the Republic of Macedonia" No. 17/11, 163/13, 147/15, 31/16); • Law on safety in the railway system ("Official Gazette of the Republic of Macedonia" No. 48/10, 17/11, 23/11, 53/11, 158/11, 137/13, 163/13, 42/14, 166 / 14, 147/15, 193/15, 31/16, 52/16, 63/16, 71/16); • Law on Construction Land ("Official Gazette of the Republic of Macedonia" No. 15/15, 98/15, 193/15, 226/15, 31/16, 142/16, 190/16); • Law on Agricultural Land ("Official Gazette of the Republic of Macedonia" No. 135/07, 17/08, 18/11, 148/11, 95/12, 79/13, 87/13, 106/13, 164/13 , 39/14, 130/14, 166/14, 72/15, 98/15, 154/15, 215/15, 7/16, 39/16); • Law on Property and Other Real Rights ("Official Gazette of the Republic of Macedonia" No. 18/01, 92/08, 139/09, 35/10); • Law on Spatial and Urban Planning ("Official Gazette of the Republic of Macedonia" No. 199/14, 44/15, 193/15, 31/16, 163/16); • Law on Road Traffic Safety ("Official Gazette of the Republic of Macedonia" No. 169/15, 226/15, 55/16); • Law on Chemicals ("Official Gazette of the Republic of Macedonia" No. 145/10, 53/11, 164/13, 116/15, 149/15, 37/16) and relevant bylaws; • Law on Transport of Hazardous Substances in Road and Rail Transport ("Official Gazette of the Republic of Macedonia" No. 92/07, 147/08, 161/09, 17/11, 54/11, 13/13, 163/13, 38/14, 166/14, 116/15, 193/15, 31/16) and others.

Annex 5 Design parameters of the railway line

Design parameters		Symbol	Design speed 100 km/h			
			Exceptional	**Limited min**	**Desirable max**	**max**
Through Line						
Horizontal						
Radius (m)		R		500 m		25,000 m
Length of curves		L_C	20 m	50 m	100 m	
Distance between two transition curves/ramps		L	20 m	50 m	100 m	
Vertical						
Gradient				0.0 ‰		25.0 ‰
Gradient, siding track					2.5 ‰	
Maximum difference in gradient without vertical curve		2.0 ‰				
Radius	Normal	**R**		2,500 m	10,000 m	25,000 m
	In switches	**R**	Not desirable			
	In superelevation ramps	**R**	Not allowed			
Length of curve		L_{VC}		20 m		
Length of straight line between vertical curves				25 m	55 m	
Cant						
Minimum cant [mm] (cant to be rounded to figures that can be divided by 5)		D	20 mm			
Maximum cant		D	150 mm			
Maximum cant deficiency		I	130 mm			
Length of superelevation ramp		L_T			10*V*ΔD/1000	
Inclination of superelevation ramp [1:m]					1:1.000	
Others						
Useful length of at least one siding track			750 m			
Distance between through track and siding/loop track			4.75 m			
Station/halt						
Horizontal						
Radius		R		500 m		25,000 m
Length of curves		L_C	20 m	50 m	100 m	
Distance between two transition curves/ramps		L	20 m	50 m	100 m	
Vertical						
Gradient				0.0 ‰	1.5 ‰	

Maximum difference in gradient without vertical curve			2.0 ‰			
Radius	Normal	**R**		2,500 m	10,000 m	25,000 m
	In switches	**R**	Not desirable			
	In superelevation ramps	**R**	Not allowed			
Length of vertical curve		L_{VC}		20 m		
Length of straight line between vertical curves				25 m	55 m	
Cant						
Minimum cant [mm] (cant to be rounded to figures that can be divided by 5)		**D**	20 mm			
Maximum cant		**D**	110 mm			
Maximum cant deficiency		**I**	130 mm			
Main station						
Length of platforms		S_L	400 m			
Width of platforms		S_W	Min. 2.50 m (side) / 3.30 m (central)			
Height of platforms		S_H	550 mm			
Distance between through track – edge of plarform		S_D	1.67 m			
Halt						
Length of platforms		H_L	220 m			
Width of platforms		H_W	2.50 m			
Height of platforms		H_H	550 m			
Distance between through track – edge of plarform		H_D	1.67 m			

Annex 6 Alignment of the Kriva Palanka – border with Bulgaria railway and longitudinal profiles of the alignment



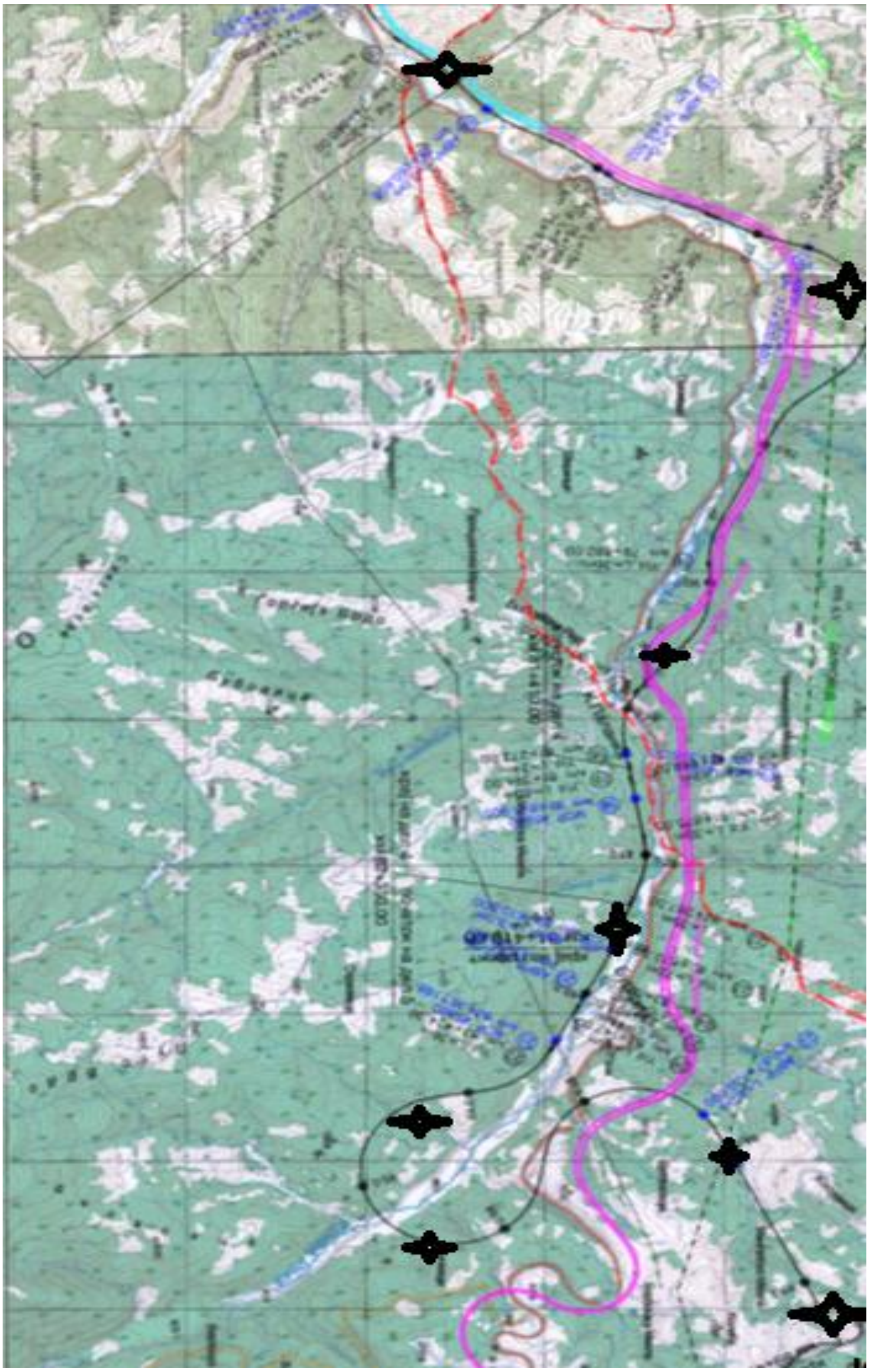
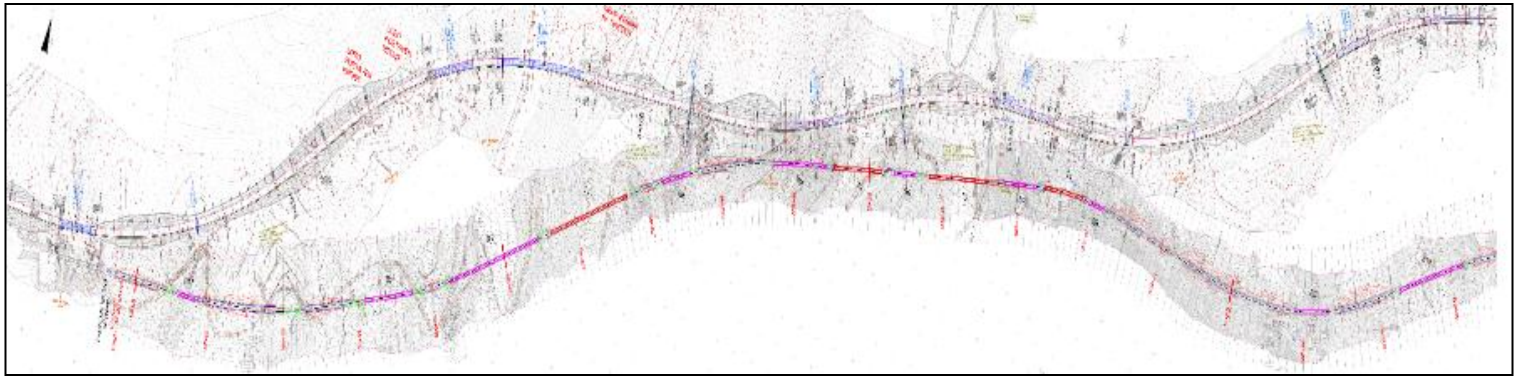
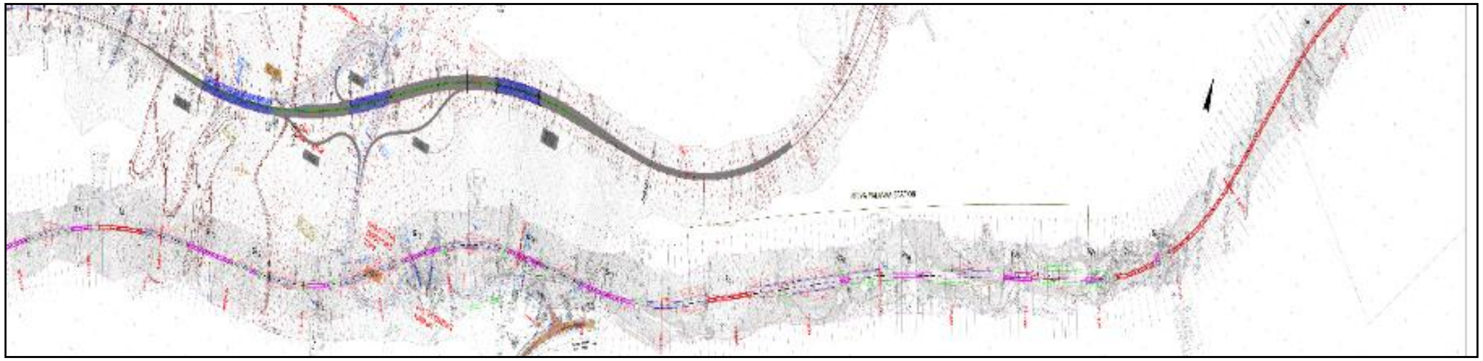
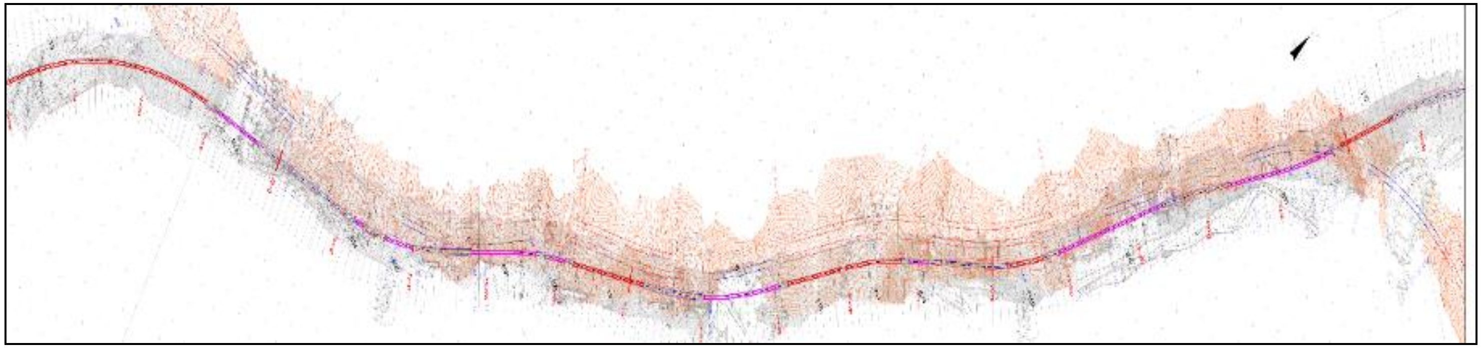
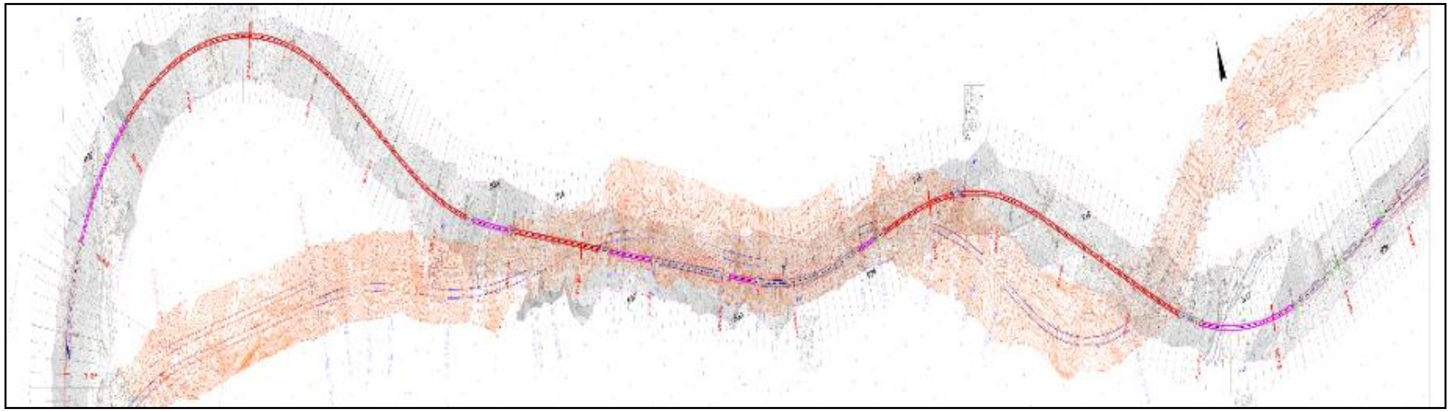


Figure 225 Alignment of the Kriva Palanka – border with Bulgaria railway









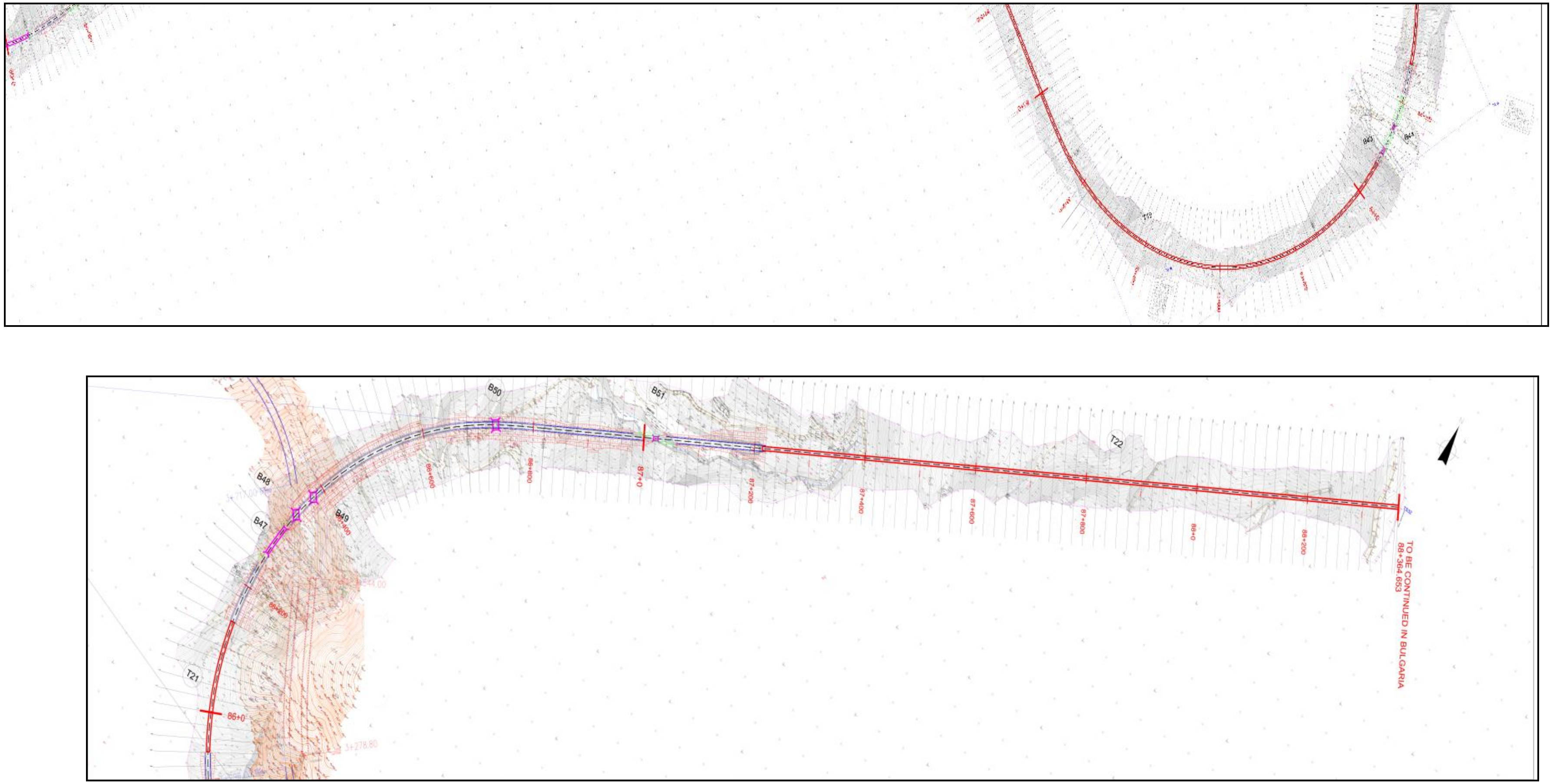
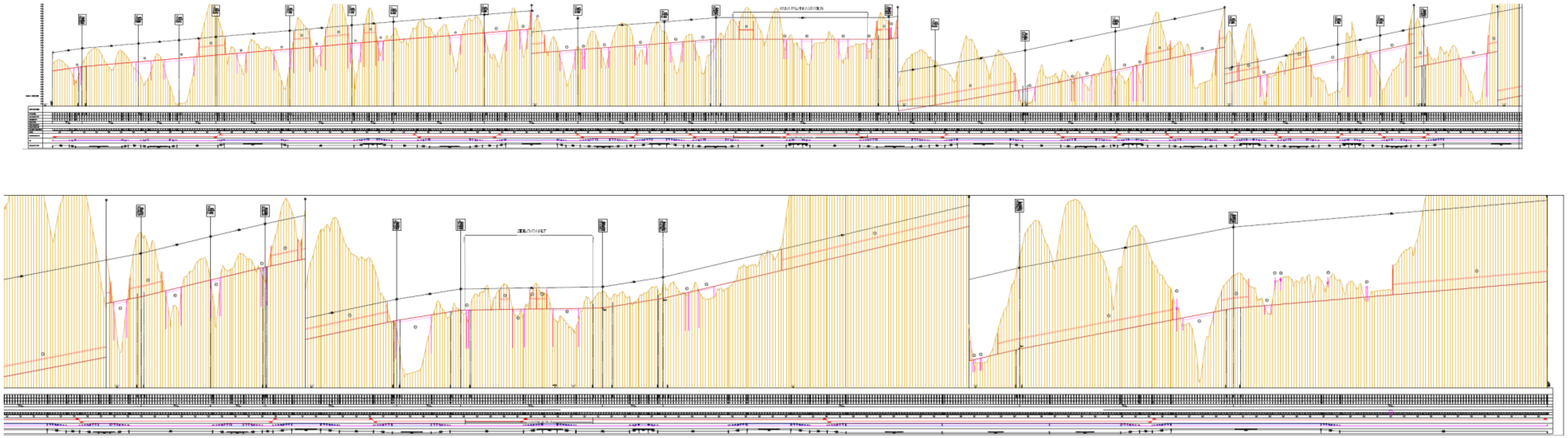


Figure 226 Alignment of the railway



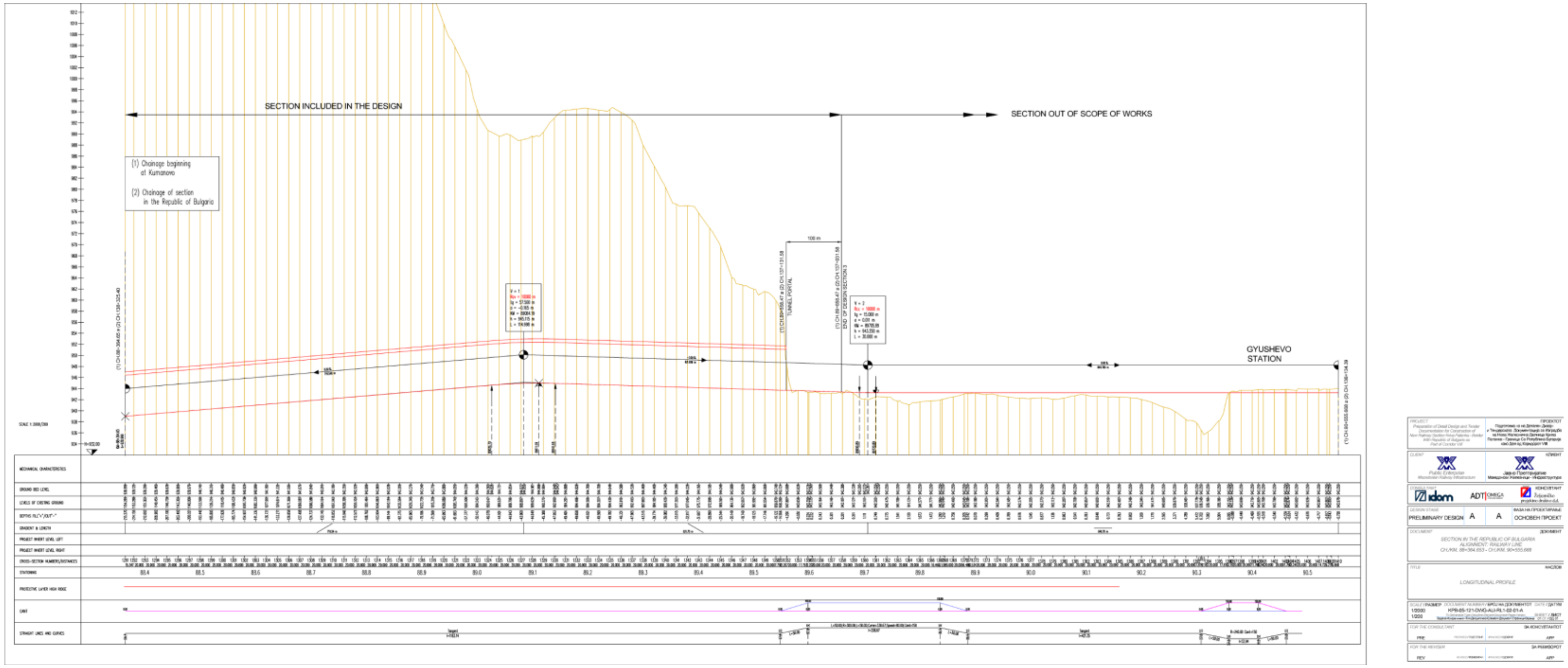


Figure 227 Longitudinal profiles of the railway

Annex 7 Data on chainages, underground sections and location of tunnels on Google maps

- **Tunel T1**

Tunnel 1 is a one-way and single tracked tunnel of 226,70 m length from CH.66+126 to CH.66+352,70.

Table 97 Chainage data – Tunnel 1

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
T01	ENTRANCE	66+126,00	66+141,64	---	---	194,69m	15.64m	226,70m
	EXIT	---	---	66+336,33	66+352,70		16.07m	

Figure 228 Location of Tunnel 1

- **Tunel T2**

Tunnel 2 is a one-way and single tracked tunnel of approximately 144 m length from CH.66+895.35 to CH.67+039.41.

Table 98 Chainage data – Tunnel 2

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
2	ENTRANCE	66+895.35	66+911.68	---	---	111.66	16.31	144.06
	EXIT	---	---	67+023.34	67+039.41		16.05	

Figure 229 Location of Tunnel 2

- **Tunnel T3**

Tunnel 3 is a one-way and single tracked tunnel of approximately 201 m length from CH.67+155 to CH.67+356.

Table 99 Chainage data – Tunnel 3

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
3	ENTRANCE	67+155.30	67+171.68	---	---	171.65	16.38	201.09
	EXIT	---	---	67+343.33	67+356.39		13.06	

Figure 230 Location of Tunnel 3

- **Tunnel T4**

Tunnel 4 is a one-way and single tracked tunnel of approximately 115 m length from CH.67+464.66 to CH.67+579.90.

Table 100 Chainage data – Tunnel 4

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
4	ENTRANCE	67+464.66	67+479.68	---	---	83.65	15.02	115.24
	EXIT	---	---	67+563.33	67+579.90		16.57	

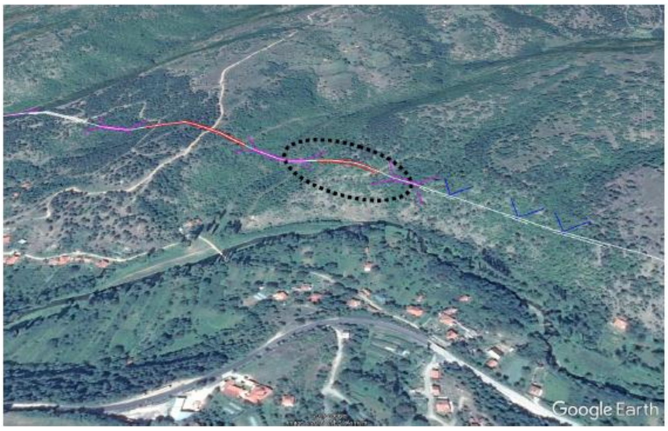


Figure 231 Location of Tunnel 4

- **Tunnel T5**

Tunnel 5 is a one-way and single tracked tunnel of approximately 136 m length from CH.68+821.56 to CH.68+957.23.

Table 101 Chainage data – Tunnel 5

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
5	ENTRANCE	68+821.56	68+836.68	---	---	101.65	15.12	135.67
	EXIT	---	---	68+938.33	68+957.23		18.90	

Figure 232 Location of Tunnel 5

Tunnel T6

Tunnel 6 is a one-way and double tracked tunnel of approximately 140m length from CH.70+516.89 to CH.70+657.14.

Table 102 Chainage data – Tunnel 6

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
6	ENTRANCE	70+516.89	70+531.87	---	---	101.26	24.01	140.25
	EXIT	---	---	70+633.13	70+657.14		38.99	

Figure 233 Location of Tunnel 6

Tunnel T7

Tunnel T07 is a one-way and single tracked tunnel of approximately 123 m length from CH.71+636.02 to CH.71+758.60.

Table 103 Chainage data – Tunnel 7

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
07	ENTRANCE	71+636.02	71+651.68	---	---	91.68	15.66	122.58
	EXIT	---	---	71+743.34	71+758.60		15.27	

Figure 234 Location of Tunnel 7

- **Tunnel T8**

Tunnel T08 is a one-way and single tracked tunnel of approximately 997m length from CH.71+792.88 to CH.72+789.77.

Table 104 Chainage data – Tunnel 8

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
08	ENTRANCE	71+792,88	71+813,74	---	---	959,55	20,86	996,89
	EXIT	---	---	72+773,29	72+789,77		16,48	

Figure 235 Location of Tunnel 8

Tunnel T9

Tunnel T09 is a one-way and single tracked tunnel of approximately 216 m length from CH.73+824.63 to CH.74+040.55.

Table 105 Chainage data – Tunnel 9

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
09	ENTRANCE	73+824.63	73+842.68	---	---	164.65	17.05	215.92
	EXIT	---	---	74+006.33	74+040.55		34.22	

Figure 236 Location of Tunnel 8

- **Tunnel T10&11**

Tunnels 10 as well as Tunnel 11 are one-way and single tracked tunnels. Considering the small distance (of approximately 17.35 m) between the exit portal of Tunnel 10 and the entrance portal of Tunnel 11 as well as the existence of a water course it was considered optimum to unite the Tunnels during the final lining construction. Therefore, within the context of the present study Tunnels 10 and 11 are considered as one; the total length of the Tunnel is approximately 336 m, extending from CH.74+423.70 to CH.74+759.80.

Table 106 Chainage data – Tunnel 10&11

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
10	ENTRANCE	74+423.70	74+439.68	---	---	139.65	15.98	155.63
	EXIT	---	---	74+579.33	---		---	
11	ENTRANCE	---	74+596.68	---	---	151.65	---	163.12
	EXIT	---	---	74+748.33	74+759.80		11.47	
					SUMS	291.30	27.45	318.75 + (17.35)=336.10m

Figure 237 Location of Tunnel 10&11

- **Tunnel T11a**

Tunnel T11a is a one-way and single tracked tunnel of approximately 181m length from CH. 74+989.95 to CH.75+171.29.

Table 107 Chainage data – Tunnel 11a

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
11a	ENTRANCE	74+989.95	75+006.68	---	---	148.65	16.73	181.34
	EXIT	---	---	75+155.33	75+171.29		15.96	

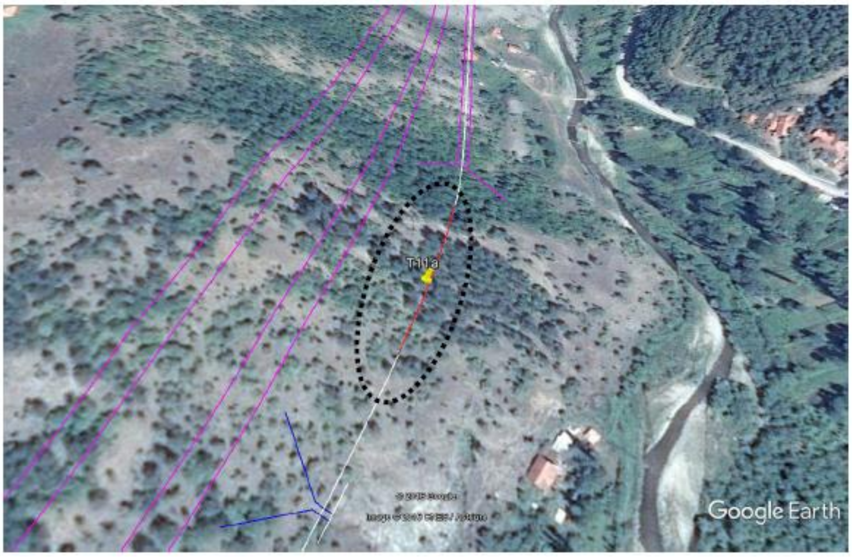


Figure 238 Location of Tunnel 11a

- **Tunnel T12**

Tunnel T12 is a one-way and single tracked tunnel of approximately 188m length from CH. 75+968.75 to CH. 76+156.68.

Table 108 Chainage data – Tunnel 12

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
12	ENTRANCE	75+968.75	75+983.68	---	---	144.65	14.93	187.93
	EXIT	---	---	76+128.33	76+156.68		28.35	

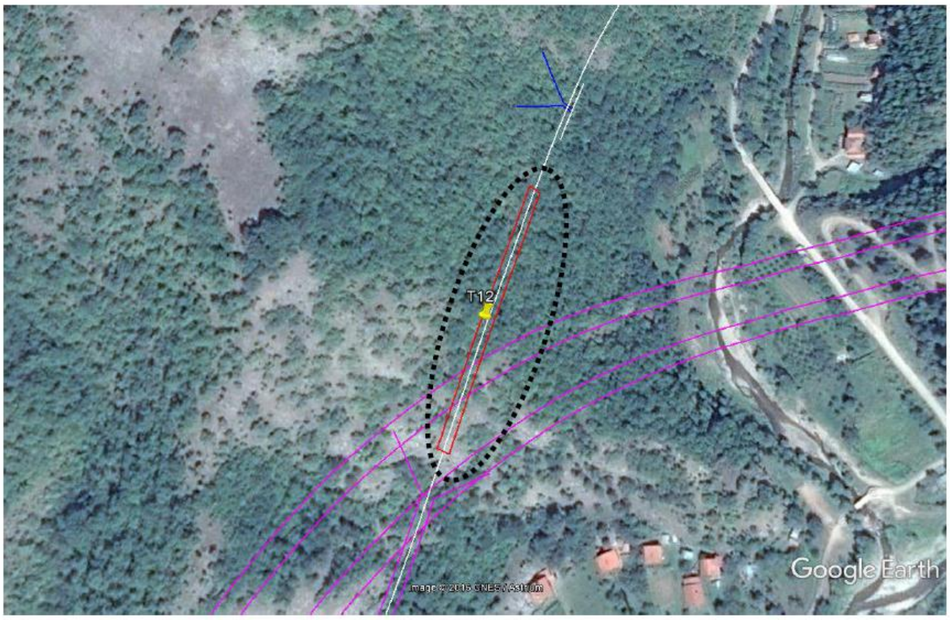


Figure 239 Location of Tunnel 12

- **Tunnel T13**

Tunnel T13 is a one-way and single tracked tunnel of approximately 1050m length from CH.76+621.70 to CH.77+689.40.

Table 109 Chainage data – Tunnel 13

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
13	ENTRANCE	---	76+621,70	---	---	1049.57	---	1067.70
	EXIT	---	---	77+671.27	77+689.40		18.13	

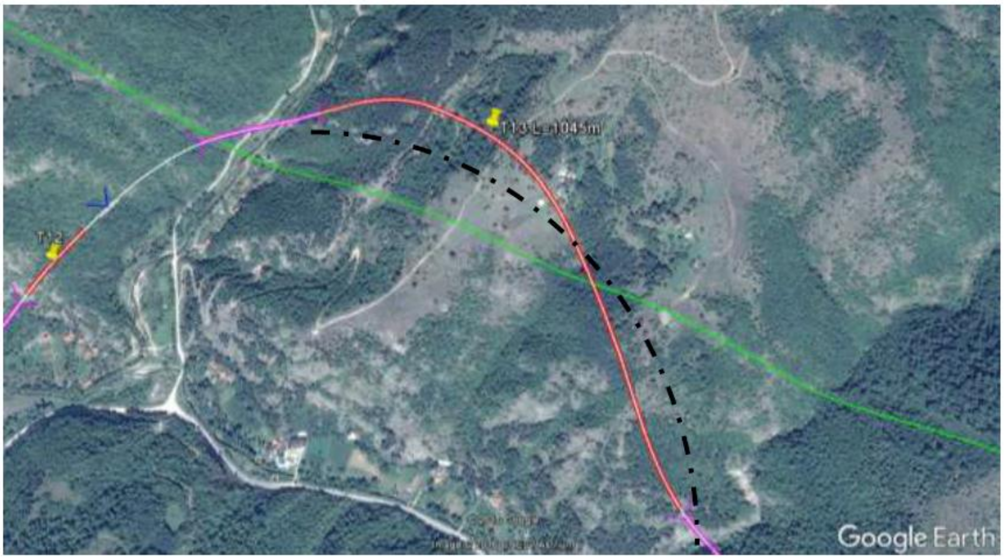


Figure 240 Location of Tunnel 13

- **Tunnel T14**

Tunnel T14 is a one-way and single tracked tunnel of approximately 188m length from CH. 75+968.75 to CH.76+156.68.

Table 110 Chainage data – Tunnel 14

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
14	ENTRANCE	77+799.89	77+811.68	---	---	231.65	15.47	258.91
	EXIT	---	---	78+043.33	78+058.80		27.26	

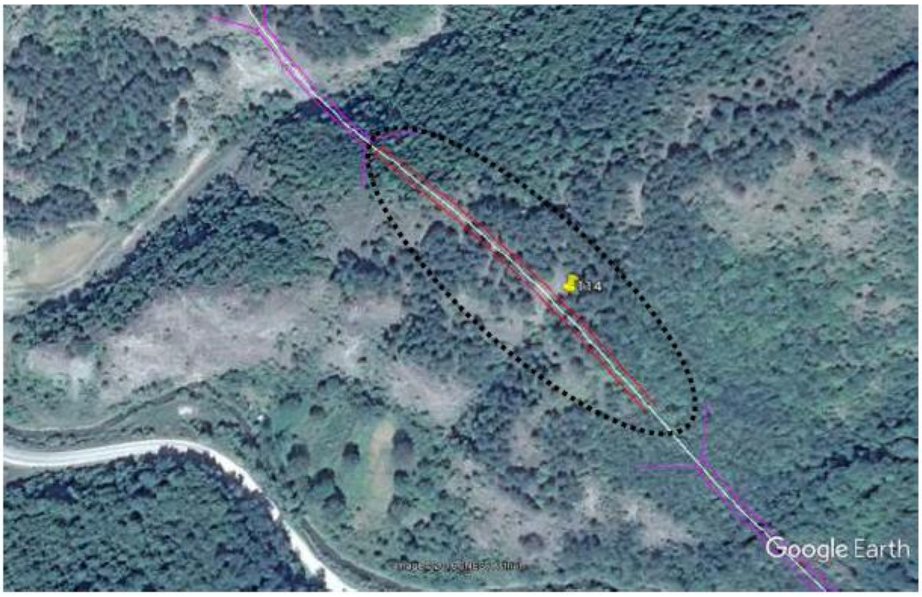


Figure 241 Location of Tunnel 14

- **Tunnel T15**

Tunnel T15 is a one-way and single tracked tunnel of approximately 240m length from CH.78+851.77 to CH.78+851.77.

Considering the small distance (of approximately 9m) between the exit portal of Tunnel 15 and the entrance portal of Tunnel 16 it was considered optimum to unite the Tunnels during the final lining construction.[85]

Table 111 Chainage data – Tunnel 15

TUNNEL	PORTAL	CHAINAGE				LENGTH (m)		
		START C&C TUNNEL	START UNDERGROUND SECTION	END UNDERGROUND SECTION	END C&C TUNNEL	UNDERGROUND SECTION	C&C TUNNEL	TOTAL LENGTH
15	ENTRANCE	78+851.77	78+866.68	---	---	216.32	14.91	240.23
	EXIT	---	---	79+083.00	79+092.00		9.00	

Figure 242 Location of Tunnel 15

- **Tunnel T16**

The Preliminary Design of the Tunnel 16 has been elaborated according to the Geotechnical Report (KPB-03-101-REP-GEO-RL1-01-07). At the moment, some laboratory and field tests are still pending, particularly related to Tunnel 16, therefore design changes can be expected in further stages of design according to the pending tests results.

The alignment of Tunnel 16 is a mine tunnel from Km 79+092 to Km 79+720 (628 m), and a Cut& Cover solution from Km 79+720 to 79+736.5 (16.5 m).

As tunnels 15 and 16 are located at only 40 metres one from each other, it is foreseen to join them with a C&C tunnel. In this case total length of tunnels 15+16 would be around 865 metres. In all the cases total length would be lower than 1.000m so no emergency galleries would be required.

- **Tunnel T17, T18&18a, T19, T20, T21, T22**

The Preliminary Design of the Tunnel 17, T18&18a, T19, T20 has been elaborated according to the Geotechnical Report (KPB-03-101-REP-GEO-RL1-01-07). At the moment, some laboratory and field tests are still pending, therefore design changes can be expected in further stages of design according to the pending tests results.

[85] Tunnel 15 is elaborated in the present study while Tunnel 16 is given in the report (2016.12.02 - KPB-03-101-REP-TUN-T16-01-03-A).

The alignment of Tunnel 17 is a Cut & Cover (C&C) solution from Km 80+571 to 80+639.3 (68.3 m), with 3 railway tracks.

The alignment of Tunnel 18 is a Cut & Cover (C&C) solution from Km 80+792 to 80+842 (50 m), with 3 railway tracks. In the same way, the Tunnel 18a is a Cut and Cover tunnel (C&C) from Km 80+842 to 80+916 (74 m), gallery with 3 railway tracks.

Tunnel 18 and 18a are analysed together from the geotechnical point of view, therefore this technical report including the design of both short tunnels.

The alignment of Tunnel 19 is a cut and cover tunnel from Km 82+611.2 to Km 82+670 (59 m ength) and a mine tunnel from Km 82+670 to Km 84+070 (1400), with a total length of 1459 m.

The alignment of Tunnel 20 is a Cut and Cover tunnel from 84+251 to 84+300 mine tunnel from Km 84+300 to Km 84+564, with a total length of 1.313 m. At the moment, some laboratory and field tests are still pending, particularly related to Tunnel 20, therefore design changes can be expected in further stages of design according to the pending tests results.

- **Tunel 21**

The alignment of Tunnel 21 is a Cut & Cover solution from Km 85+932 to Km 85+982 (50 m), mined tunnel from Km 85+982 to Km 86+119 (137 m) and, once again, a Cut & Cover solution from Km 86+119 to 86+168 (49 m).Tunnel 21 is a short single-track tunnel, 137 m plus 99 m of cut and cover tunnel from portals.

At the end of Section 3 there is a border tunnel T22 with a total length of approximately 2,348 m, of which 1,155 m would be within the territory of Macedonia and 1,193 m within the territory of Bulgaria.

- **Tunel 22**

The alignment of Tunnel 22 is a cut and cover tunnel from Km 87+210.3 to Km 87+280 (.70 m), and a mine tunnel from 87+280 to 89+558 (2,278 m), with a total length including C&C and mine tunnel of 2,348 m. This report is related to the Macedonian part of the Deve Bair Tunnel, it is from Km 87+210 to Km 88+365, with a total length along Macedonia of 1,155 m.

Construction of the tunnel from the Bulgarian side was commenced in 1941. The first 550 m of the tunnel are fully completed, performed with single-layer lining comprised of concrete blocks in the vault and in-situ cast concrete in the walls. It provides a clear opening of b/h – 5.2/ 6.0 m (Figure below). After this part, there follows a partially excavated and unfinished part of the tunnel – main galleries, etc.

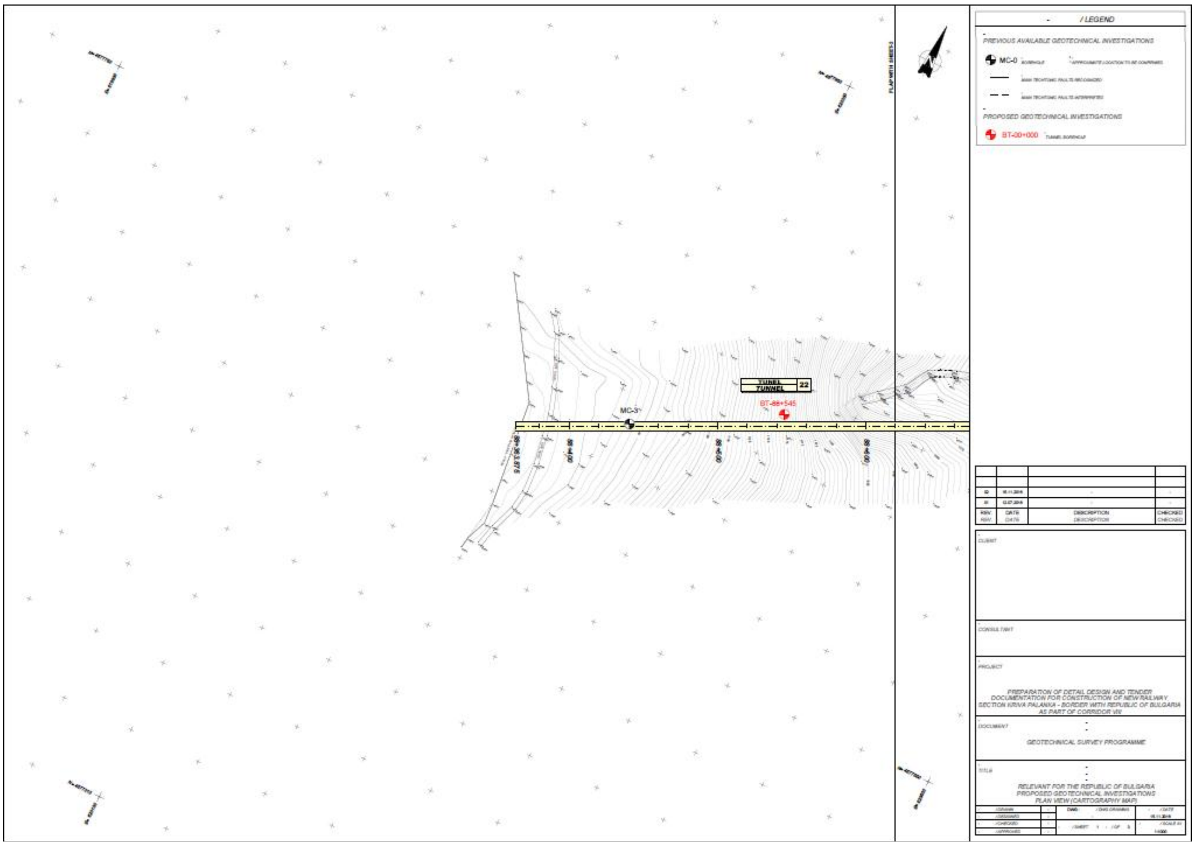
Figure 243 Cross-border tunnel “Deve Bair” from Bulgarian side. Right: Rock slide in the portal area: Left Tunnel Portal in the Republic of Bulgaria

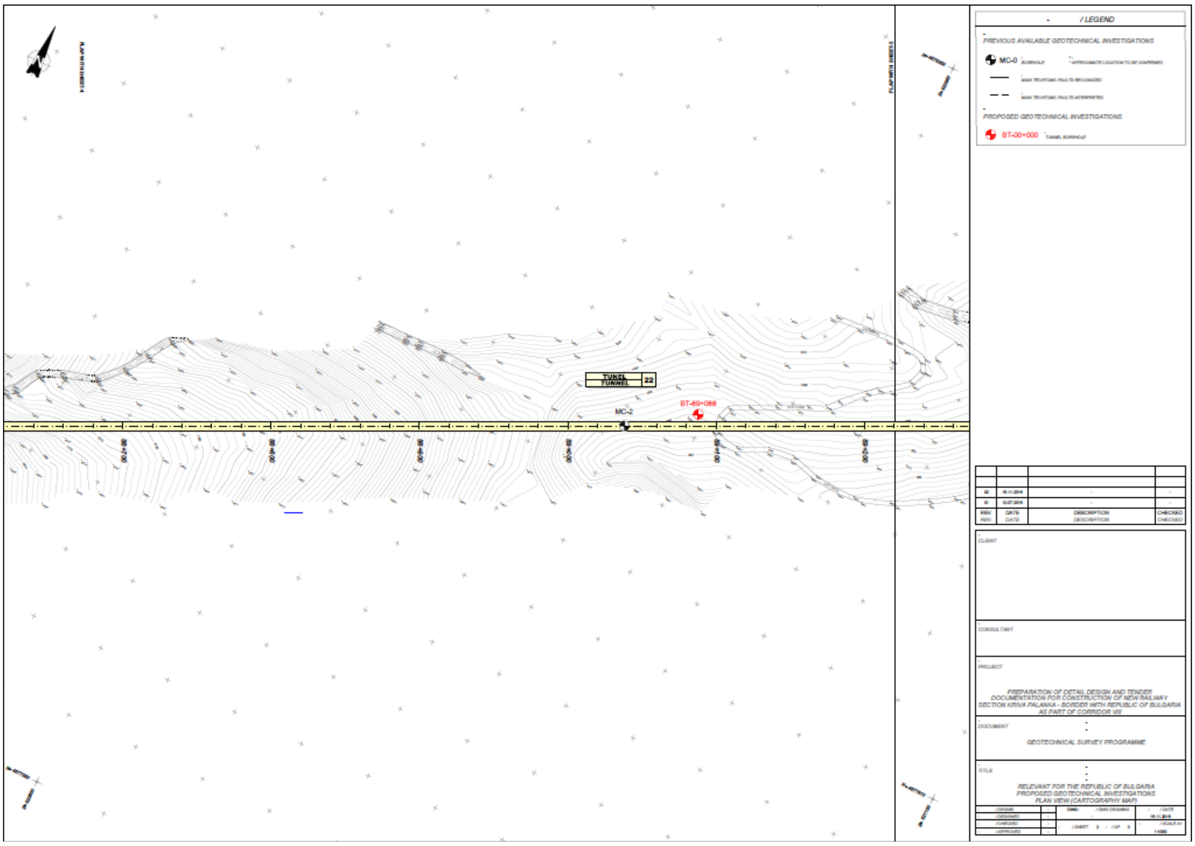
The construction works from the Macedonian side of the tunnel started in the 1940’s but these works have never been completed.

The length drilled from the Macedonian side is approximately 250 m (Figure below). The tunnel entrance has partly collapsed at the Macedonian side.

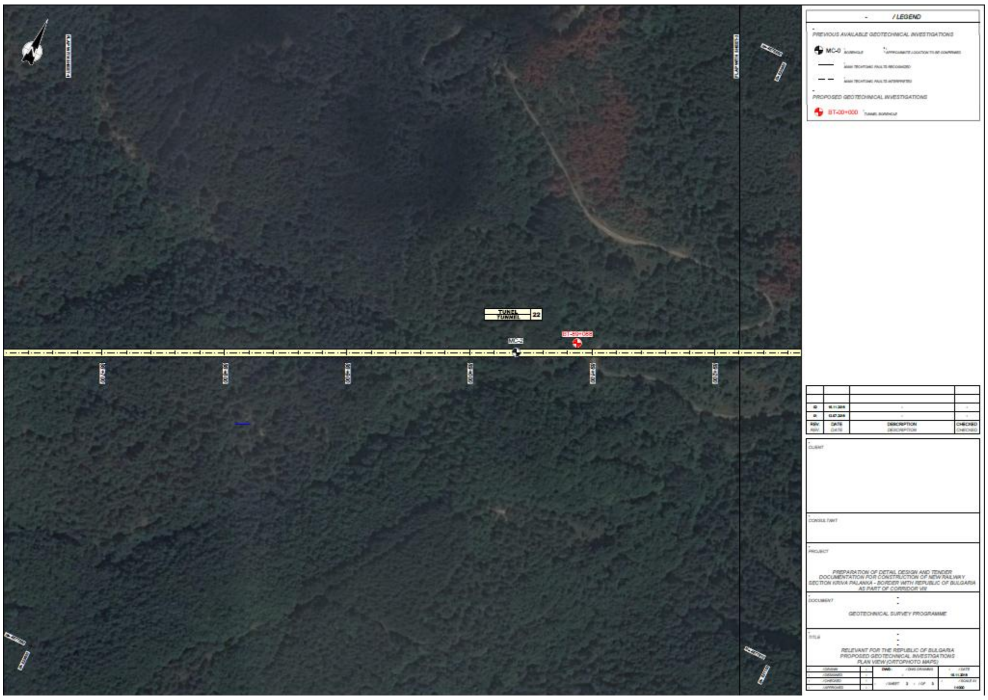
Figure 244 Cross-border tunnel “Deve Bair” from Macedonian side

In addition, the following pictures show the location of the tunnel 22, from the Macedonian and Bulgarian sides.




/ LEGEND
PREVIOUS AVAILABLE GEOTECHNICAL INVESTIGATIONS
MC-0
PROPOSED GEOTECHNICAL INVESTIGATIONS
BT-00+000
TUNEL
TUNNEL
22
MC-2
CLIENT
CONSULTANT
PROJECT
PREPARATION OF DETAIL DESIGN AND TENDER DOCUMENTATION FOR CONSTRUCTION OF NEW RAILWAY SECTION KRIVA PALANKA - BORDER WITH REPUBLIC OF BULGARIA AS PART OF CORRIDOR VIII
DOCUMENT
GEOTECHNICAL SURVEY PROGRAMME
TITLE
RELEVANT FOR THE REPUBLIC OF BULGARIA
PROPOSED GEOTECHNICAL INVESTIGATIONS
PLAN VIEW (CARTOGRAPHY MAP)


/ LEGEND
PREVIOUS AVAILABLE GEOTECHNICAL INVESTIGATIONS
MC-0
PROPOSED GEOTECHNICAL INVESTIGATIONS
BT-00+000
TUNEL
TUNNEL
22
PREPARATION OF DETAIL DESIGN AND TENDER DOCUMENTATION FOR CONSTRUCTION OF NEW RAILWAY SECTION KRIVA PALANKA - BORDER WITH REPUBLIC OF BULGARIA AS PART OF CORRIDOR VIII
GEOTECHNICAL SURVEY PROGRAMME
RELEVANT FOR THE REPUBLIC OF BULGARIA
PROPOSED GEOTECHNICAL INVESTIGATIONS
PLAN VIEW (ORTOPHOTO MAPS)


TUNEL
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TUNEL
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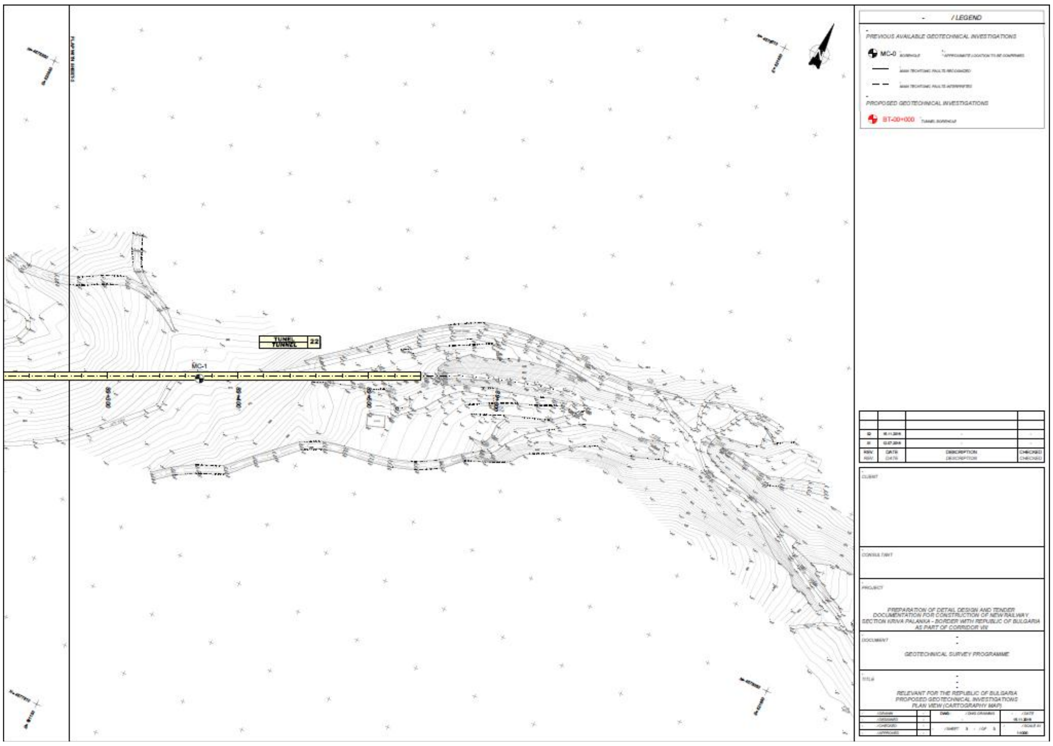
PLAN VIEW (ORTOPHOTO MAPS)



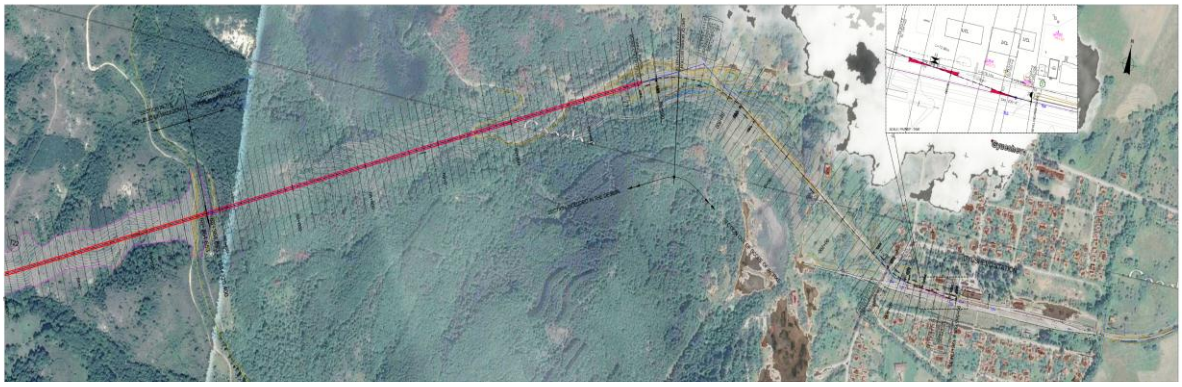


Figure 245 Border tunnel 22

Annex 8 Water permeability tests

Results of Lefranc soil water permeability tests

Structure	Borehole	Drilled	GWL depth (m)	Borehole Start (m)	Borehole End (m)	Borehole Length (m)	Drilled	Average value of KF	Borehole
Bridge 23	BV-72+887	31	Stage above GWL=9.8m	2,3	2,7	0,4	al	2.24E-06	low
Bridge 28	BT-74+272	25	Stage above GWL=4.0m	2,SS	3,15	0,5	al	I,39E-04	average
Bridge 10	BV-75+402	30	Stage above	2,5	3	0,5	pr	3,84E-06	low
Bridge 32	BV-76+517	21	1,7m	5,15	5,6	0,45	al	1,96E-05	average
Bridge 37	BV-79+877	29	0,7m	2	2,5	0,5	al	4.05E-07	very low
Bridge 37	BV-79+877	29	0,7m	5	5,5	0,5	al	2,43E-07	very low
Bridge 39	BV-80+692	15	5,1m	2,5	2,9	0,4	d	3.86E-08	very low
Bridges 43 and 44	BV-84+152	19,8	Stage above GWL	2	2,5	0,5	al	8.10E-05	low
Tunnel 22	BV-87+372	35	Stage above GWL	8	8,6	0,6	pr/3E1	1.02E-07	very low

Results obtained from Lugeon method

Drilled depth (m)	GWT (m)	Test depth interval Z start (m)	Test depth interval Z end (m)	Test length (m)	Geotechnical unit	Pressure (bar)	Permeability (LU)	Permeability K= 1,3*10-5 *Lu (m/s)	Permeability K=l,7*10-5*q (m/s)
25	8	13,70	15,70	2	s	1.05-2.05-3.05-2.05-1.05			5.07E-07
		19,00	21,00	2	s	0.95-1.95-2.95-1.95-0.95			3.63E-07
50	22	39,00	41,00	2	s	3.01-4.01-5.01-4.01-3.01			1,87E-07
		44,00	46,00	2	s	2.95-3.95-4.96-3.95-2.95			1,90E-07
20	7.5	9,00	11,00	2	s	1-2-3-2-1			4.01E-07
		15,00	17,00	2	s	1-2-3-2-1			2.83E-07
38,5	7	24,00	26,00	2	s	1-2-3-2-1			1,70E-07
		29,30	31,30	2	s	1-2-3-2-1			1,94E-07
30	6	20,00	22,00	2	s	2.54-3.54-5.04-3.54-2.54			2,55E-07

		25,00	27,00	2	s	2.63-3.63-5.13-3.63-2.63			4.62E-07
135	46.6	120,00	122,00	2	s	7.86-9.86-11.86-9.86-7.86	1,168	1.52x10-7	2,34E-07
		126,00	128,00	2	s	6.86-8.86-10.86-8.86-6.86	1,036	1.35x10-7	1,27E-07
165	52	149,00	151,00	2	s	1-1.5-2.0-1.5-1			1,19E-06
		1S3,00	155,00	2	s	The test is aborted: the water go out on the surface by preasure 1,5-1,0 Bar.			
		154,00	156,00	2	s	he test is aborted, the water go out on the surface by preasure >1,5			
60	17	49,00	51,00	2	V	2.7-3.7-4.7-5-4.7-3.7-27			5.88E-06
		55,00	57,00	2	SSgr`	2.7-3.7-4.7-5.7-6.7-5.7-473.7-2.7			6.70E-07
125	2S.5	105,60	107,60	2	Dk	4.85-6.35-6.85-6.35-4.85			4,96E-07
		114,60	116,60	2	Dk	4.85-6.35-7.85-6.35-4.85			1.28E-07
170	40.5	150,00	170,00	20	Sgr	the test is aborted, under preasure incresing of 2 Bar, water go out on the top of the borehole			
		167,00	170,00	3	SSgr	the test is aborted, the water go out on the surface by preasure >1,5			
110	46	92,00	94,00	2	Sgf	6.86-8.86-10.86-8.86-6.86	15,300	1.99x10-6	l,72E-06
		98,00	100,00	2	SSgr	6.81-8.81-10.81-8.81-6.81	12,300	1.6x10-6	l,83E-06
50	9	38,00	40,00	2	SSgr	2.02-3.02-4.02-5.02-6,02 5.02-4.02-3.02-2.02			3.72E-07
135	99.8	118,00	120,00	2	2E3	12.17-12.87-12.87	14,370	1.87x10-6	1.82E-06
		121,00	123,00	2	2E3	1317-13.87-11.17	17,700	2.3x10-6	3,01E-06
220	75	203,00	205,00	2	xa	test aborted, water abound (8.78 Bars)			
		214,00	216,00	2	xa	8.81-9.81-10.51-9.81-8.81	17,750	2.31x10-6	l,98E-06

Annex 9 Detailed characteristics of the watersheds and draining lines

CATCHMENT AREA	AREA	Culvert / Bridge Code	SIZE	METHOD
Ba.B01	0,103	B01	Very Small	Rational
Ba.C01	0,085	C01	Very Small	Rational
Ba.B02	0,030	B02	Very Small	Rational
Ba.B03	20,786	B03	Big	UH
Ba.C02	0,015	C02	Very Small	Rational
Ba.B04	0,074	B04	Very Small	Rational
Ba.B05	11,305	B05	Moderate	UH
Ba.B06	0,046	B06	Very Small	Rational
Ba.B07	3,877	B07	Small	UH
Ba.B08	0,091	B08	Very Small	Rational
Ba.C03	0,153	C03	Very Small	Rational
Ba.B09	0,237	B09	Very Small	Rational
Ba.B10	0,289	B10	Very Small	Rational
Ba.B11	0,166	B11	Very Small	Rational
Ba.C04	0,009	C04	Very Small	Rational
Ba.B12	0,735	B12	Very Small	Rational
Ba.B13	0,025	B13	Very Small	Rational
Ba.B14	0,381	B14	Very Small	Rational
Ba.B15	0,088	B15	Very Small	Rational
Ba.B16	0,475	B16	Very Small	Rational
Ba.B17	0,195	B17	Very Small	Rational
Ba.T01	0,058	D01	Very Small	Rational
Ba.C05	0,121	C05	Very Small	Rational
Ba.B18	0,064	B18	Very Small	Rational
Ba.B19	0,101	B19	Very Small	Rational
Ba.B20	6,861	B20	Moderate	UH
Ba.B21	0,146	B21	Very Small	Rational
Ba.C06	0,877	C06	Very Small	Rational

CATCHMENT AREA	AREA	Culvert / Bridge Code	SIZE	METHOD
Ba.B23	10,103	B23	Moderate	UH
Ba.C07	0,043	C07	Very Small	Rational
Ba.C08	0,032	C08	Very Small	Rational
Ba.B25	0,133	B25	Very Small	Rational
Ba.B26	0,046	B26	Very Small	Rational
Ba.B27	0,273	B27	Very Small	Rational
Ba.T02	0.018	T02	Very Small	Rational
Ba.C09	0,094	C09	Very Small	Rational
Ba.B28	0,177	B28	Very Small	Rational
Ba.T03	0,306	D02	Very Small	Rational
Ba.B29	0,363	B29	Very Small	Rational
Ba.B30	0,839	B30	Very Small	Rational
Ba.B31	0,576	B31	Very Small	Rational
Ba.B32	110,904	B32	Big	UH
Ba.B33	8,941	B33	Moderate	UH
Ba.B34	0,150	B34	Very Small	Rational
Ba.B35	0,768	B35	Very Small	Rational
Ba.C10	0,053	C10	Very Small	Rational
Ba.B36	0,045	B36	Very Small	Rational
Ba.T04	0,283	D03	Very Small	Rational
Ba.B37	66,291	B37	Big	UH
Ba.C11	0,079	C11	Very Small	Rational
Ba.B38	0,271	B38	Very Small	Rational
Ba.B39	0,387	B39	Very Small	Rational
Ba.B40	1,056	B40	Small	UH
Ba.S01	55,401	S01	Big	UH
Ba.B41	0,013	B41	Very Small	Rational
Ba.B42	0,293	B42	Very Small	Rational
Ba.B43	44,901	B43	Big	UH
Ba.B46	0,581	B46	Very Small	Rational

CATCHMENT AREA	AREA	Culvert / Bridge Code	SIZE	METHOD
Ba.B47	0,057	B47	Very Small	Rational
Ba.B51	1,280	B51	Small	UH

Annex 10 Allocation of the landfills chosen by “ADT Omega” (2017), and locations of the landfills envisaged with the Detailed Design

Figure 246 Allocation of the ladfills chosen by ADT (1-6)

Figure 247 Allocation of the ladfills chosen by ADT (7-10)

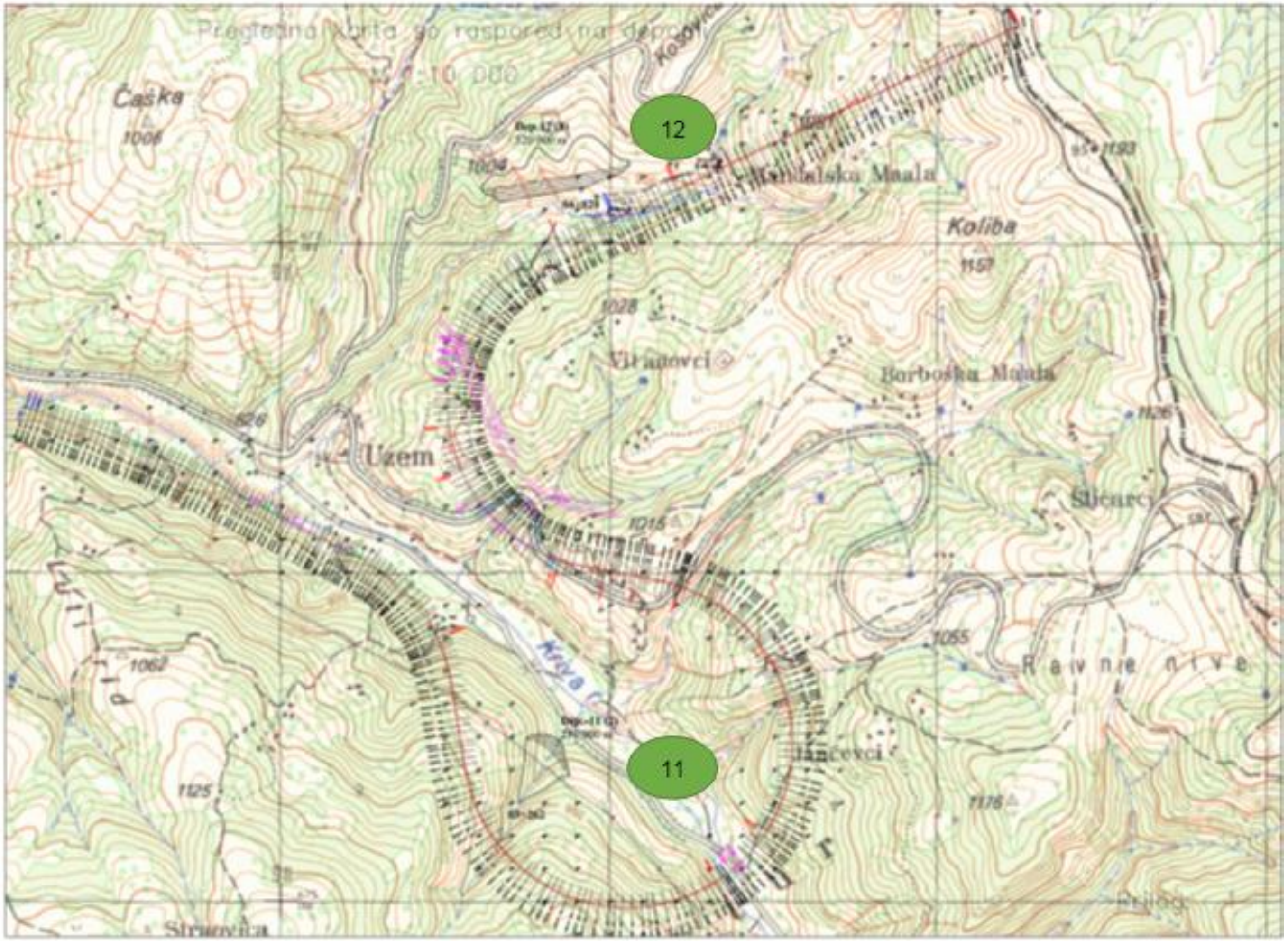
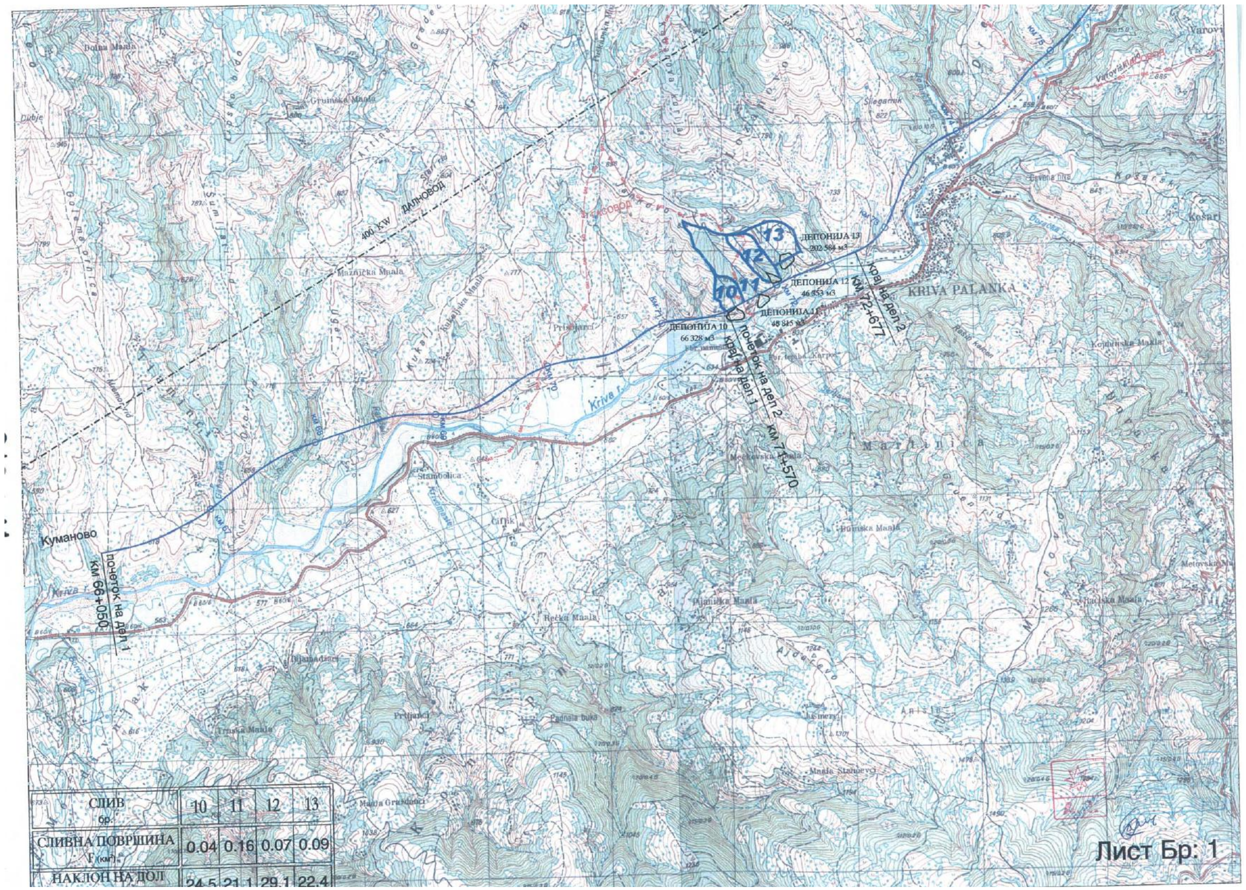
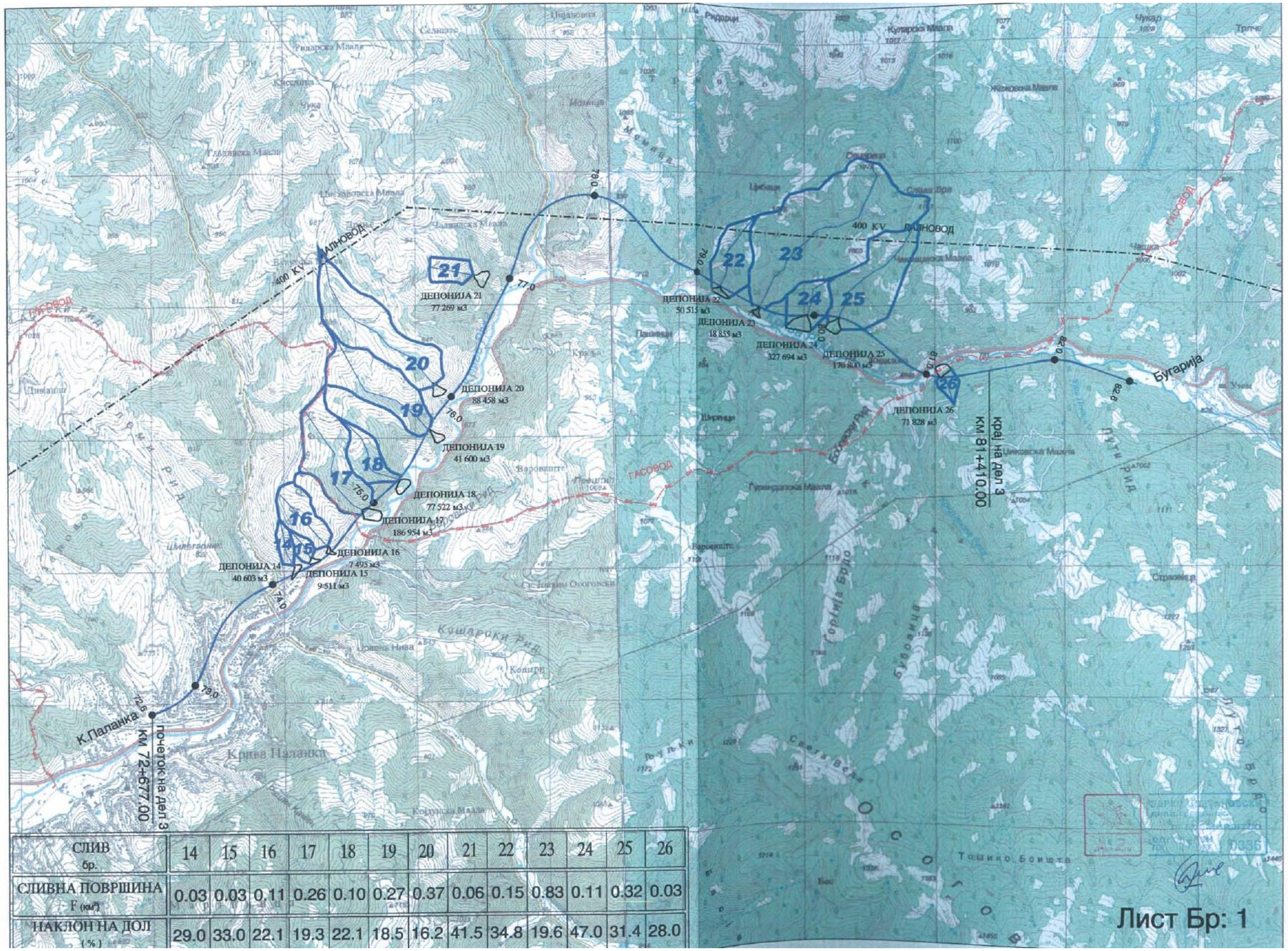


Figure 248 Allocation of the ladfills chosen by ADT (11-12)

СЛИВ br.	1	2	3	4	5	6	7	8	9
СЛИВНА ПОВРШИНА F (км²)	0.13	0.03	0.09	0.07	0.08	0.30	0.01	0.02	0.09
НАКЛОН НА ДОЛ	10.6	14.9	17.4	19.6	21.9	17.7	38.7	26.1	21.7


Куманово
почеток на деп 1
км 66+050
почеток на деп 2
крај на деп 1
км 71+570
крај на деп 2
км 72+677
10
11
12
13
ДЕПОНИЈА 10
ДЕПОНИЈА 11
ДЕПОНИЈА 12
ДЕПОНИЈА 13
KRIVA PALANKA
400 KW ДАЛНОВОД
Kriva r.
Лист Бр: 1
СЛИВ бр.
10
11
12
13
СЛИВНА ПОВРШИНА F (км²)
0.04
0.16
0.07
0.09
НАКЛОН НА ДОЛ
24.5
21.1
29.1
22.4



СЛИВ бр.	14	15	16	17	18	19	20	21	22	23	24	25	26
СЛИВНА ПОВРШИНА F (км²)	0.03	0.03	0.11	0.26	0.10	0.27	0.37	0.06	0.15	0.83	0.11	0.32	0.03
НАКЛОН НА ДОЛ (%)	29.0	33.0	22.1	19.3	22.1	18.5	16.2	41.5	34.8	19.6	47.0	31.4	28.0

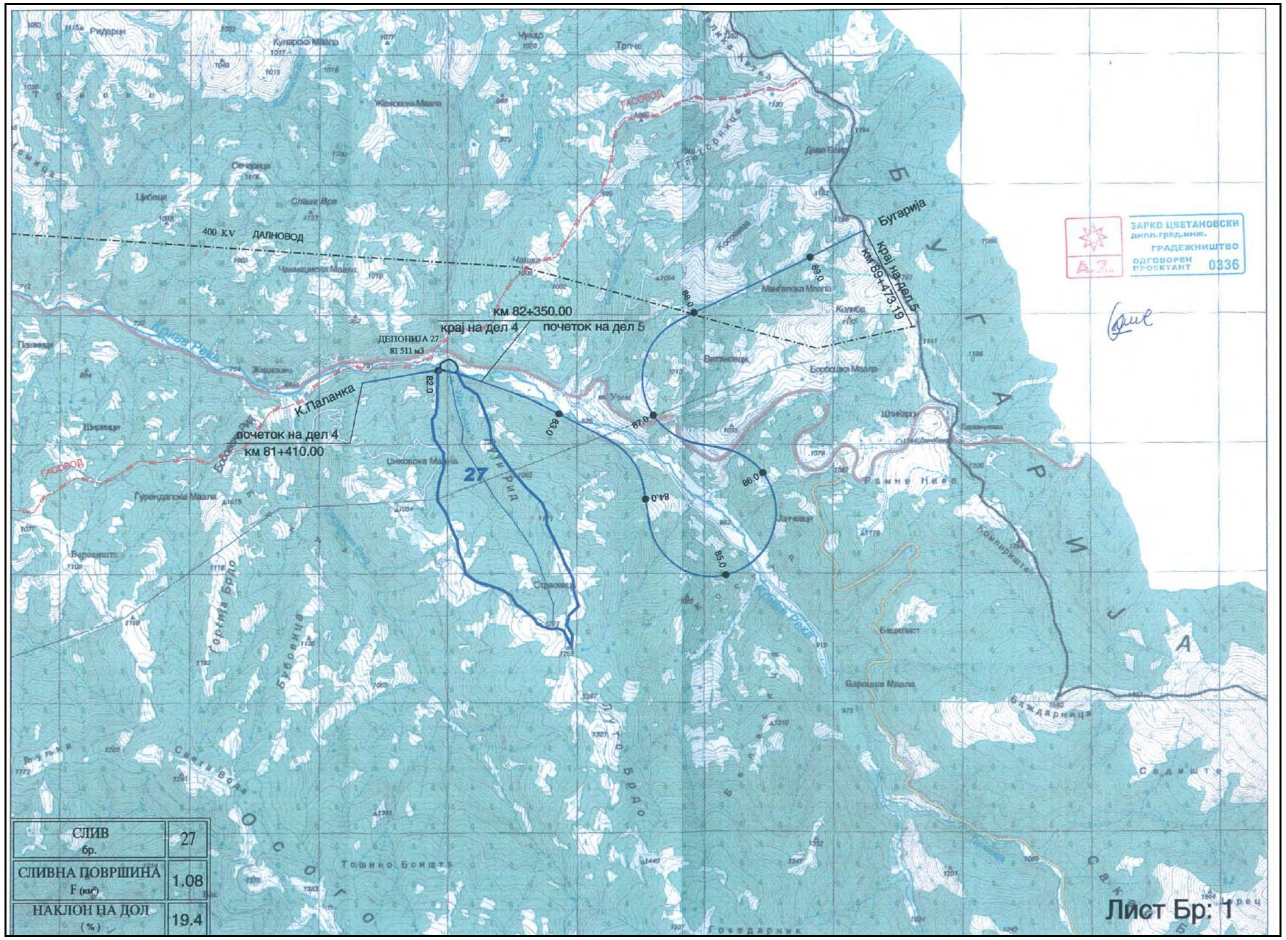
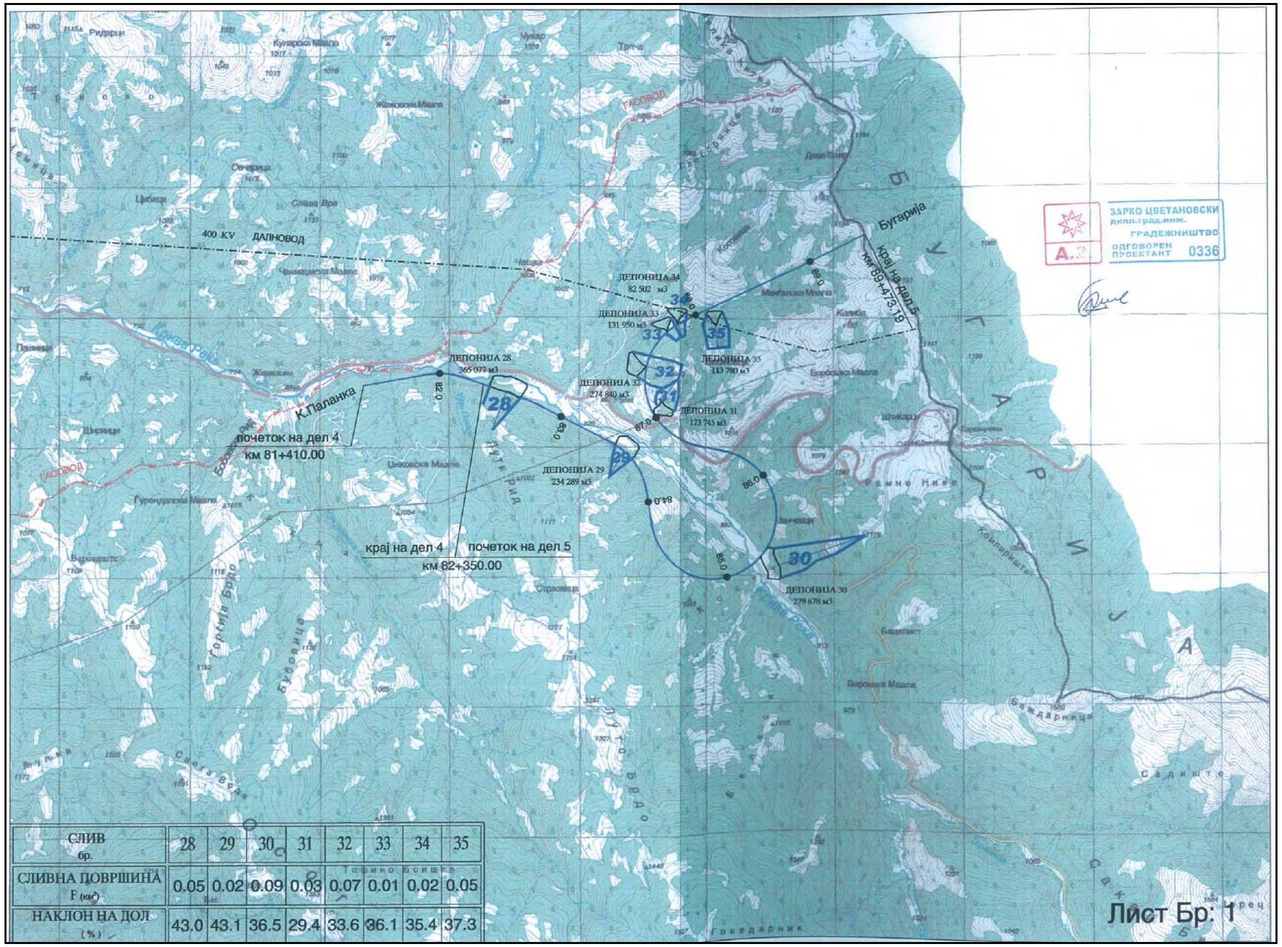


Figure 249 Location of landfills with watersheds (27)



СЛИВ бр.	28	29	30	31	32	33	34	35
СЛИВНА ПОВРШИНА F (км²)	0.05	0.02	0.09	0.03	0.07	0.01	0.02	0.05
НАКЛОН НА ДОЛ (%)	43.0	43.1	36.5	29.4	33.6	36.1	35.4	37.3

Figure 250 Location of landfills with watersheds (28-35)

Annex 11 Alternative analysis

- Cost Comparison between Reference Alignment and Alternative Aligment

TASK 3 | TASK 3

Alt > Ref
Alt < Ref

Reference Alignment - SECTION 3 -					Alternative Alignment - SECTION 3 -					Alt. - Ref (Task 3)	
Description	Unit	Unit price in €	Quantity	Cost in €	Description	Unit	Unit price in €	Quantity	Cost in €		totals
Earthworks					**Earthworks**						
Excavation	m^3	7	895.000	6.265.000	Excavation	m^3	7	915.000	6.405.000	140.000	
Addition for excavation in rock	m^3	5	625.000	3.125.000	Addition for excavation in rock	m^3	5	640.000	3.200.000	75.000	
Addition for bringing on depot	m^3	2		0	Addition for bringing on depot	m^3	2	710.000	1.420.000	1.420.000	
Embankment from excavation	m^3	10	260.000	2.600.000	Embankment from excavation	m^3	10	205.000	2.050.000	-550.000	
Embankment from quarry	m^3	11		0	Embankment from quarry	m^3	11		0	0	
Sub-ballast and drainage	m	80		0	Sub-ballast and drainage	m	80		0	0	
- Open line K.P. 66 - K.P. 89.475	m	80	9.530	762.400	- Open line K.P. 59.6 - K.P. 79.525	m	80	9.120	729.600	-32.800	
- Station Kriva Palanka	m	80	1.960	156.800	- Station Kriva Palanka	m	80	1.960	156.800	0	
- Station Zidilovo	m	80	975	78.000	- Station Zidilovo	m	80	975	78.000	0	
Cleaning and reprofiling of existing slope and c	m	5		0	Cleaning and reprofiling of existing slope and	m	5		0	0	
Sub-Total				12.987.200	**Sub-Total**				14.039.400		1.052.200
Civil Structures					**Civil Structures**						
Road over-/underpass	un	750.000	6	4.500.000	Road over-/underpass	un	750.000	6	4.500.000	0	
Motorway crossing	un	1.500.000	1	1.500.000	Motorway crossing	un	1.500.000	3	4.500.000	3.000.000	
Single track viaduct	m	9.000	4.410	39.690.000	Single track viaduct	m	9.000	1.291	11.619.000	-28.071.000	
Large viaduct (> 500m)	m	15.000		0	Large & high viaduct (L> 500m / H>100m)	m	15.000	2.162	32.430.000	32.430.000	
Double track viaduct	m	15.000		0	Double track viaduct	m	15.000		0	0	
- Station Kriva Palanka 2*80 + 2*70	m	15.000	300	4.500.000	- Station Kriva Palanka 2*80 + 2*70	m	15.000	300	4.500.000	0	
- Station Zidilovo 3 tracks	m	20.000	275	5.500.000	- Station Zidilovo 3 tracks	m	20.000	275	5.500.000	0	
Single track tunnel	m	15.000	8.765	131.475.000	Single track tunnel	m	15.000	5.672	85.080.000	-46.395.000	
Large tunnel (> 2.5km)	m	20.000		0	Large tunnel (> 2.5km)	m	20.000	3.063	61.260.000	61.260.000	
Double track tunnel	m	20.000		0	Double track tunnel	m	20.000		0	0	
- Station Kriva Palanka	m	20.000	150	3.000.000	- Station Kriva Palanka	m	20.000	150	3.000.000	0	
- Station Zidilovo 3 tracks	m	25.000	120	3.000.000	- Station Zidilovo 3 tracks	m	25.000	119	2.975.000	-25.000	
Sub-Total				193.165.000	**Sub-Total**				215.364.000		22.199.000
Permanent Way					**Permanent Way**						
Track with ballast, concrete sleeper and CWR	m	300		0	Track with ballast, concrete sleeper and CWR	m	300		0	0	
- Open line K.P. 65 - K.P. 88.514	m	300	23.423	7.026.957	- Open line K.P. 59.6 - K.P. 79.525	m	300	19.925	5.977.500	-1.049.457	
Station tracks and sidings	m	250		0	Station tracks and sidings	m	250		0	0	
- Station Kriva Palanka	m	250	2.560	640.000	- Station Kriva Palanka	m	250	2.560	640.000	0	
- Station Zidilovo	m	250	1.760	440.000	- Station Zidilovo	m	250	1.760	440.000	0	
Paved-in track	m	1.100		0	Paved-in track	m	1.100		0	0	
Turnouts in line tracks R=500	un	120.000		0	Turnouts in line tracks R=500	un	120.000		0	0	
- Station Kriva Palanka	un	120.000	5	600.000	- Station Kriva Palanka	un	120.000	5	600.000	0	
- Station Zidilovo	un	120.000	4	480.000	- Station Zidilovo	un	120.000	4	480.000	0	
Turnouts in stations R=190	un	80.000		0	Turnouts in stations R=190	un	80.000		0	0	
- Station Kriva Palanka	un	80.000	5	400.000	- Station Kriva Palanka	un	80.000	5	400.000	0	
- Station Zidilovo	un	80.000		0	- Station Zidilovo	un	80.000		0	0	
Rail replacing and re-ballasting	m	280		0	Rail replacing and re-ballasting	m	280		0	0	
Dismantling of track	m	30		0	Dismantling of track	m	30		0	0	
Maintenance facilities and equipment	%	6%	9.586.957	575.217	Maintenance facilities and equipment	%	6%	8.537.500	512.250	-62.967	
Sub-Total				10.162.174	**Sub-Total**				9.049.750		-1.112.424
Signalling & Telecommunication					**Signalling & Telecommunication**						
Signalling Cables (fiber optic)	m	30	23.423	702.696	Signalling	m	30	19.925	597.750	-104.946	
Automatic Block System	un	150.000	6	900.000	Automatic Block System	un	150.000	6	900.000	0	
Addition for turnouts	un	40.000			Addition for turnouts	un	40.000		0	0	
- Station Kriva Palanka	un	40.000	10	400.000	- Station Kriva Palanka	un	40.000	10	400.000	0	
- Station Zidilovo	un	40.000	4	160.000	- Station Zidilovo	un	40.000	4	160.000	0	
Telecommunications	m	70	23.423	1.639.623	Telecommunications	m	70	19.925	1.394.750	-244.873	
Tools, spare parts and maintenance facilities	m	4%	3.802.319	152.093	Tools, spare parts and maintenance facilities	m	4%	3.452.500	138.100	-13.993	
Sub-Total				3.954.412	**Sub-Total**				3.590.600		-363.812
Electrification					**Electrification**						
Open line V=160 km/h	m	155	23.423	3.630.594	Open line V=160 km/h	m	155	19.925	3.088.375	-542.219	
Station tracks	m	140		0	Station tracks	m	140		0	0	
- Station Kriva Palanka	m	140	2.560	358.400	- Station Kriva Palanka	m	140	2.560	358.400	0	
- Station Zidilovo	m	140	1.760	246.400	- Station Zidilovo	m	140	1.760	246.400	0	
Sub station	un	7.500.000	1	7.500.000	Sub station	un	7.500.000	1	7.500.000	0	
Tools, spare parts and maintenance facilities	%	6%	11.735.394	704.124	Tools, spare parts and maintenance facilities	%	6%	11.193.175	671.591	-32.533	
Sub-Total				12.439.518	**Sub-Total**				11.864.766		-574.753
Stations					**Stations**						
Platform	m^2	150		0	Platform	m^2	150		0	0	
- Station Kriva Palanka	m^2	150	1.200	180.000	- Station Kriva Palanka	m^2	150	1.200	180.000	0	
- Station Zidilovo	m^2	150	600	90.000	- Station Zidilovo	m^2	150	600	90.000	0	
- Halt Tlminci	m^2	150	600	90.000	- Halt Tlminci	m^2	150	600	90.000	0	
- Halt Drenja	m^2	150	600	90.000	- Halt Drenja	m^2	150	600	90.000	0	
- Halt Uzem	m^2	150	600	90.000	- Halt Uzem	m^2	150	600	90.000	0	
Platform access	un	900.000		0	Platform access	un	900.000		0	0	
Passenger building	m^2	1.000		0	Passenger building	m^2	1.000		0	0	
- Station Kriva Palanka	m^2	1.000	300	300.000	- Station Kriva Palanka	m^2	1.000	300	300.000	0	
- Station Zidilovo	m^2	1.000	200	200.000	- Station Zidilovo	m^2	1.000	200	200.000	0	
Adminstration/social building	m^3	400		0	Adminstration/social building	m^3	400		0	0	
- Station Kriva Palanka	m^3	400	244	97.600	- Station Kriva Palanka	m^3	400	244	97.600	0	
Warehouse, sheds	m^3	200		0	Warehouse, sheds	m^3	200		0	0	
- Station Kriva Palanka	m^3	200	300	60.000	- Station Kriva Palanka	m^3	200	300	60.000	0	
Access road, parking	m2	75		0	Access road, parking	m^2	75		0	0	
- Station Kriva Palanka	m^2	75	5.500	412.500	- Station Kriva Palanka	m^2	75	9.500	712.500	300.000	
- Station Zidilovo	m^2	75	2.100	157.500	- Station Zidilovo	m^2	75	2.100	157.500	0	
- Halt Tlminci	m^2	75	2.500	187.500	- Halt Tlminci	m^2	75	4.500	337.500	150.000	
- Halt Drenja	m^2	75	2.500	187.500	- Halt Drenja	m^2	75	12.500	937.500	750.000	
- Halt Uzem	m^2	75	2.500	187.500	- Halt Uzem	m^2	75	2.500	187.500	0	
Hardened surface (freight yard)	m^2	45		0	Hardened surface (freight yard)	m^2	45		0	0	
- Station Kriva Palanka	m^2	45		0	- Station Kriva Palanka	m^2	45		0	0	
- Station Zidilovo	m^2	45		0	- Station Zidilovo	m^2	45		0	0	
Gantry crane	un	2.700.000		0	Gantry crane	un	2.700.000		0	0	
Water, gas and electricity supply	un	150.000		0	Water, gas and electricity supply	un	150.000		0	0	
- Station Kriva Palanka	un	150.000	1	150.000	- Station Kriva Palanka	un	150.000	1	150.000	0	
- Station Zidilovo	un	150.000	1	150.000	- Station Zidilovo	un	150.000	1	150.000	0	
Water treatment	un	100.000		0	Water treatment	un	100.000		0	0	
- Station Kriva Palanka	un	100.000	1	100.000	- Station Kriva Palanka	un	100.000	1	100.000	0	
- Station Zidilovo	un	100.000	1	100.000	- Station Zidilovo	un	100.000	1	100.000	0	
Noise protection wall	m	1.500	500	750.000	Noise protection wall	m	1.500	1.300	1.950.000	1.200.000	
Sub-Total				3.580.100	**Sub-Total**				5.980.100		2.400.000
Mitigation measures (including land adquisition)											
Total				236.288.404					259.888.616		23.600.211
Contingencies	%	15%		35.443.261	Contingencies	%	15%		38.983.292		3.540.032
Engineering	%	6%		14.177.304	Engineering	%	6%		15.593.317		1.416.013
Total				**285.908.969**	**Total**				**314.465.225**		28.556.256
Land adquisition				6.300.000					2.800.000	-3.500.000	
Total				**292.208.969**	**Total**				**317.265.225**		

- **Evaluation matrix**

	Parameters	Indicator Value	Alt 1		Alt 2		Alt 3	
			Standard	Weighted	Standard	Weighted	Standard	Weighted
Railway Infrastructure	Alignment parameters (speed limitations)	20,00	3,00	60,00	3,00	60,00	3,00	60,00
	Compatibility with EC directives/standards	30,00	3,00	90,00	3,00	90,00	0,00	0,00
	Load Capacity	20,00	2,00	40,00	3,00	60,00	2,00	40,00
	Ballast ejection	15,00	2,00	30,00	5,00	75,00	2,00	30,00
	Eddy current brake	15,00	2,00	30,00	4,00	60,00	2,00	30,00
				2,50		3,45		1,60
Performance of construction works	Duration of construction works	60,00	3,00	180,00	1,00	60,00	3,00	180,00
	Standardisation of structural systems	40,00	4,00	160,00	2,00	80,00	4,00	160,00
				3,40		1,40		3,40
Train operation	Traffic restriction	50,00	3,00	150,00	3,00	150,00	0,00	0,00
	Line capacity	50,00	3,00	150,00	3,00	150,00	1,00	50,00
				3,00		3,00		0,50
Travelling comfort	Travelling time	50,00	3,00	150,00	3,00	150,00	1,00	50,00
	Attractiveness for passenger journeys	50,00	3,00	150,00	3,00	150,00	1,00	50,00
				3,00		3,00		1,00
Safety and maintenance	Effect of level crossings on safety of railway line	40,00	5,00	200,00	5,00	200,00	0,00	0,00
	Effect of structures on availability of the line	30,00	1,00	30,00	4,00	120,00	1,00	30,00
	Effect of track on availability of the line	30,00	2,00	60,00	1,00	30,00	2,00	60,00
				2,90		3,50		0,90
Investment Costs	Construction costs	50,00	3,00	150,00	1,00	50,00	4,00	200,00
	Maintenance costs	50,00	2,00	100,00	3,00	150,00	2,00	100,00
				2,50		2,00		3,00
Risks of realization	Risk of the technical solution	100,00	3,00	300,00	1,00	100,00	3,00	300,00
				3,00		1,00		3,00
Risks of costs	Risks of unexpected costs	100,00	3,00	300,00	3,00	300,00	3,00	300,00
				3,00		3,00		3,00
Social Impact	Noise and vibrations	100,00	4,00	400,00	2,00	200,00	4,00	400,00
				4,00		2,00		4,00
Soil	Forestry and climate change	100,00	4,00	400,00	1,00	100,00	4,00	400,00
				4,00		1,00		4,00
Water	Protected areas	100,00	4,00	400,00	1,00	100,00	4,00	400,00
				4,00		1,00		4,00
Landscape	Visual impact	100,00	1,00	100,00	3,00	300,00	1,00	100,00
				1,00		3,00		1,00

Summary matrix

Parameters	Indicator Value	Alt 1		Alt 2		Alt 3	
		Standard	Weighted	Standard	Weighted	Standard	Weighted
Railway infrastructure	5,00	2,50	12,50	3,45	17,25	1,60	8,00
Performance of construction works	10,00	3,40	34,00	1,40	14,00	3,40	34,00
Train operation	10,00	3,00	30,00	3,00	30,00	0,50	5,00
Travelling comfort	10,00	3,00	30,00	3,00	30,00	1,00	10,00
Safety and maintenance	15,00	2,90	43,50	3,50	52,50	0,90	13,50
Investment Costs	15,00	2,50	37,50	2,00	30,00	3,00	45,00
Risks of realization	5,00	3,00	15,00	1,00	5,00	3,00	15,00
Risks of costs	5,00	3,00	15,00	3,00	15,00	3,00	15,00
Social Impact	10,00	4,00	40,00	2,00	20,00	4,00	40,00
Soil	5,00	4,00	20,00	1,00	5,00	4,00	20,00
Water	5,00	4,00	20,00	1,00	5,00	4,00	20,00
Landscape	5,00	1,00	5,00	3,00	15,00	1,00	5,00
			3,03		2,39		2,31

- **Summary of compliance with the objectives**

OBJECTIVES	PARAMETERS	Without project	ALT. 1	ALT. 2	ALT. 3
Improve Accessibility for passenger traffic	Improve horizontal geometry Improve speed	✗	✓	✓	✗
	New stations and stops	✗	✓	✓	✓
Improve Accessibility for freight traffic	Load Capacity	✗	✓	✓	✓
Improve Operational Interoperability	Full electrification	✗	✓	✓	✓
	Safety system. ETCS level 1. Possible upgrade to L2 at corridor level	✗	✓	✓	✓
	Traffic management	✗	✗	✓	✓
Enhance Capacity	Implementation of signalling subsystems	✗	✓	✓	✓
	Level crossings	✗	✓	✓	✗
Improve Safety	Implementation of signalling subsystems	✗	✓	✓	✓
	Level crossings	✗	✓	✓	✗
Improve Energy efficiency	Electrification	✗	✓	✓	✓
Minimize Environmental Impact	Noise protection	✗	✓	✓	✓
	Vibrations	✗	✓	✓	✓
Climate change mitigation	Reduction of carbon footprint	✗	✓	✓	✓
Adaptation to climate change	Resilient to floods	✗	✓	✓	✓
	Landslides	✗	✓	✓	✓
	Temperature effects. Avoid CWR buckling	✗	✓	✓	✓
Improve LOS for passengers at stations	PIS (Passenger Information Systems) at stations and stops Accessibility to platforms Platform furniture	✗	✓	✓	✓
Improve Inter-Modality	New parking areas	✗	✓	✓	✓
Improve Security	Video surveillance at stations and stops	✗	✓	✓	✓
	Buried new telecommunication railway-related cable	✗	✓	✓	✓

Annex 12 Freight traffic and passenger traffic analysis

Freight traffic volume

Based on the results of the transport model and demand forecast the freight transport along the section Kriva Palanka – Bulgarian State Border and Corridor VIII will present the following annual volumes.

Table 112 Annual Freight transport volumes 2015-2050 for section Kriva Palanka – Bulgarian State Border

	2015	2022	2025	2030	2035	2040	2046	2050
"Without project" alternative								
Annual tons by train	0	0	0	0	0	0	0	0
Annual tons by truck	653.400	969.900	1.092.900	1.378.352	1.640.454	1.952.395	2.405.981	2.750.264
total annual tons	653.400	969.900	1.092.900	1.378.352	1.640.454	1.952.395	2.405.981	2.750.264
"With project" alternative								
Annual tons by train	0	0	810.900	1.022.697	1.217.169	1.448.620	1.785.168	2.040.616
Annual tons by truck	653.400	969.900	986.400	1.244.036	1.480.596	1.762.140	2.171.525	2.482.258
total annual tons	0	969.900	1.797.300	2.266.733	2.697.765	3.210.760	3.956.693	4.522.874
Differences								
Annual tons by train	0	0	810.900	1.022.697	1.217.169	1.448.620	1.785.168	2.040.616
Annual tons by truck	0	0	-106.500	-134.317	-159.858	-190.255	-234.456	-268.005
total difference tons	0	0	704.400	888.381	1.057.311	1.258.365	1.550.712	1.772.610

Table 113 Annual Freight transport volumes 2015-2050 for Corridor VIII

	2015	2022	2025	2030	2035	2040	2046	2050
"Without project" alternative								
Annual tons by train	152.400	241.500	276.844	349.152	415.545	494.563	609.461	696.672
Annual tons by truck	4.900.500	7.254.900	8.316.656	10.488.867	12.483.384	14.857.168	18.308.827	20.928.720
total annual tons	5.052.900	7.496.400	8.593.500	10.838.019	12.898.929	15.351.731	18.918.288	21.625.392
"With project" alternative								
Annual tons by train	152.400	241.500	1.090.500	2.360.400	2.809.243	3.343.436	4.250.400	4.858.609
Annual tons by truck	4.900.500	7.254.900	8.207.400	9.366.000	11.146.997	13.266.660	16.218.600	18.539.393
total annual tons	0	7.496.400	9.297.900	11.726.400	13.956.240	16.610.096	20.469.000	23.398.002
Differences								
Annual tons by train	0	0	813.656	2.011.248	2.393.698	2.848.873	3.640.939	4.161.937
Annual tons by truck	0	0	-109.256	-1.122.867	-1.336.387	-1.590.508	-2.090.227	-2.389.327
total difference tons	0	0	704.400	888.381	1.057.311	1.258.365	1.550.712	1.772.610

Related to the performance in tonne-km the freight traffic the following annual volumes could be expected.

Table 114 Annual Freight transport performance 2015-2050 for section Kriva Palanka-Bulgarian State Border (in '000 ton-km)

	2015	2022	2025	2030	2035	2040	2046	2050
"Without project" alternative								
Annual '000 tons-Km by train	0	0	0	0	0	0	0	0
Annual '000 tons-Km by truck	15.747	23.375	26.339	33.218	39.535	47.053	57.984	66.281
total annual '000 tons-Km	15.747	23.375	26.339	33.218	39.535	47.053	57.984	66.281
"With project" alternative								
Annual '000 tons-Km by train	0	0	19.218	24.238	28.847	34.332	42.308	48.363
Annual '000 tons-Km by truck	15.747	23.375	23.772	29.981	35.682	42.468	52.334	59.822
total annual '000 tons-Km	15.747	23.375	42.991	54.219	64.529	76.800	94.642	108.185

Passenger traffic

Passenger traffic volume

Based on the results of the transport model and demand forecast the passengers transport along the section Kriva Palanka – Bulgarian State Border and Corridor VIII will present the following annual volumes.

Table 115 Annual Passenger transport volumes 2015-2050 for section Kriva Palanka – Bulgarian State Border

	2015	2022	2025	2030	2035	2040	2046	2050
"Without project" alternative								
Annual Passengers by train	0	0	0	0	0	0	0	0
Annual Passengers by bus	40.800	51.600	54.095	62.321	68.850	76.063	85.722	92.789
Annual Passengers by car	1.342.500	1.698.000	1.780.105	2.050.785	2.265.632	2.502.988	2.820.863	3.053.393
total annual passengers	1.383.300	1.749.600	1.834.200	2.113.106	2.334.482	2.579.051	2.906.586	3.146.182
"With project" alternative								
Annual Passengers by train	0	0	38.100	43.893	48.492	53.572	60.376	65.352
Annual Passengers by bus	40.800	51.600	26.400	30.414	33.601	37.121	41.835	45.284
Annual Passengers by car	1.342.500	1.698.000	1.769.700	2.038.798	2.252.390	2.488.358	2.804.375	3.035.546
total annual passengers	0	1.749.600	1.834.200	2.113.106	2.334.482	2.579.051	2.906.586	3.146.182
Differences								
Annual Passengers by train	0	0	38.100	43.893	48.492	53.572	60.376	65.352
Annual Passengers by bus	0	0	-27.695	-31.906	-35.249	-38.942	-43.887	-47.505
Annual Passengers by car	0	0	-10.405	-11.987	-13.243	-14.630	-16.488	-17.847
total difference passengers	0	0	0	0	0	0	0	0

Table 116 Annual Passengers transport volumes 2015-2050 for Corridor VIII

	2015	2022	2025	2030	2035	2040	2046	2050
"Without project" alternative								
Annual Passengers by train	117.300	267.000	290.512	334.686	369.749	408.485	460.362	498.311
Annual Passengers by bus	1.874.700	2.317.800	2.521.901	2.905.377	3.209.755	3.546.021	3.996.359	4.325.788
Annual Passengers by car	59.184.000	74.777.700	81.362.487	93.734.336	103.554.283	114.403.002	128.931.979	139.560.120
total annual passengers	61.176.000	77.362.500	84.174.900	96.974.400	107.133.787	118.357.508	133.388.700	144.384.219
"With project" alternative								
Annual Passengers by train	117.300	267.000	328.800	724.800	800.733	884.620	1.009.500	1.092.715
Annual Passengers by bus	1.874.700	2.317.800	2.489.700	2.838.600	3.135.982	3.464.519	3.906.000	4.227.980
Annual Passengers by car	59.184.000	74.777.700	81.356.400	93.411.000	103.197.072	114.008.369	128.473.200	139.063.523
total annual passengers	0	77.362.500	84.174.900	96.974.400	107.133.787	118.357.508	133.388.700	144.384.219
Differences								
Annual Passengers by train	0	0	38.288	390.114	430.983	476.135	549.138	594.404
Annual Passengers by bus	0	0	-32.201	-66.777	-73.773	-81.502	-90.359	-97.808
Annual Passengers by car	0	0	-6.087	-323.336	-357.210	-394.633	-458.779	-496.597
total difference passengers	0	0	0	0	0	0	0	0

Related to the performance in passengers-km the passengers' traffic the following annual volumes could be expected.

Table 117 Annual Passengers transport performance 2015-2050 for section Kriva Palanka – Bulgarian State Border (in '000 ton-km)

	2015	2022	2025	2030	2035	2040	2046	2050
"Without project" alternative								
Annual '000 Passengers-Km by train	0	0	0	0	0	0	0	0
Annual '000 Passengers-Km by bus	983	1.244	1.304	1.502	1.659	1.833	2.066	2.236
Annual '000 Passengers-Km by car	32.354	40.922	42.901	49.424	54.602	60.322	67.983	73.587
total annual '000 passengers-Km	33.338	42.165	44.204	50.926	56.261	62.155	70.049	75.823
"With project" alternative								
Annual '000 Passengers-Km by train	0	0	903	1.040	1.149	1.270	1.431	1.549
Annual '000 Passengers-Km by bus	983	1.244	636	733	810	895	1.008	1.091
Annual '000 Passengers-Km by car	32.354	40.922	42.650	49.135	54.283	59.969	67.585	73.157
total annual '000 passengers-Km	33.338	42.165	44.189	50.908	56.242	62.134	70.025	75.797

Table 118 Annual Passengers transport performance 2015-2050 for Corridor VIII (in '000.000 ton-km)

	2015	2022	2025	2030	2035	2040	2046	2050
"Without project" alternative								
Annual '000.000 Passengers-Km by train	20	47	51	58	65	71	80	87
Annual '000.000 Passengers-Km by bus	290	358	390	449	496	548	618	669
Annual '000.000 Passengers-Km by car	9.153	11.564	12.582	14.496	16.014	17.692	19.939	21.583
total annual '000.000 passengers-Km	9.463	11.969	13.023	15.003	16.575	18.312	20.637	22.338
"With project" alternative								
Annual Passengers-Km by train	20	47	57	126	140	154	176	191
Annual Passengers-Km by bus	290	358	385	439	485	536	604	654
Annual Passengers-Km by car	9.153	11.564	12.582	14.446	15.959	17.631	19.868	21.506
total annual '000.000 passengers-Km	9.463	11.969	13.024	15.011	16.584	18.321	20.648	22.350

Annex 13 Results from the geotechnical survey and the tests for aggressiveness of water

Table 119 Values according to the SHRV test

Measuring point	Coordinates		Values according to the SHRV test									
	Y	X	1	2	3	4	5	6	7	8	9	10
MSH-1	7 604 663	4 671 904	18	22	32	15	29	32	9	29	28	14
MSH-2	7 605 021	4 672 171	42	35	28	40	38	42	32	36	33	30
			18	29	28	39	35	34	28	32	40	43
			43	26	40	30	36	40	41	42	30	32
MSH-B	7 604 963	4 672 159	22	24	25	20	22	15	18	18	22	26
			26	20	21	28	26	26	27	20	25	25
			31	21	31	29	22	29	27	28	27	34
MSH-4	7 605 183	4 672 282	30	26	41	12	23	30	28	16	26	24
			39	32	18	29	38	38	26	30	26	18
MSH-5	7 605 599	4 672 495	22	36	25	38	42	44	44	52	43	40
			32	39	44	37	44	33	39	52	30	43
MSH-6	7 605 694	4 672 519	20	8	14	27	29	33	16	32	18	28
			47	36	46	40	45	44	45	40	14	48
MSH-7	7 605 798	4 672 563	30	36	34	28	28	30	28	30	29	24
MSH-8	7 605 962	4 672 608	28	32	20	27	32	25	25	19	28	37
			16	13	21	25	25	12	22	23	8	13
MSH-9	7 606 105	4 672 665	41	19	36	41	31	31	46	39	39	25
			27	37	38	42	38	25	36	34	29	33
MSH - 10	7 606 186	4 672 690	27	30	32	22	22	29	24	25	29	25
			33	29	35	38	31	25	34	24	29	21
			32	31	32	28	29	33	33	24	41	32
MSH-11	7 606 243	4 672 702	32	28	37	33	24	23	25	21	13	22
			26	34	35	34	39	39	32	30	32	28
MSH -12	7 606 320	4 672 708	21	16	17	26	17	26	21	24	26	30
MSH -13	7 607 238	4 672 928	33	26	29	27	23	33	33	34	34	30
			37	35	44	31	36	27	32	31	29	33
MSH -14	7 607 492	4 673 069	16	25	30	21	31	24	26	30	24	23
			38	44	36	32	54	25	31	36	35	37
MSH-15	7 607 609	4 673 114	30	29	28	27	27	28	27	34	31	36
MSH -16	7 608 058	4 673 182	22	20	19	23	22	15	15	15	15	15
			36	30	28	28	27	26	38	42	28	47
MSH-17	7 608 192	4 673 233	26	33	28	18	26	36	18	15	28	30
MSH - 18	7 608 336	4 673 331	24	36	27	15	33	36	33	28	15	36
MSH -19	7 609 140	4 673 551	18	33	19	36	16	36	20	12	33	30

MSH-20	7 610 240	4 674 059	22	36	25	20	36	22	38	18	22	20
MSH-21	7 611345	4 675131	34	40	30	42	32	40	40	38	38	40
MSH-22	7 612112	4 676 085	22	20	16	18	22	28	24	20	17	16
MSH-23	7 612 799	4 677 382	23	30	24	15	37	28	20	40	40	34
MSH-24	7 613 337	4 677 820	32	27	32	26	26	26	23	24	24	27
MSH-25	7 613 995	4 677 310	41	36	32	36	40	34	35	31	38	35
			34	43	42	30	46	25	40	43	43	37
MSH-26	7 614 001	4 677 296	54	45	48	40	54	43	51	50	39	40
			40	39	30	46	36	38	34	32	44	38
MSH-27	7 614 064	4 677 197	26	24	16	24	26	20	18	20	22	23
			42	26	45	22	38	46	35	30	32	37
MSH - 28	7 615 662	4 676 593	16	20	20	20	22	19	19	21	20	20
			40	28	19	21	16	19	24	29	16	22
MSH - 29	7 615 841	4 676 508	20	18	15	15	21	19	21	21	23	22
			18	16	16	13	14	16	19	16	17	21
MSH - 30	7 615 842	4 676 481	40	40	47	36	45	36	40	36	45	38
			32	56	62	55	51	51	38	48	56	54
MSH-31	7 616 749	4 676 552	37	23	39	37	38	38	26	37	39	39
			35	20	23	22	20	23	29	18	17	19
MSH-32	7 616 779	4 676 569	21	23	24	23	18	30	35	22	31	25
MSH-33	7 617 128	4 676 527	23	24	22	28	24	19	28	26	30	26
			25	27	21	25	28	24	24	22	22	25
MSH-34	7 617 135	4 676 532	22	17	29	28	28	31	31	30	28	25
			38	34	37	24	42	43	23	38	44	39
MSH-35	7 618 442	4 675 833	20	25	28	35	31	31	27	28	37	46
MSH - 36	7 618 538	4 675 404	38	37	34	40	31	37	36	39	31	39
			21	20	23	16	24	18	18	30	20	26
MSH-37	7 619 474	4 675 211	40	35	40	25	39	40	38	43	39	37
			40	41	51	51	37	50	53	52	49	49
MSH - 38	7 618 817	4 676 075	24	26	30	30	30	25	29	31	21	32
MSH - 39	7 618 527	4 676 624	22	23	25	21	28	29	25	20	22	24
MSH - 40	7 619 283	4 677 242	36	44	37	39	42	39	45	32	39	36
			39	45	32	32	48	30	30	35	37	48
MSH-41	7 620 230	4 677 631	46	50	45	42	50	35	45	40	39	44

Table 120 Depth of the boreholes, their coordinates and number of selected samples

Borehole	Depth m	Facility	Coordinates		No of samples	No of SPT[86]
			Y	X		
BV-65+697	15	Viaduct 2	7 604 663	4 671 909	2	

[86] Standard Penetration Test (SPT)

BV-65+952	20	Viaduct 3	7 604 883	4 672 042	7	4
BT-66+132	20	Tunnel 1	7 605 024	4 672 147	2	
BT-66+345	20		7 605 182	4 672 286	3	
BV-66+817	20	Viaduct 5	7 605 597	4 672 494	2	
BT-66+906	20	Tunnel 2	7 605 693	4 672 526	3	
BT-67+017	20,3		7 605 806	4 672 563	4	
BT-67+187	25	Tunnel l 3	7 605 961	4 672 615	4	
BT-67+349	20		7 606 102	4 672 657	2	
BV-67+422	15	Viaduct 3	7 606 210	4 672 686	3	
BT-67+482	20	Tunnel 4	7 606 242	4 672 706	2	
BT-67+567	20		7 606 319	4 672 706	4	
BV-68+537	15	Viaduct 10	7 607 248	4 672 927	3	
BT-68+830	20	Tunnel 5	7 607 492	4 673 069	3	
BT-68+947	20		7 607 608	4 673 106	3	
BV-69+432	15	Viaduct 14	7 608 081	4 673 176	2	
BC-69+531	20	Cut	7 608 176	4 673 233	4	
BV-69+722	15	Viaduct 15	7 608 331	4 673 334	3	2
BV-70+032	15	Viaduct 16	7 608 620	4 673 442	5	2
BT-70+552	25	Tunnel 6	7 609 135	4 673 546	5	
BT-70+646	25		7 609 210	4 673 596	4	
BV-71+367	15	Viaduct 20	7 609 871	4 673 874	6	2
BV-71+587	15	Viaduct 21	7 610 067	4 673 954	4	1
BT-71+692	30	Tunnel 7	7 610 164	4 674 018	5	
BV-71+767	15	Viaduct 22	7 610 240	4 674 057	2	
BT-71+892	50	Tunnel 8	7 610 355	4 674 153	5	
BT-72+272	20		7 610 465	4674 497	6	
BT-72+562	38,5		7 610 552	4 674 679	10	5
BV-72+887	31	Viaduct 23	7 610 888	4 674 943	8	11
BV-73+372	16	Viaduct 25	7 611 345	4 675 130	4	2
BV-73+697	15	Viaduct 26	7 611 538	4 675 371	8	1
BT-73+900	50	Tunnel 9	7 611 662	4 675 539	7	
BV-74+272	25	Viaduct 28	7 611934	4 675 792	7	10
BV-74+352	15.4		7 611 974	4 675 864	8	4
BT-74+437	20	Tunnel 10	7 612 017	4 675 925	5	
BT-74+597	20	Tunnel 11	7 612 098	4 676 073	4	
BT-74+692	50		7 612 142	4 676 155	5	
BV-74+825	15	Viaduct 29	7 612 216	4 676 247	2	
BT-75+117	30	Tunnel 11 a	7 612 396	4 676 493	6	
BV-75+337	20	Viaduct 30	7 612 478	4 676 689	5	3
BV-75+402	30		7 612 508	4 676 764	7	2
BV-75+782	15	Viaduct 31	7 612 669	4 677 096	6	
BT-76+132	20	Tunnel 12	7 612 791	4 677 415	4	
BV-76+517	21	Viaduct 32	7 613 010	4 677 724	5	5
BT-76+857	135	Tunnel 13	7 613 344	4 677 823	4	
BT-77+108	165		7 613 536	4 677 725	8	
BV-77+737	15	Viaduct 33	7 614 006	4 677 304	4	
BT-77+820	20	Tunnel 14	7 614 081	4 677 252	4	
BT-79+492	60	Tunnel 16	7 615 597	4 676 708	S	
BT-79+702	33		7 615 763	4 676 555	3	

BV-79+877	29	Viaduct 37	7 615 942	4 676 469	6	7
BV-80+037	15	Viaduct 37	7 616 083	4 676 443		2
BT-80+692	15	Viaduct 39	7 616 717	4 676 542	4	
BV-81+112	15	Viaduct 40	7 617128	4 676 521	3	
BV-82+092	15	Viaduct 42	7 618 034	4 676 152	5	3
BT-82+670	30	Tunnel 19	7 618 486	4 675 795	5	1
BT-82+872	125		7 618 531	4 675 598	15	
BT-83+530	170		7 618 823	4 675 033	9	
BT-84-070	20		7 619 317	4 675 084	6	
BV-84+152	19.8	Viaduct 44	7 619 383	4 675 104	1	6
BT-84+277	20.5	Tunnel 20	7 619472	4 675 201	5	2
BT-84+842	110		7 619 487	4 675 748	10	
BT-85+182	50		7 619 230	4 675 956	6	
BV-85+595	25		7 618 822	4 676 053	4	2
BV-85+655	19	Viaduct 46	7 618 759	4 676 081	5	2
BV-85+790	16		7 618 644	4 676 173	4	2
BT-8S+963	25	Tunnel 21	7 618 550	4 676 289	5	2
BT-86+142	30		7 618 506	4 676 459	7	2
BV-86+297	15.3	Viaduct 47	7 618 531	4 676 612	5	2
BT-87+372	35	Tunnel 22	7 619 317	4 677 211	10	2
BT-87+712	135.9	Tunnel 22	7 619 651	4 677 366	3	
BT-88+322	220		7 620 227	4 677 635	2	
TOTAL						
72	2565,70				350,00	89,00

Table 121 Tabular summary of the groundwater in boreholes at the railway alignment

CLIENT/КЛИЕНТ idom

ТАБЕЛАРЕН ПРЕГЛЕД ОД МОНИТОРИНГ НА НИВО НА ПОДЗЕМНА ВОДА ВО ДУПНАТИНИ ИЗВЕДЕНИ НА ТРАСА НА ПРУГАТА

PROJECT NAME / ПРОЕКТ: New railway section Kriva Palanka - Border with R. Bulgaria / Нова железничка пруга на делница Крива Паланка - граница со Р. Бугарија

GEOHYDRO GHC CONSULTING — SUBCONTRACTOR / ПОДИЗВЕДУВАЧ

PAGES / СТРАНА: 1 of 2

BOREHOLES / ДУПНАТИНИ				Date / Датум GWT / НПВ (m)																											
Ред. Бр.	Reference Стационажа (PK)	Length Должина (m)	Piezometers Пиезометар	28.05.2016	08.06.2016	09.06.2016	11.06.2016	16.06.2016	21.06.2016	23.06.2016	24.06.2016	26.06.2016	29.06.2016	30.06.2016	06.07.2016	07.07.2016	14.07.2016	27.07.2016	03.08.2016	06.08.2016	12.08.2016	17.08.2016	20.08.2016	03.09.2016	03.10.2016	05.10.2016	07.10.2016	21.10.2016	27.10.2016	28.10.2016	01.11.2016
1	65+697	15	√	5,50	-	-	8,10	-	-	-	-	7,50	-	-	-	-	8,30	-	-	-	-	-	-	-	-	-	-	-	filled	-	-
2	65+952	20	√	-	-	-	0,80	-	-	-	-	0,90	-	-	-	-	1,00	-	-	-	-	-	-	-	-	-	-	0,90	0,90	-	-
3	66+132	20		-	-	-	16,40	-	-	-	-	16,50	-	-	-	-	/	-	-	-	-	-	-	-	-	-	-	-	/	-	-
4	66+345	20		-	-	-	-	-	-	/	-	/	-	-	-	-	/	-	-	-	-	-	-	-	-	-	-	-	/	-	-
5	66+817	20	√	-	-	-	8,00	-	-	-	-	8,10	-	-	-	-	8,60	-	-	8,60	-	-	-	-	-	-	-	-	8,25	-	-
6	66+906	20		-	-	-	/	-	-	/	-	/	-	-	-	-	/	-	-	-	-	-	-	-	-	-	-	-	/	-	-
7	67+017	20,3	√	-	-	8,00	18,60	-	-	/	-	/	-	-	-	-	/	-	-	-	-	-	-	-	-	-	-	-	/	-	-
8	67+187	25	√	-	-	-	21,50	-	-	/	-	/	-	-	-	-	/	-	-	-	-	-	-	-	-	-	-	-	/	-	-
9	67+349	20	√	-	-	-	13,20	-	-	/	-	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-
10	67+422	15		-	-	-	/	-	-	/	-	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-
11	67+482	20		-	-	-	/	-	-	/	-	/	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-
12	67+567	20		-	-	-	17,30	-	-	/	-	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-
13	68+537	15		-	-	-	-	11,10	-	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-
14	68+830	20		-	-	-	-	/	-	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-
15	68+947	20		-	-	-	-	-	-	/	/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-
16	69+432	15		-	-	6,40	-	-	-	-	-	-	-	-	-	-	/	-	-	-	-	-	-	-	-	-	-	-	/	-	-
17	69+531	20		-	-	-	-	-	-	-	-	-	-	-	-	-	5,00	5,00	-	-	-	-	-	-	-	-	-	-	/	-	-
18	69+722	15	√	-	-	-	-	-	-	-	3,80	-	-	-	-	-	6,20	-	-	-	-	-	-	-	-	-	-	-	/	-	-
19	70+032	15	√	-	-	-	-	-	-	-	2,40		-	-	-	-	2,90	-	-	-	-	-	-	-	-	-	-	-	2,8	-	-
20	70+552	25	√	-	-	-	-	-	-	-	-	-	-	7,60	-	-	8,00	8,20	-	-	-	-	-	-	-	-	-	-	9,7	-	-
21	70+646	25		-	-	-	-	-	-	-	12,40	-	-	-	-	-	19,00	-	-	-	-	-	-	-	-	-	-	-	19,2	-	-
22	71+367	15	√	-	-	-	-	-	-	-	3,70	-	-	-	-	-	4,80	-	-	-	-	-	-	-	-	-	-	-	3,2	-	-
23	71+587	15	√	-	-	-	-	-	-	-	6,90	-	-	-	-	-	7,00	-	-	-	-	-	-	-	-	-	-	-	7,2	-	-
24	71+692	30	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16,80	-	20,10	-	-	-	-	-	24,1	-	-
25	71+767	15		-	-	-	-	-	-	-	2,20	-	-	-	-	-	2,30	-	-	-	-	-	-	-	-	-	-	-	2,4	-	-
26	71+892	50	√	-	-	-	-	-	-	-	-	-	-	-	-	-	20,20	-	-	-	-	-	-	-	-	-	-	-	29,3	-	-
27	72+272	20		-	-	-	-	-	-	-	-	-	-	-	-	-	8,20	8,35	-	-	-	-	-	-	-	-	-	-	filled	-	-
28	72+562	38,5	√	-	-	-	-	-	-	-	-	-	-	-	-	-	/	17,80	-	-	-	-	-	-	-	-	-	-	20,9	-	-
29	72+887	31	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,80	-	-	-	-	-	-	-	9,0	-	-
30	73+372	16	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,5	-	8,10
31	73+697	15		-	-	-	-	-	-	-	-	-	-	10,70	-	-	10,70	-	-	-	-	-	-	-	-	-	-	-	collapse	-	-
32	73+900	50	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27,30	-	-	-	-	-	-	-	/	-	-
33	74+272	25	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,00	-	-	-	-	-	-	-	-	-	-	3,9	-	-
34	74+352	15,4	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,80	-	-	-	-	-	-	-	-	-	-	6,9	-	-
35	74+437	20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,10	-	-	-	-	-	-	-	-	-	-	13,7	-	-
36	74+597	20	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,70	-	-	-	-	-	-	-	9,6	-	-
37	74+692	50		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41,00	-	-	-	-	-	-	-	31,6	-	-
38	74+825	15		-	-	-	-	-	-	-	-	-	-	4,60	-	-	/	-	-	-	-	-	-	-	-	-	-	-	collapse	-	-
39	75+117	30	√	-	-	-	-	-	-	-	-	-	-	-	-	-	26,20	23,20	-	-	-	-	-	-	-	-	-	-	22,9	-	-
40	75+337	20	√	-	-	-	-	-	-	-	-	-	-	4,90	-	-	5,00	-	-	-	-	-	-	-	-	-	-	-	5,1	-	-
41	75+402	30	√	-	-	-	-	-	-	-	-	-	-	-	-	5,00	7,30	-	-	-	-	-	-	-	-	-	-	-	7,5	-	-
42	75+782	15		-	-	-	-	-	-	-	-	-	-	-	-	-	4,00	-	-	-	-	-	-	-	-	-	-	-	4,15	-	-
43	76+132	20	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12,30	-	-	-	-	-	-	-	12,0	-	-

CLIENT/КЛИЕНТ idom

ТАБЕЛАРЕН ПРЕГЛЕД ОД МОНИТОРИНГ НА НИВО НА ПОДЗЕМНА ВОДА ВО ДУПНАТИНИ ИЗВЕДЕНИ НА ТРАСА НА ПРУГАТА

PROJECT NAME / ПРОЕКТ: New railway section Kriva Palanka - Border with R. Bulgaria / Нова железничка пруга на делница Крива Паланка - граница со Р. Бугарија

GEOHYDRO GHC CONSULTING — SUBCONTRACTOR / ПОДИЗВЕДУВАЧ

PAGES / СТРАНА: 2 of 2

BOREHOLES / ДУПНАТИНИ				Date / Датум GWT / НПВ (m)																											
Ред. Бр.	Reference Стационажа (PK)	Length Должина (m)	Piezometers Пиезометар	28.05.2016	08.06.2016	09.06.2016	11.06.2016	16.06.2016	21.06.2016	23.06.2016	24.06.2016	26.06.2016	29.06.2016	30.06.2016	06.07.2016	07.07.2016	14.07.2016	27.07.2016	03.08.2016	06.08.2016	12.08.2016	17.08.2016	20.08.2016	03.09.2016	03.10.2016	05.10.2016	07.10.2016	21.10.2016	27.10.2016	28.10.2016	01.11.2016
44	76+517	21	√	-	-	-	-	-	1,70	-	1,40	-	-	-	-	-	1,40	-	-	-	-	-	-	-	-	-	-	1,80	1,55	-	1,70
45	76+857	135	√	-	-	-	-	-	-	-	-	-	-	-	-	-	42,60	42,60	47,60	-	-	-	-	-	-	-	-	-	49,0	-	-
46	77+108	165	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53,30	53,10	-	-	-	-	-	-	-	-	-	pump	-	-
47	77+737	15	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,20	-	-	-	-	-	0,4	-
48	77+820	20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-	-	-	-	/	-
49	79+492	60	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-	-	-	broken	-
50	79+702	33	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,90	-	-	-	-	12,0	-
51	79+877	29	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,60	-	1,75	-
52	80+037	15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	/	-	-	-	-	-	/	-
53	80+692	15	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,10	-	-	-	-	8,35	-
54	81+112	15		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,60	-	-	-	-	-	5,7	-
55	82+092	15	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,00	-	-	-
56	82+670	30	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,40	-	-	-	-	-	8,0	-
57	82+872	125	√	-	-	-	-	-	-	-	-	-	-	-	-	-	26,50	-	-	-	-	-	-	-	-	-	-	-	-	filled	-
58	83+530	170	√	-	-	-	-	-	-	-	-	-	-	-	41,30	40,00	40,50	-	-	-	-	-	-	-	-	-	-	-	-	43,7	-
59	84+070	20		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	collapsed	-	-	-	-	collapsed	-
60	84+152	19,8	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,30	-	-	9,60	-	10,0	-
61	84+277	20,5		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,80	-	-	-	-	-	collapsed	-
62	84+842	110	√	-	21,30	45,50	-	-	-	46,00	-	-	-	-	-	-	46,00	46,80	-	-	-	-	-	-	-	-	-	48,60	-	-	-
63	85+182	50	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20,50	-	-	-	21,10	-	-	-
64	85+595	25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,70	-	-	-	-	-	11,4	-
65	85+655	19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,40	-	-	-	-	-	/	-
66	85+790	16		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,90	-	-	-	-	-	12,0	-
67	85+963	25	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,30	18,70	-	/	-	-	-	/	-
68	86+142	30	√	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,70	15,60	15,80	-	16,30	16,30	-	-	16,4	-
69	86+297	15,3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,50	-	6,60	-	-	-	6,4	-
70	87+372	35		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27,70	-	-	-
71	87+712	135,9	√	-	-	-	-	-	-	/	97,80	-	98,00	-	-	-	99,80	-	-	-	-	-	-	-	-	-	-	124,80	-	-	-
72	88+322	220	√	-	-	-	-	12,30	-	75,60	-	-	-	-	-	-	75,60	-	-	-	-	-	-	-	-	-	-	-	-	collapsed	-

Table 122 Results from the Standard Penetration Test (SPT)

Boreholes	Depth of test [m]	Type of material	Penetration of cone e cm	Number of blows for penetration e – N	Number of blows required for penetration of 30,5 cm – Np	Conical corrected number of blows Nc	Corrected number of blows for the length of rods –N'	Correction quotient Cn	Finite number of blows N SPT
BV - 65+952	2.60	al/GP	14	50	108.93	81.70	61.27	1.54	94.41
	5.40	al/GP/GC	15	50	101.67	76.25	64.81	1.31	85.17
	7.50	al/GW	30	32	32.53	24.40	23.18	1.04	24.21
	9.70	al/GW	14	50	108.93	81.70	77.61	0.93	71.96
BV-69 + 722	2.00	d	14	50	108.93	81.70	0.75	1.39	85.10
	4.00	Sep	2	50	762.50	571.88	0.85	1.02	496.01
BV - 72+887	2.00	pr/SFs	30	25	50.83	38.13	28.59	1.47	42.05
	4.00	pr/SFs	30	95	96.58	72.44	61.57	1.16	71.60
	6.00	pr/SFs	13	50	117.31	87.98	83.58	0.88	73.97
	8.00	pr/SFs	11	50	138.64	103.98	98.78	0.75	73.72
	10.0	pr/SFs	13	50	117.31	87.98	83.58	0.65	54.27
	12.0	t/GFc	29	86	90.45	67.84	67.84	0.68	46.15
	14.0	t/GFc	30	94	95.57	71.68	71.68	0.65	46.24
	16.0	t/GFc	30	91	92.52	69.39	69.39	0.53	37.11
	18.0	t/GW	30	89	90.48	67.86	67.86	0.51	34.27
	20.0	t/GW	19	87	139.66	104.74	104.74	0.48	50.12
	22.0	DR	4	50	381.25	285.94	285.94	0.53	152.91
BV - 70 + 032	2.50	d	30	40	40.67	30.50	0.75	1.29	29.52
	5.30	d	30	73	74.22	55.66	0.85	1.04	31.19
BV - 71 + 367	2.35	pr/SFs	30	64	65.07	48.80	0.75	1.37	50.20
	5.40	pr/SFs	30	78	79.30	59.48	0.85	1.02	32.25
BV - 71 + 587	2.50	pr/SFs	30	81	82.35	61.76	0.75	1.34	62.28
BT-72 + 562	2.00	PI	30	12	12.20	9.15	0.75	1.44	9.87
	4.00	PI	30	40	40.67	30.50	0.85	1.12	29.13
	6.00	PI	30	5	305.00	228.75	0.95	0.92	200.29
	8.00	PI	30	63	64.05	48.04	0.95	0.78	35.65
	10.00	PI	30	59	59.98	44.99	0.95	0.72	20.57
BV - 73+372	2.00	d	13	50	117.31	87.98	65.99	1.47	97.04
	4.00	d	3	50	508.33	381.25	324.06	1.16	376.82
BV - 73 + 697	2.00	pr/SFs	30	48	48.80	36.60	0.75	1.44	39.50
BV - 74+ 272	2.00	pr/GFs	30	23	23.38	17.54	13.15	1.47	19.34
	4.00	al/GFs	12	50	127.08	95.31	81.02	1.16	94.20
	6.00	al/GFs	30	45	45.75	34.31	32.60	0.97	31.65
	8.00	al/GFs	0	50	/	/	/	/	/
	10.0	al/GFs	30	56	56.93	42.70	40.57	0.80	32.45
	12.0	al/GFs	30	51	51.85	38.89	38.89	0.85	32.96
	14.0	al/GFs	30	54	54.90	41.18	41.18	0.68	28.01
	16.0	al/GP	30	63	64.05	48.04	48.04	0.63	30.40
	18.0	al/GFs	30	69	70.15	52.61	52.61	0.59	31.13
	20.0	al/GFs	30	64	65.07	48.80	48.80	0.67	32.53
BT - 74+ 352	2.00	pr/SFs	30	20	20.33	15.25	11.44	1.47	16.82
	4.00	pr/SFs	30	36	36.60	27.45	23.33	1.16	27.13
	6.00	pr/GFs	30	49	49.82	37.36	35.49	0.88	31.41
	8.00	pr/SFc/Cl	30	24	24.40	18.30	17.39	0.78	13.58
BV - 75 + 337	2.00	pr/SFc	30	44	44.73	33.55	0.75	1.44	36.21
	4.00	pr/SFc	30	41	41.68	31.26	0.85	1.12	29.86
	6.00	pr/SFc	30	46	46.77	35.08	0.95	0.97	22.98
BV - 75 + 402	2.00	d	30	36	36.60	27.45	0.75	1.39	28.59
	6.50	d	30	87	88.45	66.34	0.95	0.88	33.89
BV - 76 + 517	2.10	al	11	50	138.64	103.98	0.75	1.50	67.14
	4.40	al/GP	13	50	117.31	87.98	0.85	1.30	56.99

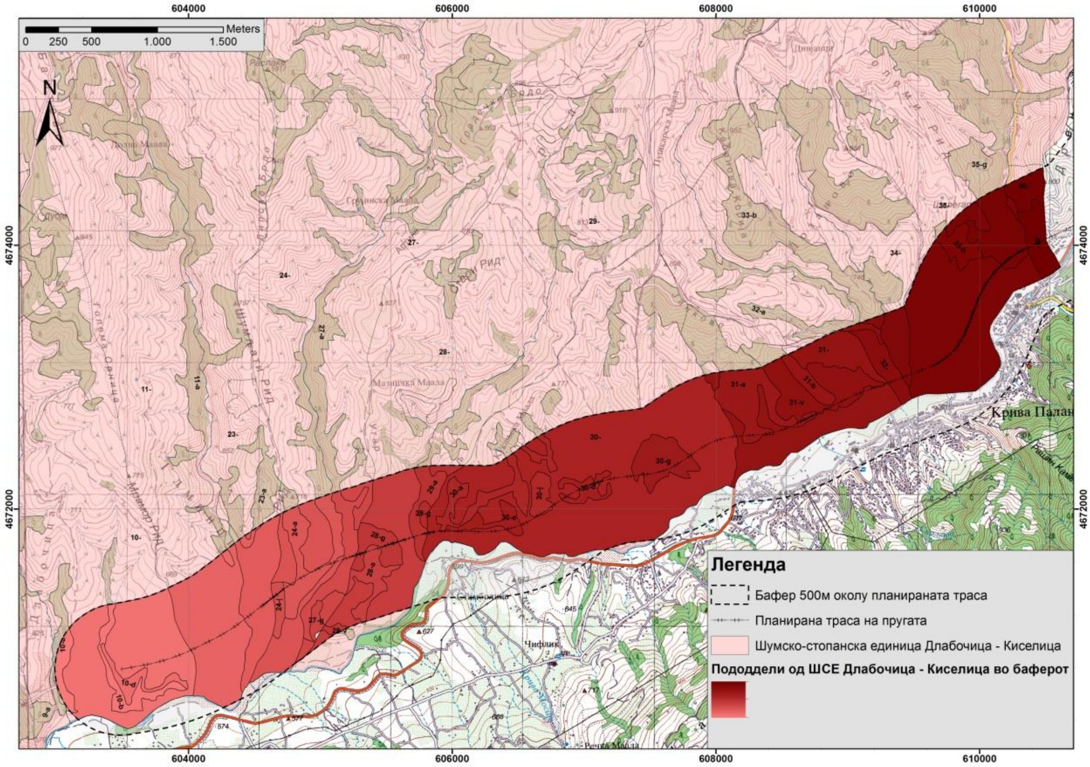
	6.70	al/GFs	30	73	74.22	55.66	0.95	1.15	38.51
	9.00	al/GFs	30	82	83.37	62.53	0.95	1.03	37.77
	11.60	al/GFs	30	90	91.50	68.63	1.00	0.92	38.29
BV - 79+877	2.00	al	4	50	381.25	285.94	214.45	1.50	321.28
	4.00	al/GW	30	48	48.80	36.60	31.11	1.34	41.62
	6.30	al/GW	30	58	58.97	44.23	42.01	1.07	44.98
	8.00	al/GW	30	58	58.97	44.23	42.01	0.97	40.89
	10.0	al/GW	30	64	65.07	48.80	46.36	0.88	40.76
	12.0	al/SW	30	78	79.30	59.48	59.48	0.94	55.71
	14.0	al/SW	30	90	91.50	68.63	68.63	0.87	59.80
BV - 80+037	2.00	DR/GFs	30	28	28.47	21.35	16.01	1.47	23.55
	4.00	DR/GFs	20	89	135.73	101.79	86.52	1.16	100.61
BV - 82+092	2.00	d	4	50	381.25	285.94	214.45	1.47	315.37
	4.00	Sep'	11	50	138.64	103.98	88.38	1.23	109.11
	6.00	Sep'	7	50	217.86	163.39	155.22	1.00	155.77
BT - 82+670	2.00	Sep'	5	50	305.00	228.75	171.56	1.47	252.30
BV - 84+152	2.00	al	3	50	508.33	381.25	285.94	1.47	420.50
	4.00	al	3	50	508.33	381.25	324.06	1.16	376.82
	8.00	al/SW	2	50	762.50	571.88	543.28	0.75	405.43
	10.0	al/GW	1	50	1525.00	1143.75	1086.56	0.65	701.01
	12.0	al/GW	6	50	254.17	190.63	190.63	0.60	114.83
	14.0	al/GW	10	50	152.50	114.38	114.38	0.64	73.32
BT - 84+277	2.00	d/SFs	7	50	217.86	163.39	122.54	1.47	180.21
	4.00	Sep'	14	50	108.93	81.70	69.44	1.16	80.75
BV-85+595	2.00	d/SFs	10	50	152.50	114.38	85.78	1.47	126.15
	4.00	Sep'	8	50	190.63	142.97	121.52	1.16	141.31
BV-85+655	2.00	d/SFs	30	60	61.00	45.75	34.31	1.47	50.46
	4.00	Sep'	4	50	381.25	285.94	243.05	1.16	282.61
BV - 85+790	2.00	N/SFs	30	49	49.82	37.36	28.02	1.47	41.21
	4.00	Sep'	5	50	305.00	228.75	194.44	1.16	226.09
BT - 85+963	2.00	d/SFs	30	33	33.55	25.16	18.87	1.47	27.75
	4.00	d/SFs	30	59	59.98	44.99	38.24	1.16	44.46
BT-86+142	2.00	Sab'	30	10	10.17	7.63	5.72	1.47	8.41
	4.00	Sab'	30	28	28.47	21.35	18.15	1.16	21.10
	6.00	Sab'	30	39	39.65	29.74	28.25	0.88	25.00
BV - 86+297	2.00	pr/SFs	14	50	108.93	81.70	61.27	1.47	90.11
	4.00	Sab'	12	50	127.08	95.31	81.02	1.16	94.20
BT - 87+372	2.00	d	3	50	508.33	381.25	285.94	1.47	420.5

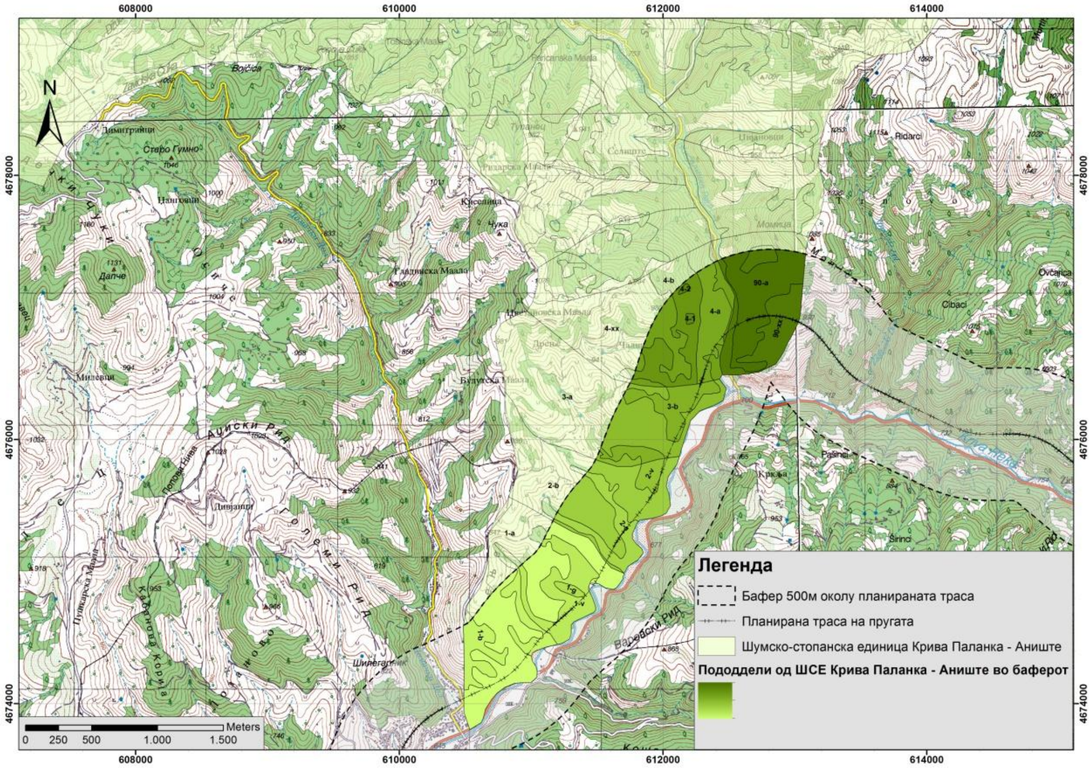
Table 123 Basic data for the depth of test pits

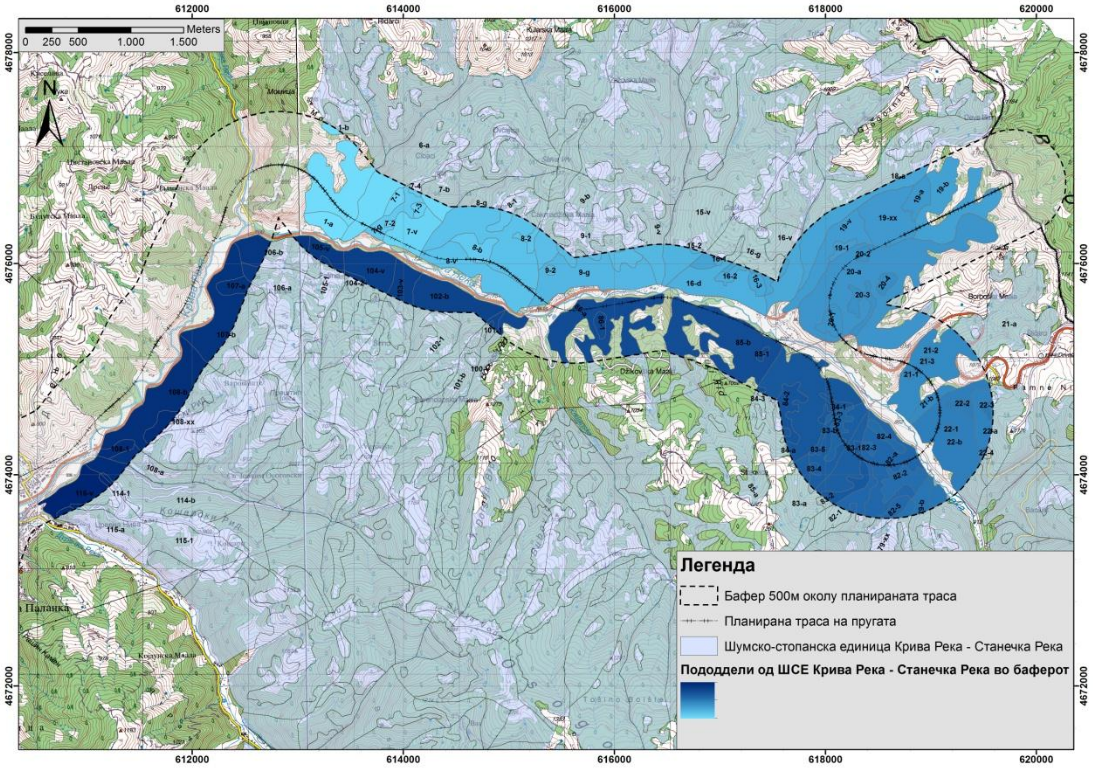
Test pit	Depth m	Facility	Coordinates		Token sample
			Y	X	
TP-65+132	0.50	Viaduct 1	7 604 135	4 671 705	
TP-65+182	0.80	Embankment	7 604 187	4 671 717	
TP-65+247	0.60	Cut	7 604 249	4 671 733	
TP-65+532	1.20	Cut	7 604 515	4 671 834	
TP-65+887	1.0	Viaduct 3	7 604 827	4 672 006	
TP-66+495	0.5	Viaduct 4	7 605 316	4 672 366	1
TP-66+518	0.7	Viaduct 4	7 605 335	4 672 377	
TP-66+852	1.4	Viaduct 5	7 605 639	4 672 503	1
TP-68+487	0.6	Viaduct 10	7 607 202	4 672 898	
TP-68+562	0.7	Viaduct 10	7 607 268	4 672 940	
TP-68+770	0.2	Viaduct 11	7 607 441	4 673 043	
TP-69+517	0.3	Cut	7 608 163	4 673 223	
TP-69+742	0.6	Viaduct 15	7 608 351	4 673 342	
TP-70+052	1.3	Viaduct 16	7 608 643	4 673 441	
TP-70+226	1.3	Viaduct 17	7 608 817	4 673 455	
TP-70+251	1.6	Viaduct 17	7 608 842	4 673 457	1

TP-70+276	1.2	Viaduct 17	7 608 866	4 673 463	
TP-70+324	0.9	Viaduct 17	7 608 912	4 673 472	1
TP-71+117	1.1	Viaduct 19	7 609 628	4 673 800	
TP-71+392	1.4	Viaduct 20	7 609 897	4 673 893	1
TP-72+837	4.5	Viaduct 23	7 610 884	4 674 888	1
TP-74+297	2.0	Viaduct 28	7 611 951	4 675 821	
TP-74+322	2.0	Viaduct 28	7 611 962	4 675 834	1
TP-74+382	0.8	Viaduct 28	7 611 998	4 675 883	
TP-75+187	0.5	Viaduct 30	7 612 426	4 676 554	
TP-75+427	3.5	Viaduct 30	7 612 511	4 676 782	1
TP-79+967	0.9	Viaduct 37	7 616 006	4 676 452	1
TP-80+059	0.9	Viaduct 37	7 616 094	4 676 446	
TP-80+192	1.1	Embankment	7 616 229	4 676 462	1
TP-80+267	0.8	Cut	7 616 302	4 676 472	
TP-80+317	1.0	Viaduct 38	7 616 352	4 676 480	1
TP-81+542	1.4	Cut	7 617 532	4 676 386	
TP-81+772	1.4	Cut	7 617 756	4 676 286	1
TP-82+162	3.0	Viaduct 42	7 618 094	4 676 115	1
TP-82+660	3.3	Cut	7 618 474	4 675 801	1
TP-84+092	3.8	Viaduct 43	7 619 360	4 675 095	1
TP-85+682	0.6	Viaduct 46	7 618 741	4 676 086	
TP-85+712	0.7	Viaduct 46	7 618 718	4 676 100	
TP-85+742	1.0	Viaduct 46	7 618 699	4 676 116	1
TP-85+821	3.0	Viaduct 46	7 618 638	4 676 175	
TP-85+922	1.4	Cut	7 618 576	4 676 253	
TP-86+202	2.8	Cut	7 618 517	4 676 506	1
TP-86+272	2.2	Viaduct 47	7 618 524	4 676 594	
TP-86+337	1.1	Viaduct 48	7 618 533	4 676 665	
Total					
44	61,6				17

Annex 14 Forestry commercial sections and subsections within the project area






Легенда
Бафер 500м околу планираната траса
Планирана траса на пругата
Шумско-стопанска единица Крива Река - Станечка Река
Пододдели од ШСЕ Крива Река - Станечка Река во баферот
Meters
0 250 500 1.000 1.500
612000
614000
616000
618000
620000
4678000
4676000
4674000
4672000

Annex 15 Biodiversity

Mammals

Table 124 Valorization of the mammals fauna in the railway corridor area Kriva Palanka - Deve Bair

Species	Bern Convention appendices	Habitat Directive Annexes	Bonn Convention	CITES Appendices	Emerald species 2002	The IUCN Red List
	Carnivora					
Canis lupus	II	II IV		II	•	**LC**
Ursus arctos	II	II IV		II	•	**LC**
Lutra lutra	II	II IV		I	•	**NT**
Felis sylvestris	II	IV		II		**LC**
Martes foina	III					**LC**
Martes martes	III					**LC**
Meles meles	III					**LC**
Mustela nivalis	III					**LC**
Mustela putorius	III					**LC**
	Lagomorpha					
Lepus europeus	III					**LC**
	Rodentia					
Sciurus vulgaris	III					**LC**
Glis glis	III					**LC**
	Artiodactyla					
Capreolus capreolus	III					**LC**
	Insectivora					
Erinaceus europeus	III					**LC**
Crocidura suaeveolans	III					**LC**
	Chiroptera					
Rhinolophus ferrumequinum	II	II IV	II			**LC**
Rhinolophus hipposideros	II	II IV	II			**LC**
Myotis mystacinus	II	IV	II			**LC**
Myotis myotis	II	II IV	II			**LC**
Pipistrellus pipistrellus	III	IV	II			**LC**

Birds

The valorization of birds was preformed according to the most relevant conservation documetns, EU Bird Directive and International conventions.

A. Bird Directive - Council Directive 79/409/EEC on the conservation of wild birds

- **Annex I** - Species of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution. In this connection, account shall be taken of:

  (a) species in danger of extinction;

  (b) species vulnerable to specific changes in their habitat;

  (c) species considered rare because of small populations or restricted local distribution;

  (d) other species requiring particular attention for reasons of the specific nature of their habitat.
- **Annex II -** Owing to their population level, geographical distribution and reproductive rate throughout the community, the species listed in annex II may be hunted under national legislation. Member states shall ensure that the hunting of these species does not jeopardize conservation efforts in their distribution area.

  Annex II/1 - The species referred to in Annex II/1 may be hunted in the geographical sea and land area where this directive applies.

  Annex II/2 - The species referred to in Annex II/2 may be hunted only in the member states in respect of which they are indicated.
- **Annex III** - Member states shall prohibit, for all of naturally occurring birds in the wild state in the European territory of the member states, the sale, transport for sale, keeping for sale and the offering for sale of live or dead birds and of any readily recognizable parts or derivatives of such birds

B. Bonn Convention

- Appendix I - Species threatened by extinction
- Appendix II - Migratory species conserved through Agreements

Migratory species that have an unfavourable conservation status or would benefit significantly from international co-operation organized by tailored agreements are listed in Appendix II to the Convention. For this reason, the Convention encourages the Range States to conclude global or regional Agreements for the conservation and management of individual species or, more often, of a group of species listed on.

C. SPEC - Species of European Conservation Concern (for birds only)

SPEC 1	European species of global conservation concern
SPEC 2	Unfavourable conservation status in Europe, concentrated in Europe
SPEC 3	Unfavourable conservation status in Europe, not concentrated in Europe
Non-SPEC^E	Favourable conservation status in Europe, concentrated in Europe
Non-SPEC	Favourable conservation status in Europe, not concentrated in Europe

D. European Threat Status (ETS)

- CR - Critically Endangered - if the European population meets any of the IUCN Red List Criteria for Critically Endangered.
- EN-Endangered - if the European population meets any of the IUCN Red List Criteria for Endangered
- VU-Vulnerable-if the European population meets any of the IUCN Red List Criteria for Vulnerable
- D - Declining - if the European population does not meet any of the IUCN Red List Criteria, but declined by more than 10% over 10 years or three generations, whichever is longer

- R - Rare - if the European population does not meet any of the IUCN Red List Criteria and is not Declining, but numbers fewer than 10000 breeding pairs (or 20000 breeding individuals or 40000 wintering individuals) and is not marginal to a larger non-European population.
- H - Depleted - if the European population does not meet any of the IUCN Red List Criteria and is not Rare or Declining, but has not yet recovered from a moderate or large decline suffered during 1970-1990.
- L - Localised - if the European population does not meet any of the IUCN Red List Criteria and is not Declining, Rare or Depleted, but is heavily concentrated, with more than 90% of the European population occurring at 10 or fewer sites.
- S - Secure - if the European population does not meet any of the criteria listed above.
- DD - Data Deficient - if there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.
- NE - Not Evaluated - if its European population has not yet been evaluated against the criteria.

E. African-Eurasian Migratory Waterbirds (AEWA)

The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is the largest of its kind developed so far under the Bonn Convention. It was concluded on 16 June 1995 in The Hague, the Netherlands and entered into force on 1 November 1999 after the required number of at least fourteen Range States, comprising seven from Africa and seven from Eurasia had ratified. Since then the Agreement is an independent international treaty. Parties to the Agreement are called upon to engage in a wide range of conservation actions which are described in a comprehensive Action Plan. This detailed plan addresses such key issues as: species and habitat conservation, management of human activities, research and monitoring, education and information, and implementation.

- Annex 1. Definition of the Agreement Area
- Annex 2. Waterbird species to which the Agreement applies
- Annex 3. ACTION PLAN

Most of the species are categorized as least concern - LC (119 species). There are no bird species in the higher threat categories (EN, VU).

Table 125 Valorization of the ornithofauna in the railway corridor area Kriva Palanka - Deve Bair

Species	IUCN	SPEC	ETS	Birds Directive	Emerald Network	Bern Convention	Bonn Convention	AEWA	CITES
Ardea cinerea	LC	Non-SPEC	S			III			
Ciconia ciconia	LC	SPEC Cat. 2	H	I	Included	II	II	Included	
Anas plathyrhynchos	LC	Non-SPEC	(S)	II/A; III/A		III	II	Included	
Accipiter gentilis	LC	Non-SPEC	S			II	II		II
Accipiter nisus	LC	Non-SPEC	S			II	II		II
Buteo buteo	LC	Non-SPEC	S			II	II		II
Falco tinnunculus	LC	SPEC Cat. 3	D			II	II		II
Falco subbuteo	LC	Non-SPEC	(S)			II	II		II
Perdix perdix	LC	SPEC Cat. 3	VU	II/A; III/A		III			
Coturnix coturnix	LC	SPEC Cat. 3	(H)	II/B		III	II		
Charadrius dubius	LC	Non-SPEC	(S)			II	II	Included	
Actitis hypoleucos	LC	SPEC Cat. 3	(D)			II	II	Included	
Columba livia	LC	Non-SPEC	(S)	II/A		III			
Columba oenas	LC	Non-SPEC-E	(S)	II/B		III			
Columba palumbus	LC	Non-SPEC-E	S	II/A; III/A		Not included			
Streptopelia decaocto	LC	Non-SPEC	S	II/B		III			
Streptopelia turtur	LC	SPEC Cat. 3	D	II/B		III	II		
Cuculus canorus	LC	Non-SPEC	S			III			
Tyto alba	LC	SPEC Cat. 3	(D)			II			I
Otus scops	LC	SPEC Cat. 2	(H)			II			II
Athene noctua	LC	SPEC Cat. 3	(D)			II			II

Species	IUCN	SPEC	ETS	Birds Directive	Emerald Network	Bern Convention	Bonn Convention	AEWA	CITES
Strix aluco	LC	Non-SPEC-E	S			II			II
Asio otus	LC	Non-SPEC	(S)			II			II
Caprimulgus europaeus	LC	SPEC Cat. 2	(H)	I	Included	II			
Apus apus	LC	Non-SPEC	(S)			III			
Alcedo atthis	LC	SPEC Cat. 3	H	I	Included	II			
Merops apiaster	LC	SPEC Cat. 3	(H)			II	II		
Upupa epops	LC	SPEC Cat. 3	(D)			II			
Jynx torquilla	LC	SPEC Cat. 3	(D)			II			
Picus canus	LC	SPEC Cat. 3	(H)	I	Included	II			
Picus viridis	LC	SPEC Cat. 2	(H)			II			
Dryocopus martius	LC	Non-SPEC	S	I	Included	II			
Dendrocopos major	LC	Non-SPEC	S			II			
Dendrocopos syriacus	LC	Non-SPEC-E	(S)	I	Included	II			
Dendrocopos medius	LC	Non-SPEC-E	(S)	I	Included	II			
Dendrocopos minor	LC	Non-SPEC	(S)			II			
Melanocorypha calandra	LC	SPEC Cat. 3	(D)	I	Included	II			
Calandrella brachydactyla	LC	SPEC Cat. 3	D	I	Included	II			
Galerida cristata	LC	SPEC Cat. 3	(H)			III			
Lullula arborea	LC	SPEC Cat. 2	H	I	Included	III			
Alauda arvensis	LC	SPEC Cat. 3	(H)	II/B		III			
Ptyonoprogne rupestris	LC	Non-SPEC	S			II			
Hirundo rustica	LC	SPEC Cat. 3	H			II			

Species	IUCN	SPEC	ETS	Birds Directive	Emerald Network	Bern Convention	Bonn Convention	AEWA	CITES
Hirundo daurica	LC	Non-SPEC	(S)			II			
Delichon urbica	LC	SPEC Cat. 3	(D)			II			
Anthus campestris	LC	SPEC Cat. 3	(D)	I	Included	II			
Anthus trivialis	LC	Non-SPEC	S			II			
Anthus spinoletta	LC	Non-SPEC	(S)			II			
Motacilla flava	LC	Non-SPEC	(S)			II			
Motacilla cinerea	LC	Non-SPEC	S			II			
Motacilla alba	LC	Non-SPEC	S			II			
Cinclus cinclus	LC	Non-SPEC	S			II			
Troglodytes troglodytes	LC	Non-SPEC	S			II			
Prunella modularis	LC	Non-SPEC-E	S			II			
Erithacus rubecula	LC	Non-SPEC-E	S			II	II		
Luscinia megarhynchos	LC	Non-SPEC-E	(S)			II	II		
Phoenicurus ochruros	LC	Non-SPEC	S			II	II		
Phoenicurus phoenicurus	LC	SPEC Cat. 2	(H)			II	II		
Saxicola rubetra	LC	Non-SPEC-E	(S)			II	II		
Oenanthe oenanthe	LC	SPEC Cat. 3	(D)			II	II		
Oenanthe hispanica	LC	SPEC Cat. 2	(H)			II	II		
Turdus merula	LC	Non-SPEC-E	S	II/B		III	II		
Turdus pilaris	LC	Non-SPEC-EW	(S)	II/B		III	II		
Turdus philomelos	LC	Non-SPEC-E	(S)	II/B		III	II		
Turdus iliacus	LC	Non-SPEC-EW	(S)	II/B		III	II		

Species	IUCN	SPEC	ETS	Birds Directive	Emerald Network	Bern Convention	Bonn Convention	AEWA	CITES
Turdus viscivorus	LC	Non-SPEC-E	S	II/B		III	II		
Cettia cetti	LC	Non-SPEC	S			II	II		
Acrocephalus arundinaceus	LC	Non-SPEC	(S)			II	II		
Hippolais pallida	LC	SPEC Cat. 3	(H)			II	II		
Sylvia curruca	LC	Non-SPEC	S			II	II		
Sylvia communis	LC	Non-SPEC-E	S			II	II		
Sylvia atricapilla	LC	Non-SPEC-E	S			II	II		
Phylloscopus bonelli	LC	SPEC Cat. 2	D			II	II		
Phylloscopus sibilatrix	LC	SPEC Cat. 2	D			II	II		
Phylloscopus collybita	LC	Non-SPEC	S			II	II		
Phylloscopus trochilus	LC	Non-SPEC	S			II	II		
Regulus regulus	LC	Non-SPEC-E	S			II	II		
Regulus ignicapilla	LC	Non-SPEC-E	(S)			II	II		
Muscicapa striata	LC	SPEC Cat. 3	H			II	II		
Ficedula albicollis	LC	Non-SPEC-E	S	I	Included	II	II		
Ficedula hypoleuca	LC	Non-SPEC-E	S			II	II		
Aegithalos caudatus	LC	Non-SPEC	S			III			
Parus palustris	LC	SPEC Cat. 3	D			II			
Parus lugubris	LC	Non-SPEC-E	(S)			II			
Parus ater	LC	Non-SPEC	(S)			II			
Parus caeruleus	LC	Non-SPEC-E	S			II			
Parus major	LC	Non-SPEC	S			II			

Species	IUCN	SPEC	ETS	Birds Directive	Emerald Network	Bern Convention	Bonn Convention	AEWA	CITES
Sitta europea	LC	Non-SPEC	S			II			
Sitta neumayer	LC	Non-SPEC-E	(S)			II			
Certhia familiaris	LC	Non-SPEC	S			II			
Remiz pendulinus	LC	Non-SPEC	(S)			III			
Oriolus oriolus	LC	Non-SPEC	S			II			
Lanius collurio	LC	SPEC Cat. 3	(H)	I	Included	II			
Lanius minor	LC	SPEC Cat. 2	(D)	I	Included	II			
Lanius excubitor	LC	SPEC Cat. 3	(H)			II			
Lanius senator	LC	SPEC Cat. 2	(D)			II			
Lanius nubicus	LC	SPEC Cat. 2	(D)	I		II			
Garrulus glandarius	LC	Non-SPEC	S	II/B		Not included			
Pica pica	LC	Non-SPEC	S	II/B		Not included			
Corvus monedula	LC	Non-SPEC-E	(S)	II/B		Not included			
Corvus frugilegus	LC	Non-SPEC	(S)	II/B		Not included			
Corvus cornix	LC	Non-SPEC	S	II/B		Not included			
Corvus corax	LC	Non-SPEC	S			III			
Sturnus vulgaris	LC	SPEC Cat. 3	D	II/B		Not included			
Passer domesticus	LC	SPEC Cat. 3	D			Not included			
Passer hispaniolensis	LC	Non-SPEC	(S)			III			
Passer montanus	LC	SPEC Cat. 3	(D)			III			
Fringilla coelebs	LC	Non-SPEC-E	S			III			
Fringilla montifringilla	LC	Non-SPEC	S			III			

Species	IUCN	SPEC	ETS	Birds Directive	Emerald Network	Bern Convention	Bonn Convention	AEWA	CITES
Carduelis chloris	LC	Non-SPEC-E	S			II			
Carduelis carduelis	LC	Non-SPEC	S			II			
Carduelis cannabina	LC	SPEC Cat. 2	D			II			
Pyrrhula pyrrhula	LC	Non-SPEC	(S)			III			
Coccothraustes coccothraustes	LC	Non-SPEC	S			II			
Emberiza citrinella	LC	Non-SPEC-E	(S)			II			
Emberiza cirlus	LC	Non-SPEC-E	S			II			
Emberiza cia	LC	SPEC Cat. 3	(H)			II			
Emberiza melanocephala	LC	SPEC Cat. 2	(H)			II			
Miliaria calandra	LC	SPEC Cat. 2	(D)			III			

Amphibians and Reptiles

Table 126 Valorization of amphibians and reptiles in the railway corridor area Kriva Palanka - Deve Bair

	Species	Convention					
	Amphibians	**Bern**	**HD**	**Emerald**	**CITES**	**IUCN**	**Distribution in MK/ endemism**
1	*Lissotriton vulgaris*	App.III				LC	
2	*Salamandra salamandra*	App.III				LC	
3	*Bombina variegata*	App.II	Ann.IV	App.X		LC	Balkan endemic
4	*Rana graeca*	App.III	Ann.IV			LC	Balkan endemic
5	*Pelophylax ridibundus*	App.III				LC	
6	*Rana dalmatina*	App.II	Ann.IV			LC	
7	*Bufo bufo*	App.III				LC	
8	*Pseudepidalea viridis*	App.II	Ann.IV			LC	
9	*Hyla arborea*	App.II	Ann.IV			LC	
	Reptiles						
10	*Eurotestudo hermanni*	App.II	Ann.IV	App.X	App.II		Balkan endemic
11	*Anguis fragilis*	App.III					
12	*Podarcis muralis*	App.II	Ann.IV			LC	
13	*Podarcis erhardii*	App.III	Ann.IV			LC	Balkan endemic
14	*Podarcis taurica*	App.II	Ann.IV			LC	
15	*Lacerta viridis*	App.II	Ann.IV			LC	
16	*Lacerta trilineata*	App.II	Ann.IV			LC	
17	*Zamenis longissimus*	App.II	Ann.IV			LC	
18	*Coronella austriaca*	App.III	Ann.IV				
19	*Dolichophis caspius*	App.II	Ann.IV				
20	*Natrix natrix*	App.III				LR/LC	
21	*Natrix tessellata*	App.II	Ann.IV			NT	
22	*Vipera ammodytes*	App.II	Ann.IV			LC	

- **Insects**

Table 127 List of ground beetle species in the Kriva Palanka – Deve Bair railway corridor

Species Name	Pubescent Oak and Oriental Hornbeam	Pubescent Oak and Hornbeam (degraded)	Italian and Turkey Oak	Flowering Ash and Sessile Oak	Submontane Beech Forests	Sandy and gravel riverbanks	Hill Pastures	Hill Pastures with sparse vegetation	Hill pastures on rocky sites	Cliffs and Rocks	Rivers & Streams	Stands of Black locust's	Black Pine plantations	Abandoned fields	Agricultural land	Rural settlements - villages	Urban settlements
Abax carinatus carinatus				+	+												
Abax ovalis				+	+												
Acinopus picipes							+	+	+								
Agonum duftschmidi						+											
Agonum sexpunctatum						+											
Amara aenea	+	+					+	+	+			+	+	+	+	+	+
Amara anthobia						+											
Amara convexior			+	+	+												
Amara curta					+												
Amara lucida						+											
Amara montivaga	+	+	+	+	+										+		
Amara ovata				+	+												
Anchomenus dorsalis						+							+				
Anisodactylus binotatus						+											

Anisodactylus nemorivagus						+											
Aptinus merditanus					+												
Bembidion assimile						+											
Bembidion azurescens azurescens						+											
Bembidion decorum decorum						+											
Bembidion geniculatum geniculatum						+											
Bembidion lampros						+											
Bembidion punctulatum punctulatum																	
Bembidion quadrimaculatum quadrimaculatum						+											
Bembidion siculum smyrnense						+											
Bembidion subcostatum vau						+											
Bembidion tibiale						+											
Bembidion varium						+											
Calathus cinctus							+	+	+								
Calathus distinguendus					+												
Calathus erratus erratus							+	+									
Calathus fuscipes fuscipes	+	+	+	+	+		+	+	+			+	+	+	+	+	+
Calathus melanocephalus melanocephalus	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+
Carabus convexus dilatatus	+	+	+	+	+												
Carabus coriaceus cerisyi	+	+	+	+	+		+	+	+			+	+	+	+	+	+
Carabus granulatus granulatus																	
Carabus hortensis				+	+								+				
Carabus intricatus intricatus	+		+	+	+								+				
Carabus montivagus montivagus	+	+	+	+	+												

Chlaenius festivus festivus						+											
Chlaenius nitidulus						+											
Chlaenius vestitus						+											
Cicindela campestris campestris							+	+	+					+	+	+	+
Cicindela germanica							+	+	+								
Clivina collaris						+											
Cymindis axillaris axillaris							+	+	+	+							
Dixus obscurus							+	+	+								
Elaphrus aureus						+											
Harpalus affinis	+	+	+	+	+	+	+	+		+		+	+	+	+	+	+
Harpalus anxius							+	+	+					+	+	+	+
Harpalus atratus	+																
Harpalus attenuatus							+	+	+					+	+	+	+
Harpalus dimidiatus		+					+	+	+					+	+	+	+
Harpalus flavicornis flavicornis							+	+	+								
Harpalus rubripes	+	+	+	+	+												
Harpalus rufipalpis rufipalpis	+	+	+	+	+												
Harpalus rufipes	+	+				+	+	+	+	+		+	+	+	+	+	+
Harpalus saxicola																	
Harpalus serripes serripes							+	+	+					+	+	+	+
Harpalus tardus							+	+	+					+	+	+	+
Harpalus triseriatus triseriatus							+	+	+								
Laemostenus punctatus	+	+	+	+	+												
Licinus cassideus cassideus					+												

Licinus silphoides							+	+									
Limodromus assimilis					+												
Lionychus quadrillum						+											
Microlestes fissuralis							+	+	+			+	+	+	+	+	+
Molops robustus robustus					+												
Molops rufipes denteletus			+	+	+								+				
Myas chalybaeus				+	+												
Nebria brevicollis						+							+				
Notiophilus substriatus	+	+	+	+	+												
Omophron limbatum						+											
Oodes helopioides helopioides																	
Ophonus cribricollis							+	+	+								
Ophonus rufibarbis	+	+	+				+	+	+								
Pachycarus atrocoeruleus atrocoeruleus							+	+	+								
Panagaerus cruxmajor																	
Paranchus albipes						+											
Paratachys bistriatus						+											
Parophonus dejeani						+											
Parophonus maculicornis						+											
Platynus scrobiculatus serbicus					+								+				
Poecilus cupreus					+	+	+	+				+	+	+	+	+	+
Poecilus versicolor					+												
Pterostichus brucki					+												
Pterostichus cursor																	

Pterostichus minor minor					
Pterostichus niger niger			+		
Pterostichus nigrita			+	+	+
Pterostichus oblongopunctatus			+		+
Stenolophus mixtus				+	
Stenolophus teutonus				+	
Tapinopterus balcanicus	+	+	+		+

Table 128 List of butterfly species in the Kriva Palanka – Deve Bair railway corridor

Species Name	Pubescent Oak and Oriental Hornbeam	Pubescent Oak and Hornbeam (degraded)	Italian and Turkey Oak	Flowering Ash and Sessile Oak	Submontane Beech Forests	Willow Woodlands	Sandy and gravel riverbanks	Hill Pastures	Hill Pastures with sparse vegetation	Hill pastures on rocky sites	Cliffs and Rocks	Rivers & Streams	Stands of Black locust's	Black Pine plantations	Tree lines and other anthropogenic stands	Abandoned fields	Fields and acres	Rural settlements - villages	Urban settlements
Carcharodus alceae		X																	
Carcharodus flocciferus					X					X	X								
Erynnis tages																		X	
Hesperia comma								X	X	X	X								
Ochlodes sylvanus					X														
Pyrgus alveus					X									X				X	
Pyrgus malvae								X								X			
Pyrgus serratulae					X			X	X							X			
Spialia orbifer					X														

Thymelicus sylvestris	X	X	X	X	X														
Iphiclides podalirius		X						X	X	X	X					X			X
Papilio machaon		X						X	X	X	X								
Parnassius mnemosyne					X					X	X					X			
Zerynthia polyxena										X	X		X		X	X			
Anthocharis cardamines	X		X	X		X							X	X	X				
Aporia crategi		X					X	X	X							X		X	
Colias alfacariensis						X	X			X	X								
Colias crocea		X				X		X	X	X	X					X		X	X
Euchloe ausonia								X	X										
Gonepteryx rhamni		X				X		X	X										
Leptidea sinapis	X	X	X	X		X												X	
Pieris brassicae													X		X	X		X	X
Pieris mannii					X	X		X	X							X			X
Pieris napi					X			X	X									X	
Pieris rapae								X	X							X			X
Pontia edusa						X		X	X							X			X
Plebeius agestis		X						X	X										
Callophrys rubi								X	X				X		X				
Celsatrina argiolus						X													
Cyaniris semiargus					X			X	X										
Cupido osiris							X											X	
Glaucopsyche alexis																			
Lycaena alciphron																			
Lycaena phleas								X	X										
Lycaena thersamon								X	X	X	X								
Lycaena tityrus						X		X	X							X		X	
Lycaena dispar																			
Plebeius argus																X		X	
Plebeius sephirus		X					X	X	X										

Polyommatus belargus						X												X	
Polyommatus icarus						X		X	X							X		X	X
Polyommatus amanda							X												
Pseudophilotes vicrama							X	X	X									X	
Satyrium acaciae		X			X													X	
Satyrium spini						X								X					
Scolitantides orion							X			X	X								
Hamearis lucina		X			X													X	
Aglais io		X				X										X			X
Aglais urticae		X				X		X	X				X		X			X	
Apatura ilia						X													
Neptis sappho					X														
Aphantopus hyperantus	X	X	X	X	X	X													
Arethusana arethusa		X						X	X							X		X	
Argynnis adippe		X			X	X													
Argynnis aglaja					X		X												
Argynnis niobe		X						X	X	X	X					X			
Argynnis pandora																X			
Argynnis paphia					X	X												X	
Boloria euphrosyne					X			X	X										
Brintesia circe	X	X	X	X		X	X									X			
Chazara briseis					X														
Coenonympha papmphilus	X	X	X	X				X	X							X		X	
Erebia euryale					X														
Erebia ligea		X			X	X													
Erebia medusa		X			X		X						X		X	X		X	
Euphydryas aurinia		X			X			X	X							X			
Hipparchia statilinus														X					
Hipparchia syriaca							X							X					
Hyponephele lycaon		X					X			X	X								

Lasiommata maera										X	X								
Lasiommata megera								X	X	X	X								
Libythea celtis													X		X				X
Limenitis reducta		X				X		X	X										
Maniola jurtina	X		X	X		X	X									X		X	
Melanargia galathea	X		X	X	X											X			
Melitaea athalia								X	X										
Nymphalis antiopa		X				X													X
Nymphalis polychloros		X			X	X												X	X
Pararge aegeria	X		X	X	X	X							X	X	X				
Polygonia c-album						X										X		X	X
Pyronia tithonus					X	X	X							X					
Vanessa atalanta	X	X	X	X	X	X				X	X			X		X		X	X
Vanessa cardui		X				X		X	X							X		X	

- **Diatoms**

Table 129 Relative percentage composition of the diatom community in the rivers interfering with the railway corridor

Species	River Gabarska	River Gradechka	River Kiselichka		River Kriva 1		River Kriva 2	
	Epilithon	Macrophytes	*Vaucheria*	*Cladophora*	Moss	Sediment	Epiphyton	Epilithon
Achnantidium minutissimum	3	6	6	2	3		4	11
Amphora minutissima	2	4	2		2	2		
Amphora pediculus	3	6	4			2		
Cocconeis placentula var. lineata	24	1	5					
Cocconeis pseudolineata	6		1				1	
Cooconeis pediculus	5		23	53				
Cymbella lange-bertalotii			1					
Diatoma ehrenbergii	3		8	2		2		
Odontidium neomaximum	2				15	18	4	19

Diatoma moniliformis			8	23				
Diatoma vulgaris				12				
Encyonema minutum	1					1	6	1
Encyonema silesiacum			2	1	18	27	40	20
Fragilaria recapitelata		2	1	1			1	
Fragilaria tenera					23	14	23	18
Geissleria decussis	1							
Gomphonema minutum		4					2	
Gomphonema olivaceum	3	4	1	1				
Gomphonema pumilum	19		4					4
Gomphonema tergesstimum	1		2		2	5		
Hannaea arcus			1		24	15	14	25
Melosira varians	1							
Meridion circulare		1						
Navicula antonii	2		1					
Navicula atomus		1					1	1
Navicula capitatoradiata		1		1	1			
Navicula cryptotenella	1	1	2	1				
Navicula gregaria			1					
Navicula lanceolata			2					
Navicula tripunctata	3	1	4					
Navicula veneta	6	3	6					
Nitzschia dissipata		7	8	1			1	
Nitzschia inconspicua			1					

Nitzschia linearis	3	6	2		3	8		
Nitzschia palea		4			2	1		1
Nitzschia fonticola		20				3		
Planotidium frequentissimum	3	13			2			
Planotidum lanceolatum	1	6	2	2	5	2		
Reimeria sinuata	3		2				1	
Rhoicosphenia abbreviata	2	5					2	
Ulnaria ulna	2	4						

- **Macroinvertebrates**

Table 130 Qualitative composition of macroinvertebrates in the rivers interfering with the railway corridor

Species	River Gabarska	River Gradechka	River Kiselichka	River Kriva (at Zhidilovo)	River Kriva (at Uzem)
MOLLUSCA					
GASTROPODA					
Ancylus fluviatilis	+			+	
Radix labiata	+				
Galba truncatula	+				
ANNELIDA					
HIRUDINEA					
Erpobdella octoculata	+	+		+	
ARTHROPODA					
CRUSTACEA					
Amphipoda					
Gammarus balcanicus	+		+	+	
INSECTA					
Diptera					
Ibisia marginata			+	+	+

Tabanus sp.	+			+	+
Plecoptera					
Isoperla grammatica	+	+			
Perla bipunctata			+	+	+
Protonemura praecox					+
Ephemeroptera					
Baetis rhodani	+	+	+	+	+
Ecdyonurus venosus				+	
Epeorus assimilis			+	+	
Ephemera danica			+		
Rhithrogena semicolorata			+		+
Trichoptera					
Ecclisopteryx guttulata			+	+	
Hydropsyche instabilis	+		+		
Hydropsyche pellucidula				+	+
Limnephilus lunatus	+	+			
Odontocerum hellenicum			+		
Oecismus monedula	+	+	+	+	+
Potamophylax cingulatus	+	+	+	+	+
Rhyacophila obliterata			+	+	
Sericostoma flavicorne					+
Silo pallipes	+				
Odonata					
Caliaeschna microstigma	+				
Cordulegaster heros	+				
Coleoptera					
Agabus bipustulatus (ad.)		+			

Deronectes moestus (ad.)	+	+			
Elmis aenea (lar.)			+		

- **Assessment of the ecological status based on diatoms and macroinvertebrates**

Table 131 Values of the IPS and IBD indices, as determined for the river ecosystems interfering with the railway corridor

River	River Gabarska	River Gradechka	River Kiselichka		River Kriva 1		River Kriva 2	
Substrate	Epilythic communities	Macrophytes	*Vaucheria*	*Cladophora*	Moss	Sediment	Epiphytic communities	Epilythic communities
IPS	12.8	12.4	14.5	15.4	12.8	12.5	13.2	12.6
IBD	15.6	13.7	16.5	16.6	13.5	13.4	13.8	13.2

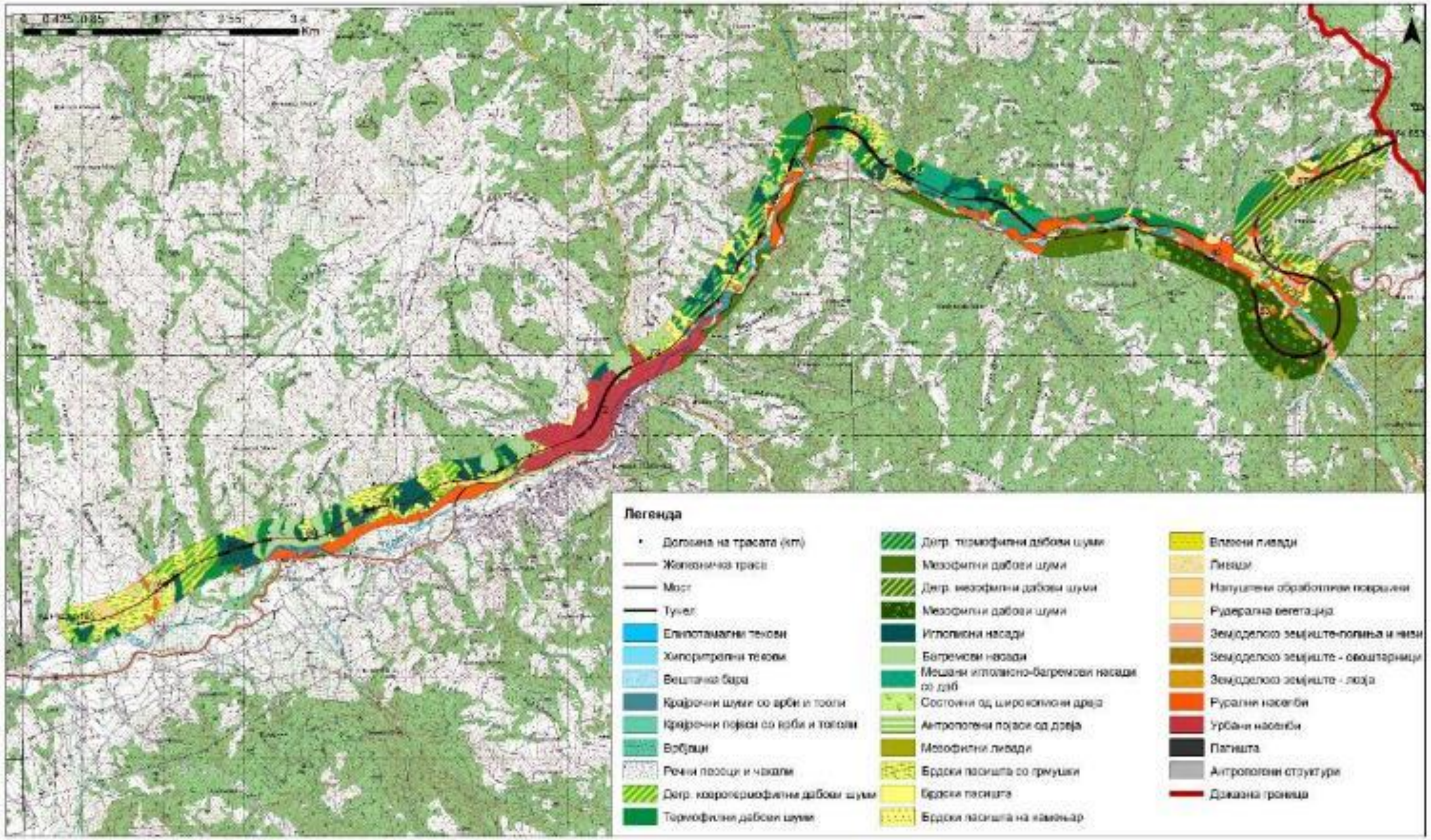
Table 132 Assessment of the ecological status of the river ecosystems interfering with the railway corridor

River	River Gabarska	River Gradechka	River Kiselichka	River Kriva (at Zhidilovo)	River Kriva (at Uzem)
BMWP	63	51	101	78	56
ASPT	5.1	4.1	5.9	5.5	4.5
Ecological status	**F**	**G**	**G**	**F**	**F**

Table 133 Valorization of the insect fauna in the railway corridor area Kriva Palanka - Deve Bair

Species		IUCN Red List	EU Habitats Directive	Bern Convention
Paracaloptenus caloptenoides	**Orthoptera**			**Annex II**
Anax imperator	**Odonata**	LC		
Calopteryx splendens	**Odonata**	LC		
Cordulegaster bidentata	**Odonata**	NT		
Ischnura elegans	**Odonata**	LC		
Orthetrum brunneum	**Odonata**	LC		
Orthetrum cancellatum	**Odonata**	LC		
Platycnemis pennipes	**Odonata**	LC		
Symmpetrum sanguineum	**Odonata**	LC		
Carabus intricatus	**Coleoptera**	LR/nt		
Cerambyx cerdo	**Coleoptera**	VU	Appendix II	**Annex II**
Morimus funereus	**Coleoptera**	VU		**Annex II**
Lucanus cervus	**Coleoptera**			**Annex II**
Euphydryas aurinia	**Lepidoptera**		Appendix II	**Annex II**
Lycaena dispar	**Lepidoptera**	LR/nt	Appendix II	**Annex II**
Parnassius mnemosyne	**Lepidoptera**		Appendix II	**Annex IV**
Zerynthia polyxena	**Lepidoptera**		**Appendix II**	**Annex IV**

Annex 16 Habitats map



Annex 17 Calculation of air emission

- ***Blasting-generated dust emission***

In accordance with the available data it is considered that blastings will be conducted on an area of 400 m^2 per day, in a network of boreholes, with each covering an area of 1.5 m^2. This means that 267 charges of explosives will be activated daily. Using emission factors of solid particles from the guidelines of the Australian Environment Agency, the value of the emission of dust from drilling and blasting is determined. No emission factors for PM 10 are obtained, but following the emission factors for similar activities, it is assumed that their level is 10%. The calculated values of estimated emissions are shown in Table 134.

Table 134 Particulate matter emission from drilling and blasting

Activity	Quantity/ no of blastings	Emission factor		Unit	Emission (t)		
		Total suspended particles (TSP)	PM10		Total suspended particles (TSP)	PM10	PM 2.5
Drilling	249912	0.59	0.31	kg/borehole	147.4	77.5	7.7
Blasting	3744	11.7	6.09	kg/blasting	43.8	22.8	2.3

- ***Emission resulting from loading and unloading of earth and aggregate***

Every dispersal of material in or from the vehicle generates dust. The quantity of dust generated depends on the amount of material to be dispersed, the wind speed and the humidity of the material. The United States Environmental Agency has adopted the following formula for the calculation of particulate matter emissions at discontinuous loading and unloading of loose material. This formula does not apply to loading and unloading with a conveyor belt.

$$E = \frac{k \cdot 0.0016 \cdot \left(\frac{W}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \qquad \text{...} \quad 1$$

Where:

E – emitted quantity of particulate matter of a certain size

W – mean wind speed (m/s)

M – humidity content of the material (%)

k – particle size quotient, referring to particles being emitted (released), with a value of:

Size of particles	**Total suspended particles (TSP)**	**PM 10**	**PM 2.5**
k	0.74	0.35	0.053

In the Report on Materials, Borrow Pits and Landfills, which is part of this Project-Version A dated 05.04.2017, it is stated that during the project's implementation, 4,215,590.0 tons of earth will be dug. This material will be loaded at the place of the excavation in a transport vehicle and it will be unloaded at a given landfill or at the site of re-use. Regardless of the fact that the designer is currently revising the number of landfills and the amount of material to be deposited, the original values are retained in the emission calculations, since all material must be loaded and unloaded regardless of the destination.

In addition to the excavated amount of earth / rock material, the pre-prepared aggregate will be used in the construction. It should also be loaded onto a transport vehicle (dump truck) and unloaded at the point of application. The expected emission of suspended particulate matter from loading and unloading of materials is given in Table 135.

Table 135 Emission of suspended particles from loading and unloading of dugged material during the construction of the railway

Interval	Landfill no.	Quantity (t)	Emission of suspended particles (t)		
			TSP	PM 10	PM 2.5
66+050 - 72+570	1	200000	0.21	0.10	0.015
	2	290000	0.31	0.15	0.022
	3	700000	0.74	0.35	0.053
	4	100000	0.11	0.05	0.008
	5	100000	0.11	0.05	0.008
	6	50000	0.05	0.03	0.004
	7	200000	0.21	0.10	0.015
71+570 - 72+692	1	100000	0.11	0.05	0.008
	2	100000	0.11	0.05	0.008
	3	50000	0.05	0.03	0.004
	4	200000	0.21	0.10	0.015
72+677 - 81+410	1	890	0.00	0.00	0.000
	2	70500	0.07	0.04	0.005
	3	256000	0.27	0.13	0.019
	4	92400	0.10	0.05	0.007
	5	40000	0.04	0.02	0.003
	6	32300	0.03	0.02	0.002
	7	53500	0.06	0.03	0.004
	8	156000	0.17	0.08	0.012
82+350 - 89+473	1	50000	0.05	0.03	0.004
	2	250000	0.26	0.13	0.019
	3	150000	0.16	0.08	0.011
	4	250000	0.26	0.13	0.019
	5	66000	0.07	0.03	0.005
	6	80000	0.08	0.04	0.006
	7	55000	0.06	0.03	0.004
	8	520000	0.55	0.26	0.039
Total		**4212590**	**3.9**	**1.9**	**0.3**

- ***Emissions resulting from transport of materials***

Emission from the transport of excavated material

The transport of the excavated material, aggregate, concrete and other materials to and from the construction sites will be carried out on access roads that will be partially new, and the existing access roads will be used without any asphalt or other covering layer. For the calculation of emissions of solid particles from traffic on such roads, the following formula is given in US EPA (Compilation of Air Pollutants Emission Factors, Section 13.2.2 from AP 42):

$$E = k \cdot \left(\frac{s}{12}\right)^{a} \cdot \left(\frac{W}{3}\right)^{b} \cdot (1 - Eff) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; 2$$

Where:

E – emission of solid particles (kg/VKT[87])

K – size-of-particles-dependent quotient

S – silt contents at the surface (%)

W – vehicle weight

a and *b* are non-dimensional quotients

Eff – efficiency of the emission alleviation techniques

The values of the quotients in case of lack of additional data are given in the following table.

Table 136 Values of the quotients

Quotient	Total suspended particles (TSP)	PM 10	PM 2.5
k	1.3769	0.4215	0.04215
a	0.7	0.9	0.9
b	0.45	0.45	0.45
s	8.5	8.5	8.5

For the calculation of the particulate matter emissions from the transport of materials, the expression (2) is used. In addition, it is assumed that the total weight of the transport trucks is 32 tons. The assumption is that the access roads will be regularly sprayed with water, whereby emissions of solid particles will be reduced by 70%.

In the absence of information on the exact location of the sites for disposal or re-use, the data from Table 17 in the document "Report on materials, borrowings and landfills", version A from 05.04.2017 are accepted. This is due to the fact that the materials will be transported regardless of whether they will be deposited or re-used. There are deviations due to different distances, but this is not very important for this phase, especially since a more conservative approach is adopted.

The results of the calculation of the emission of solid particles from the transport of excavated material, by applying the mitigation measures (spraying the access roads with water), are shown in Table 137.

Table 137 Emission of suspended particles in the air from the transport of excavated material during the construction of the railway

Interval	Landfill no.	Quantity (m^3)	Distance (km)	Load capacity (m^3)	No. of loading rounds	VKT	Emission when mitigation measures are applied (t)		
							TSP	PM 10	PM 2.5
66+050 - 71+570	1	200000	0.6	15	13334	16000.8	15.0	4.3	0.4
	2	290000	0.4	15	19334	15467.2	14.5	4.1	0.4

[87] Kg from a vehicle per kilometer

	3	700000	1	15	46667	93334.0	87.6	25.0	2.5
	4	100000	1.4	15	6667	18667.6	17.5	5.0	0.5
	5	100000	0.6	15	6667	8000.4	7.5	2.1	0.2
	6	50000	0.8	15	3334	5334.4	5.0	1.4	0.1
	7	200000	1	15	13334	26668.0	25.0	7.1	0.7
71+57 - 072+692	1	100000	1.2	15	6667	16000.8	15.0	4.3	0.4
	2	100000	1	15	6667	13334.0	12.5	3.6	0.4
	3	50000	0.8	15	3334	5334.4	5.0	1.4	0.1
	4	200000	0.6	15	13334	16000.8	15.0	4.3	0.4
72+677 - 81+410	1a	890	0.6	15	60	72.0	0.1	0.0	0.0
	2a	70500	0.5	15	4700	4700.0	4.4	1.3	0.1
	3a	256000	0.6	15	17067	20480.4	19.2	5.5	0.5
	4a	92400	0.4	15	6160	4928.0	4.6	1.3	0.1
	5a	40000	1.2	15	2667	6400.8	6.0	1.7	0.2
	6a	32300	0.6	15	2154	2584.8	2.4	0.7	0.1
	7a	53500	1	15	3567	7134.0	6.7	1.9	0.2
	8a	156000	0.8	15	10400	16640.0	15.6	4.5	0.4
82+350 - 89+473	1b	50000	1	15	3334	6668.0	6.3	1.8	0.2
	2b	250000	0.8	15	16667	26667.2	25.0	7.1	0.7
	3b	150000	0.6	15	10000	12000.0	11.3	3.2	0.3
	4b	250000	0.6	15	16667	20000.4	18.8	5.4	0.5
	5b	66000	1	15	4400	8800.0	8.3	2.4	0.2
	6b	80000	1	15	5334	10668.0	10.0	2.9	0.3
	7b	55000	1	15	3667	7334.0	6.9	2.0	0.2
	8b	520000	0.6	15	34667	41600.4	39.0	11.2	1.1
Total (t)		**4212590**			**280850**	**430820**	**404**	**115**	**12**

Emission from the transport of aggregate and concrete

The construction of this part of the railway line will require 80000 m^3 of aggregate and 220800 m^3 of concrete. The aggregate and the concrete will be transported along the same roads as the excavated material. The same equation (2) is used for calculations. The volume of the mixer for concrete is smaller than that of the dumper, but the weight is compensated by the greater specific density of the concrete, ie the assumed gross weight of a mixer is 32 t. It is also assumed that the average distance in one direction is 3 km.

On the basis of the available data and the above assumptions, calculations were made for the expected emission of solid particles from the aggregate and concrete transport. The results are given in Table 138.

Table 138 Emission of suspended particles from the transport of concrete and aggregate during the construction of the railway line

Source of emission	Emission of solid particles (t)		
	TSP	PM 10	PM 2.5
Transport of aggregate	30.0	8.6	0.9

Transport of concrete	124.3	35.5	3.6
Total	**154.3**	**44.1**	**4.4**

Emission from open areas

A free estimate is that the surface of all landfills together will be about 25 ha. An additional assumption is that the average open working area up to completion of works and protection against erosion will be about 5 ha. On the basis of these assumptions and the emission factors according to NPI, total particle emissions and PM10 are calculated. The results are shown in Table 139.

Table 139 Emission of suspended particles from open areas during the construction of the railway line

	Area (ha)	Emission factor ($kg \cdot ha^{-1} \cdot h^{-1}$)		Emission (t)		
		TSP	PM 10	TSP	PM 10	PM 2.5
Landfills	25	0.4	0.2	262.8	**131.4**	13.1
Open working area	5	0.4	0.2	52.6	**26.3**	2.6

- **Emission from combustion – transport vehicles and heavy machines**

During the performance of the transport activities, emissions of exhaust gases will be generated, which will contain carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), sulfur oxides (SO_X), traces of non-combusted hydrocarbons, smoke and dust.

Without information on the organization of construction sites and their activities, it is impossible to estimate the emissions from the machinery and equipment without a significant degree of uncertainty. The knowledge about the volume of excavation, transport and structures to some extent reduces the uncertainty, because it roughly determines the number of vehicles and machines, as well as the duration of their use. These assumed values are listed in the table below.

Table 140 Envisaged equipment, its power and spent energy for the construction of the railway

Type of equipment	No of units	Power (kW)	Activity (h/day)	Activity (day/year)	Total (kWh)
Water truck	2	180	8	312	898560
Diesel dumper	12	220	10	300	7920000
Diesel backhoe loader	1	100	8	100	80000
Diesel drilling machine	1	220	8	100	176000
Diesel cement/mortar mixer	6	220	10	200	2640000
Diesel levelling device	1	220	10	100	220000
Bulldozers	3	220	12	240	1900800
Loaders	3	220	10	300	1980000
Diesel generator sets	4	40	8	312	399360

The emission factors of the individual devices shown in Table 144 are derived from NONROAD 2005 model of the US EPA. The NONROAD 2008 version is also available online (https://www.epa.gov/moves/nonroad-model-nonroad-engines-equipment-and-vehicles#2008amodel).

Table 141 Emission factors of gases from the transport vehicles and heavy machines

Emission factors (g/kWh)							
Type of equipment	**VOC**	**CO**	**NOx**	**PM 10**	**PM 2.5**	**SO_2**	**CO_2**
Water truck	0.598	2.815	7.466	0.558	0.544	1.006	728.960
Diesel compactor	0.503	2.013	6.664	0.462	0.449	1.006	729.232
Diesel dumper	0.598	2.815	7.466	0.558	0.544	1.006	728.960
Diesel backhoe loader	0.694	3.318	7.902	0.626	0.598	1.006	728.688
Diesel drilling machine	0.816	3.114	9.724	0.680	0.666	0.993	720.392
Diesel cement/mortar mixer	0.830	3.155	9.901	0.653	0.639	0.993	720.392
Diesel cranes	0.598	1.768	7.779	0.462	0.449	0.993	721.072
Diesel levelling device	0.476	1.850	6.433	0.449	0.435	1.006	729.368
Diesel tractors/loaders	2.516	11.166	9.819	1.863	1.809	1.292	939.896
Bulldozers	0.490	1.877	6.474	0.449	0.435	1.006	729.368
Loaders	0.517	2.108	6.800	0.476	0.462	1.006	729.232
Diesel generator sets	1.646	5.114	8.119	0.993	0.966	1.102	798.728

The estimated emission of gaseous substances in the air from the work of the mechanization during construction of the railway line is shown in Table 142.

Table 142 Emission of gaseous substances and suspended particles in the air by the transport vehicles and the equipment

Emission (t/year)								
Type of equipment	**VOC**	**CO**	**NOx**	**SO_2**	**CO_2**	**TSP**	**PM 10**	**PM 2.5**
Water truck	1.61	7.59	20.13	2.71	1938.09	1.50	1.50	1.47
Diesel dumper	14.22	66.89	177.40	23.91	17320.09	13.25	13.25	12.93
Diesel backhoe loader	0.11	0.42	1.50	0.24	175.05	0.10	0.10	0.10
Diesel drilling machine	0.37	1.75	4.17	0.53	384.75	0.33	0.33	0.32
Diesel cement/mortar mixer	6.46	24.67	77.01	7.86	5705.50	5.39	5.39	5.28
Diesel levelling device	0.39	1.17	5.13	0.66	475.91	0.31	0.31	0.30
Bulldozers	14.35	63.67	55.99	7.37	5359.66	10.62	10.62	10.31
Loaders	2.91	11.15	38.45	5.98	4332.45	2.67	2.67	2.59
Diesel generator sets	3.23	12.64	13.95	1.55	1125.58	2.26	2.26	2.20
Total (t/year)	**43.65**	**189.95**	**393.74**	**50.81**	**36817.07**	**36.43**	**36.43**	**35.48**

The results obtained are surprisingly high, but one should bear in mind that the calculations processed the worst variant. According to the carbon dioxide emission, along the construction site, vehicles and other internal combustion engines will burn about 12 tonnes of diesel fuel a day. Emissions will be deployed along the line, but this will not be uniform and will have a certain concentration of emissions, mainly on and around stationary construction sites.

Activity	**Emission during construction (t)**							
	TSP	**PM 10**	**PM 2.5**	**VOC**	**CO**	**NOx**	**SO_2**	**CO_2**
Drilling and blasting	191.3	100.3	10.0					
Loading and unloading	3.9	1.9	0.3					

Transport of excavated material	404	115.0	12					
Transport of concrete	124	35.5	3.6					
Transport of aggregate	30	8.6	0.9					
Emission from open areas	315.4	157.7	15.8					
Emission from internal combustion engines	**36**	**36**	**35**	**44**	**190**	**394**	**51**	**36817**
Total	**1105.3**	**455.3**	**78.0**	**44**	**190.0**	**393.7**	**50.8**	**36817**

Despite undertaking measures to mitigate emissions of suspended particulates, transport remains the most significant source of emissions.

Volatile organic compounds and aerosols

As a result of the envisaged activities, this type of emission is expected in the project area. They can cause a local disruption of ambient air quality within and in the immediate surroundings of the project area.

Annex 18 Railway noise level modeling

1. Railway noise level modeling

The noise level modeling for the railway section Kriva Palanka-Border with the Republic of Bulgaria was made on the basis of the Feasibility Study for the construction of a new railway line on the section Kriva Palanka-Border with the Republic of Bulgaria, as part of corridor VIII and the data from the designer of the line.

- **Initial data**

The Feasibility Study has developed several options for corridors, an analysis of the technical and economic characteristics has been carried out and an optimal combination has been proposed. In each combination, railways with standard width (1435 mm) are provided. The sleepers will be made of reinforced concrete, and the ballast will be from crushed stone. Depending on the configuration, there will be a variable layer thickness between the ballast and the surface. A typical section of the line is shown in Figure 251.

The rail fastenings will be completely welded, and the joints between the rails and the thresholds will be flexible.

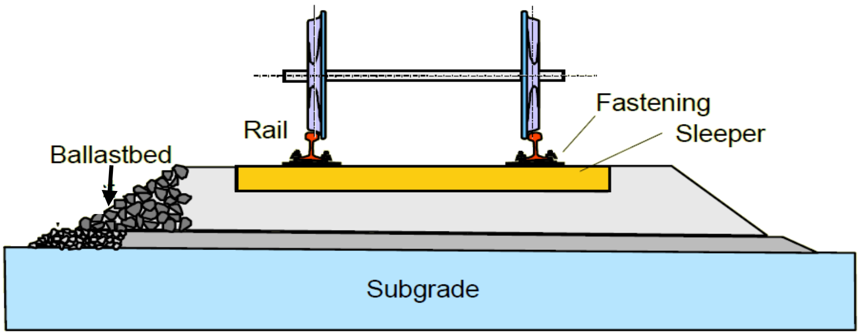


Figure 251 Typical structure of a railway track

Number and type of trains:

According to frequency analysis, the noise calculations include:

- Local and international freight trains with a gross weight of 700 t;
- Passenger trains;
- High-speed passenger trains;
- International high-speed trains.

Due to the absence of data on the technical characteristics of the trains, the suggestions for average values from SCHALL 03 have been accepted whereby the length of the freight trains are being assessed according to the weight and requirements in the design requirements. The maximum length of any train on the section of Kriva Palanka-Border with Bulgaria must not be more than 700 m, since the side tracks have a length of 750 m. The calculations assume that the freight trains are 500 m long.

It is assumed that all trains of one category have the same characteristics:

Table 143 Length, speed and participation of wheels with disc brakes on the trains of the section Kriva Palanka-Border with the Republic of Bulgaria

Type of train	Length (m)	Speed (km/h)	Presence of disk brakes (%)
Freight	500	90	0
Passenegr	150	100	0

Hogh-speed passenger train	150	100	20
International high-speed train	205	100	100

At this stage of the Project, the Timetable can not be accurately predicted, hence the exact number of certain types of trains can not be envisaged for the periods of day, evening and night, but the calculations follow the rule that most of the transport is performed during the day. Therefore, the following division is made for the periods of day, evening, night in both directions:

Table 144 Expected train frequency at the section Kriva Palanka-border with the Republic of Bulgaria in 2040

Type of train	Number of trains-day	Number of trains-evening	Number of trains-night
Freight	11	4	5
Passenger	5	1	2
High-speed passenger	6	2	4
International high-speed train	5	1	2

In the Feasibility Study, train speeds have not been made (although the line is designed for a speed of 100 km / h), for the sake of certainty, for the calculations on the noise level are accepted speeds close to the maximum for which the railway is designed, ie those in Table 143.

Due to compensation from shifting tracks, braking, etc., at the station and the halt and their vicinity, speeds of 70 km/h were used, as recommended by the standard.

Terrain

The data for the terrain are obtained as isohipses at every half meter altitude, and in the range from 50-65 m to the left and right of the alignment in dwg format, as well as individually measured points in the same format. The drawings also include the closest noise receptors.

Railway

Coordinates of the railway are taken from the graphics supplement Axis-3d.dwg, obtained from the designer. Since all the drawings were not in the same coordinate system, small deviations are possible that do not significantly affect the calculated noise levels.

Since the main project is not yet ready, and the differences in the terrain and the track at different points are significant, simulation of the alignment is 3.5 meters left and right from the axis of the railway has been made, so that sufficient space for triangulation is left. Figure 253 shows the appearance of the terrain with the track and receptors between the chainages km 72 + 780 and 73 + 824, which are prepared for the calculation of the impact of the noise. Bridges are presented as a line noise source, and corrections from +3 to +5 dB (A) are added to the calculations.

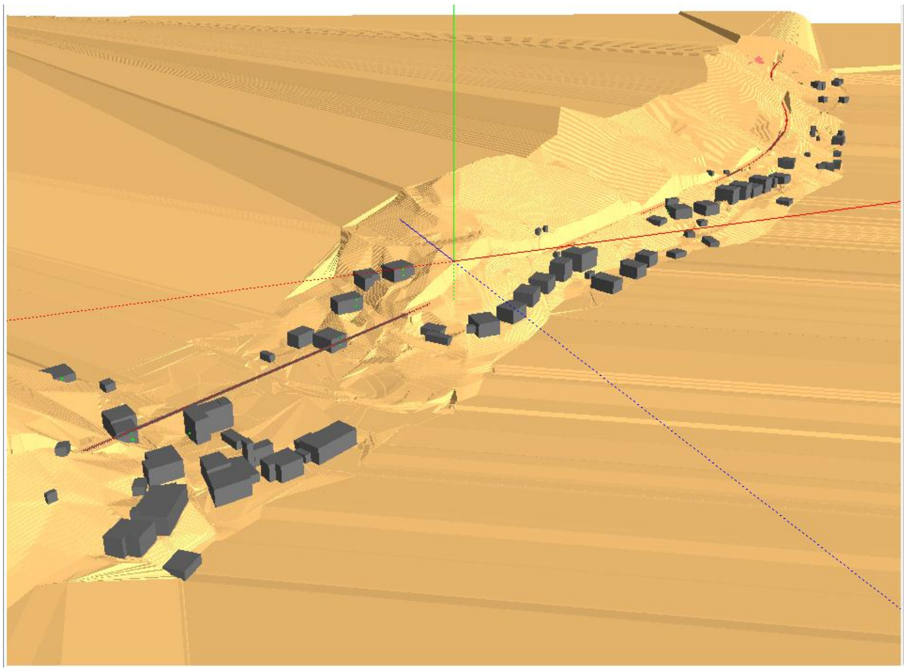


Figure 252 Overpassing the differences in the height of the terrain and the railway (station Kriva Palanka)

Receptors

The most sensitive receptors are the surrounding dwelling facilities. Their coordinates are taken from the submitted drawings in dvg format. Although an overview of the terrain was made, it was not possible to check which of the houses were abandoned, auxiliary or serve as a picnic place.

Basic characteristics of the method for determination of noise from railway traffic (SHALL):

According to SCHALL 03 the noise level for day, evening and night time (07-23 h) is calculated according to the formulas:

$$L_d = L_{d(25)} + D_{train} + D_{speed} + D_{railway} + D_{distance} + D_{height} + D_{terrain} + DLS$$

$$L_e = L_{e(25)} + D_{train} + D_{speed} + D_{railway} + D_{distance} + D_{height} + D_{terrain} + DLS$$

$$L_n = L_{n(25)} + D_{train} + D_{speed} + D_{railway} + D_{distance} + D_{height} + D_{terrain} + DLS$$

In which:

- $L_{d(25)}$, $L_{d(25)}$, $L_{d(25)}$–assessed mean noise level for the periods of day, evening and night, accordingly, at a reference distance of 25 m. They are calculated using the formula:

  $L_{d,e,n(25)} = 51 + 10 \cdot log[M \cdot (5 - 0.04 \cdot p)]$ [dB(A)]

Where:

M-number of trains per day exhibiting certain traits,

p-percentage share of wheels with disc brakes,

- D_{train}-correction due to different railway wagons. This correction is determined according to the following table:

Table 145 Correction of the noise level according to the types of wagons comprising the train

Type of train	D_{train} dB(A)
Wagons with disc brakes	-2
Wagons designed for speed >100 km/h with absorption wheels	-4
Wagons for suspension railways	3
Wagons at two tracks at non-suspension railway	2
All other wagons	0

- D_{speed} – Correction regarding the speed of train which is determined with the equation

$$D_{speed} = 20 \cdot log(v \cdot 10^{-3}) + 10 \cdot log(l)$$

Where

v-speed of train [km/h]

l-length of train [m]

- $D_{railway}$ – Correction due to different types of railways:

Table 146 Correction of the noise level according to the construction of the railway

Type of railway	$D_{railway}$ dB(A)
Railway subgrade with earth	-2
Gravel ballast – wooden sleepers	0
Gravel ballast – sleepers	2
Concrete slabs – slab track	5
Gravel ballast – concrete slabs and elastic fastenings	-1

- $D_{distance}$ – Correction due to the distance (*r*) of the source from the receptor. It is calculated based on the formula

$$D_{distance} = 15.8 - 10 \cdot \log(r) - 0.0142 \cdot r^{0.9}$$

- D_{height} – Correction due to the dampening of the noise from the terrain and the air

$$D_{height} = -4.8 \cdot e^{-\left[\frac{h_m}{r}\left(8.5+\frac{100}{r}\right)\right]^{\frac{1}{3}}}$$

- $D_{terrain}$ - Correction due to the terrain, vegetation, etc. This phase of the project does not takes into consideration the terrain correction.

DLS – Reducing the estimated noise level by 5, since it is considered that the railway has less disturbing effect on people than other sources of noise.

The method also includes curvature corrections if it is less than 500 m, cross-bridge corrections or road level crossing if they are at a distance less than 3r from the receptor, as well as corrections for reflections from individual surfaces.

The noise impact model was made using the SoundPlan Essentials software package. The results of the modeling are presented below.

Chainage 65+760 to 66+100 (village of Talminci)

The village of Talminci is located in the valley and the line practically completely passes over the village with a bridge. A rough representation of the terrain and inhabited houses for the purposes of the calculations is given in Figure 254.

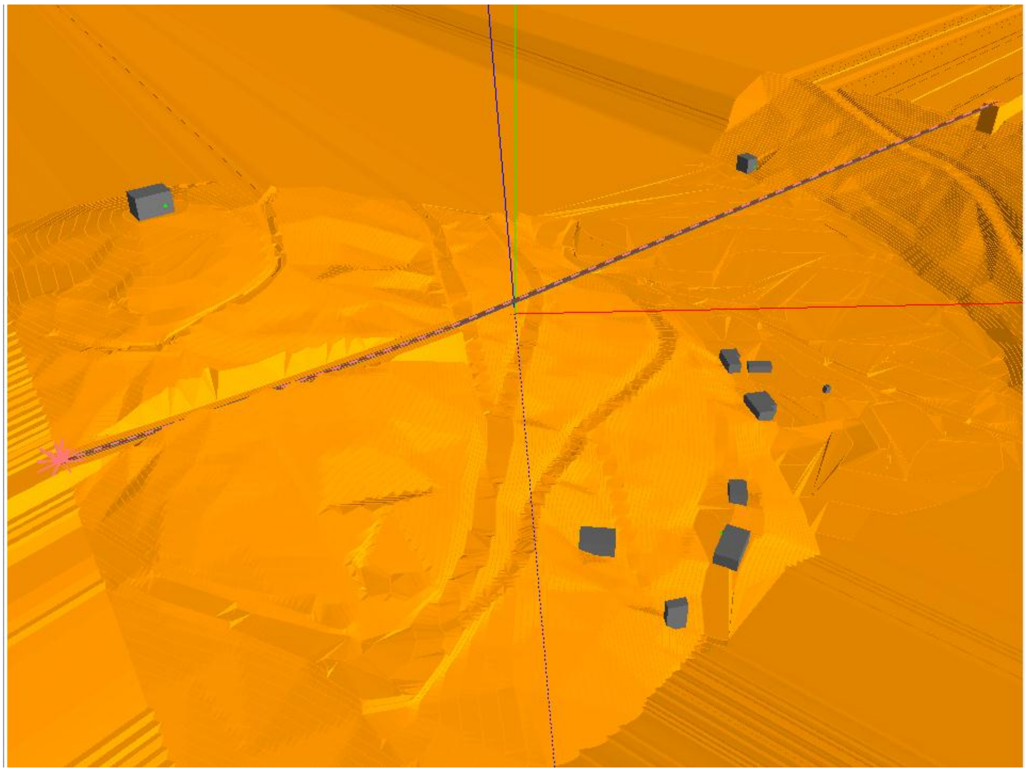


Figure 253 3D representation of the terrain and houses at the village of Talminci

Data on the type of trains and frequency of traffic for the given location, as well as for noise emissions are given in Table 147.

Table 148 lists the track data and the corrected noise emission values. Noise levels in receptors are presented in Table 149.

Site receptor locations are presented in Figure 254 along with the contour of the noise limit values. A daytime estimated daily noise map is presented in Figure 255, while the map for the evening period is shown in Figure 256, and for the night in Figure 257.

In all receptors, except for one, the maximum permissible noise is expected to be exceeded, especially in the night time.

Station Kriva Palanka (70 + 460 to 71 + 807)

This sequence of the railway covers the railway station in Kriva Palanka to the entrance to the second tunnel passing under the city (tunnel No. 8).

After several lonely houses, near the station 70 + 900, on the right side encounters the first large group of dwellings. Due to the configuration of the terrain, the houses are 15 to 20 meters higher or lower than the track. Emission data are given in Table 150 and track data in Table 151. The levels of noise in the receptors are presented in Table 152. Figure 258 shows the locations of individual receptors with noise level values and noise limit values .

Figure 259 represents a map of the noise levels in the vicinity of the chainages 70 + 460 to 71 + 807 during the day (07-19 h), while Figure 260 is a noise map of future rail traffic during the night (23 - 07 h).

Kriva Palanka (72+774 to 73+840)

The second part of the railway line across Kriva Palanka extends from the tunnel exit no. 8 to the exit from the city, ie to the entrance to the tunnel no. 9.

The size of the bridges is the main reason for the occurrence of noise above the permissible limits in a number of receptors. Where the track goes through deeper cuts, the terrain itself is a sound barrier. Table 153 provides data on trains and emissions, while rail data and corrections are shown in Table 154. The levels of noise at the receptors are shown in Table 155. The locations of the receptors with marked values of the noise level are shown in Figure 261. Figure 262 and Figure 263 are maps of noise from rail traffic in periods of day and night respectively.

Pashina Vodenica (75+180 to 75+500)

The village itself is far enough from the railway line, from which it is separated by a river, but a smaller group of houses across the river is in the immediate vicinity or under the bridge over which the railway should pass. It is unclear whether the houses or some of them will collapse due to the construction of the railway, but since the height of the bridge is significant, calculations have been made for the noise that the houses would be exposed if they continue to exist. The results show that all 6 objects would be exposed to significant noise during the day, and the noise above the maximum threshold during the evening and the night.

Data on the type of trains and the frequency of traffic for the given location, as well as noise emissions are given in Table 156. Table 157 lists the data for the line and the corrected noise emission values. Noise levels in the receptors are presented in Table 158. Figure 264 shows the locations of the individual points with the noise level values and the noise limit values.

Figure 265 represents a map of the noise levels in the vicinity of the chainages 123 + 727 to 124 + 693 for a daily period, and the noise levels during the night period are mapped in Figure 266.

Zhidilovo (79+732 to 80+080)

In Zhidilovo the railway enters the tunnel no. 16 and crosses the bridge through the asphalt road and the river. The bridge is curved with a maximum height of about 50 m. Exclusively for the needs of noise modeling, in order to maintain the curvature, columns with appropriate heights are incorporated in the model.

Table 159 presents data on trains and emissions, while track data and corrections are shown in Table 160. The levels of noise at the receptors are shown in Table 161. The locations of the individual receptors are shown in Figure 267. Figure 268 is a map of the daily, and Figure 268 of the night noise from the future rail traffic on this section of the railway line.

***Uzem* (82+020 to 82+520)**

This section of the railway extends from the chainage 82 + 020 to 82 + 520. Between the railway and the village Uzem flows Kriva Reka. At the beginning of the segment there is a bridge for which correction of noise emissions has been made.

Table 162 gives data on the emissions from the railway traffic, and the data for the railway are listed in Table 163. According to Table 164, in which data are given on the possible noise impacts, which may exceed the limit values, ie facilities no. 1, 3, 4, 6 and 10. Of these, facilities no. 1 and 10 are industrial, so higher limit values apply, and objects 3 and 4 are likely to collapse. Accordingly, only objects 5 and 6 should be further protected.

Identification of objects on a map with marked noise levels is given in Figure 270, and the noise levels in day and night periods are mapped in Figure 271 and Figure 272 respectively.

***Uzem* (82+610 to 82+640)**

An isolated group of 4 houses is located relatively close to the track, but the configuration of the terrain provides sufficient protection against noise. Figure 273 shows the contours of the limit values and the noise levels of the receptors caused by the railway traffic at that location.

***Uzem* (86+141 to 86+260)**

Similar to the previous section, Uzem (82 + 610 to 82 + 640), there is also a group of houses near the railway line at this section. Regarding the position of the railway, it is located in a deep cut which is found at the outlet of the tunnel no. 21. The contours of the limit values and the noise levels of the railway traffic are given in Figure 274.

Mainly due to the configuration of the terrain, the nearby inhabited objects at this stretch are not exposed to excessive noise, that is, there is no noise disturbance.

Table 147 Data on emission of noise from railway traffic between the chainages 65+760 and 66+100 (Talminci)

Km: 65+760		Lm,E25: 65.1 / 64.9 / 63.3									
Type of train	Share of disc brakes	Number of trains			Length of train	Speed	Correction for type of train	Max	Level of noise emission		
		Day	Evening	Night					Day	Evening	Night
	%				m	km/h	dB		dB(A)	dB(A)	dB(A)
Freight	-	11	4	5	500	90	-	-	63.7	64.1	62
Passenger	20	5	1	2	150	100	-	-	55.2	53	53
High-speed	100	6	2	4	150	100	-	-	49.8	49.8	49.8
Express	20	5	1	2	205	100	-	-	56.5	54.3	54.3

Table 148 Data on the railway between the chainages 65+760 and 66+100 (Talminci)

Railway chainage	Railway axis coordinates			Type of railway	Curve radius	Reflexion	Correction for bridge	Correction for passage	Emission corrected value		
km	X	Y	Z								
				$D_{Drailway}$	D_{Curve}	D_R	D_{bridge}	$D_{passage}$	day	evening	night
65+760	604720.3	4671974	607.47	2	-	-	-	-	67.1	66.9	65.3
65+847	604794.3	4672020	608.21	2	-	-	3	-	70.1	69.9	68.3
66+097	604994.2	4672170	610.4	2	-	-	-	-	67.1	66.9	65.3
66+100	604996.5	4672171	610.42	2	-	-	-	-	67.1	66.9	65.3

Table 149 Noise impact from railway traffic between the chainages 65+760 and 66+100 (Talminci)

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
1	South-East	Ground floor	65	60	55	-	53.6	53.5	51.9	58.7	-	-	-	-
2	North	Ground floor	65	60	55	-	58.5	58.3	56.7	63.6	-	-	1.7	-
3	North-West	Ground floor	65	60	55	-	59.2	59.1	57.5	64.3	-	-	2.5	-
4	North	Ground floor	65	60	55	-	60.7	60.6	59	65.8	-	0.6	4	-
5	North	Ground floor	65	60	55	-	63	62.8	61.2	68.1	-	2.8	6.2	-
6	North	Ground floor	65	60	55	-	63.9	63.7	62.1	69	-	3.7	7.1	-
7	South-East	Ground floor	65	60	55	-	60.4	60.3	58.7	65.6	-	0.3	3.7	-

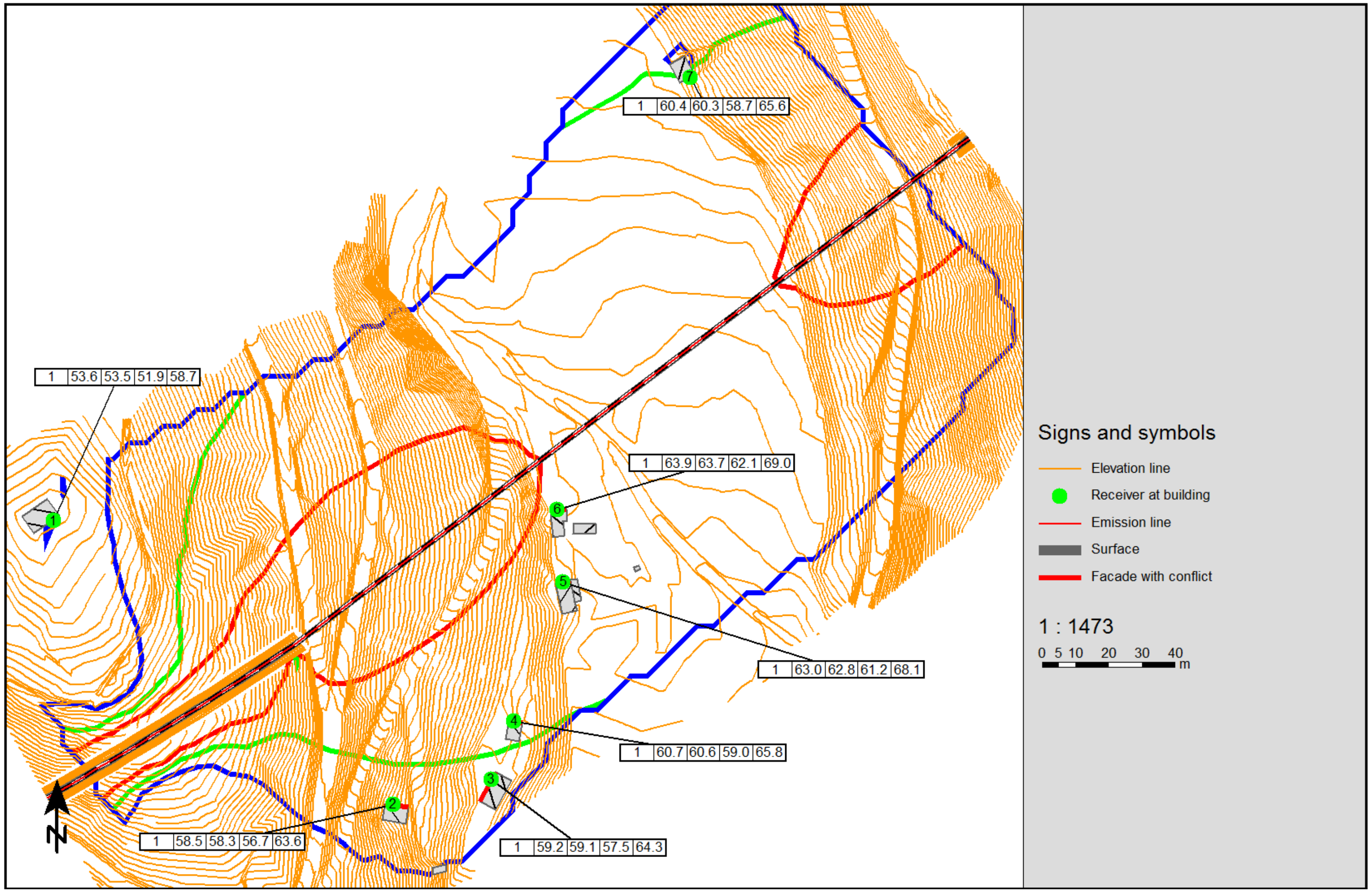


Figure 254 Allocation of the receptors and contours of noise limit values for day, evening and night along the railway, between the chainages 65 + 760 and 66 + 100 (village of Talminci)

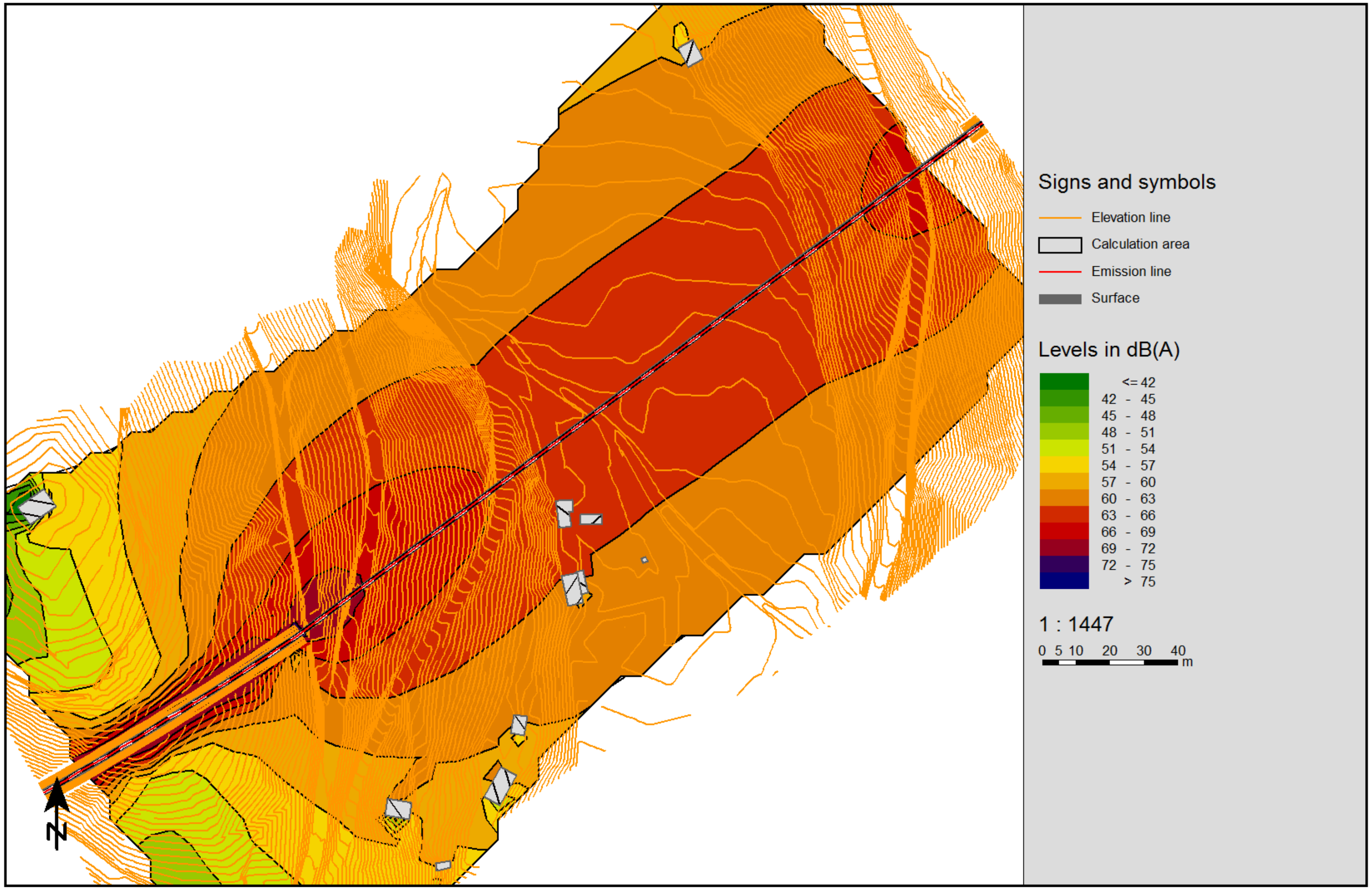


Figure 255 Map of the noise levels along the railway between the chainages 65 + 760 and 66 + 100 (village of Talminci) (L_d) resulting from the envisaged railway operation

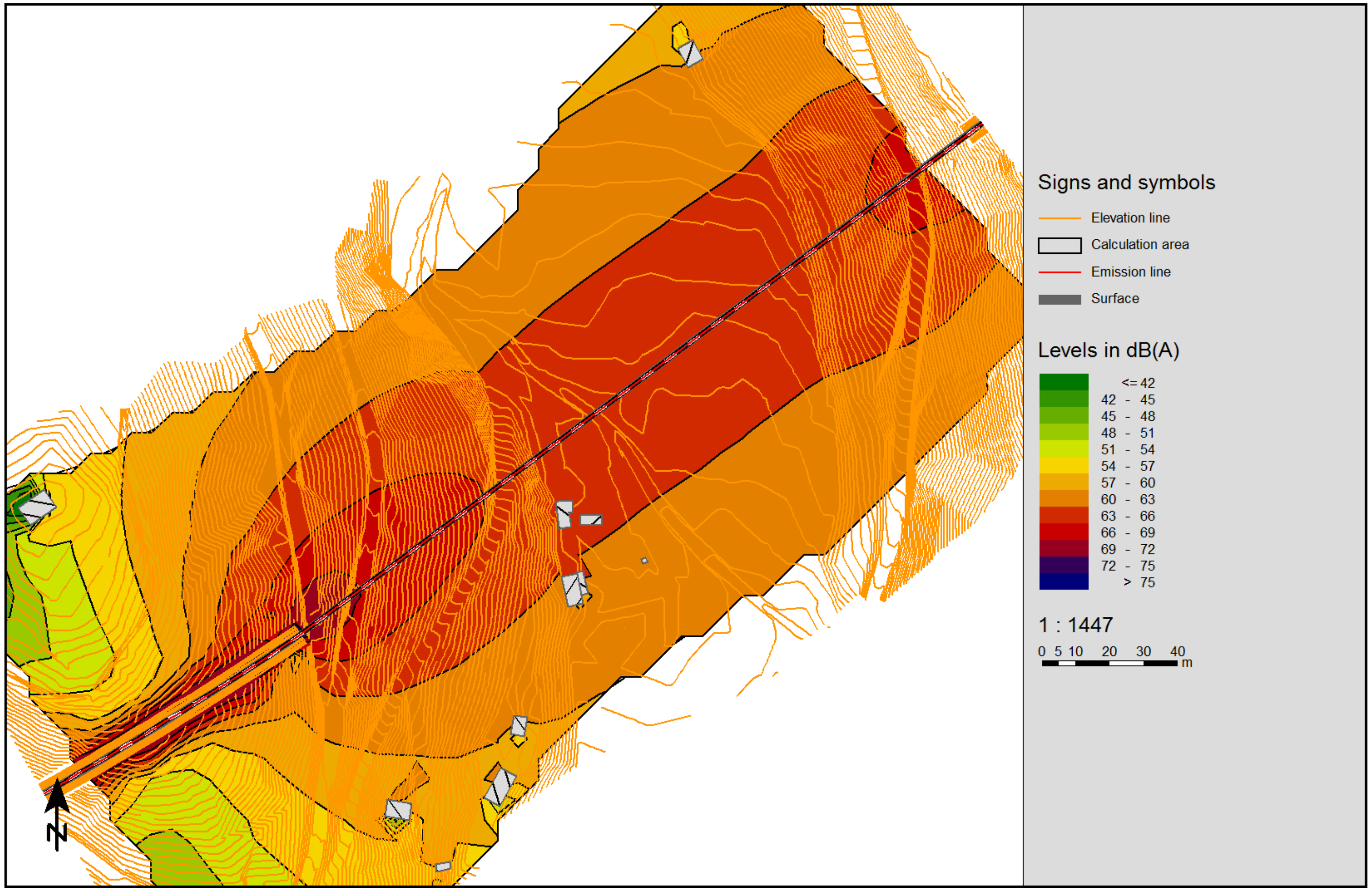


Figure 256 Map of the noise levels along the railway between the chainages 65 + 760 and 66 + 100 (village of Talminci) (L_v) resulting from the envisaged railway operation

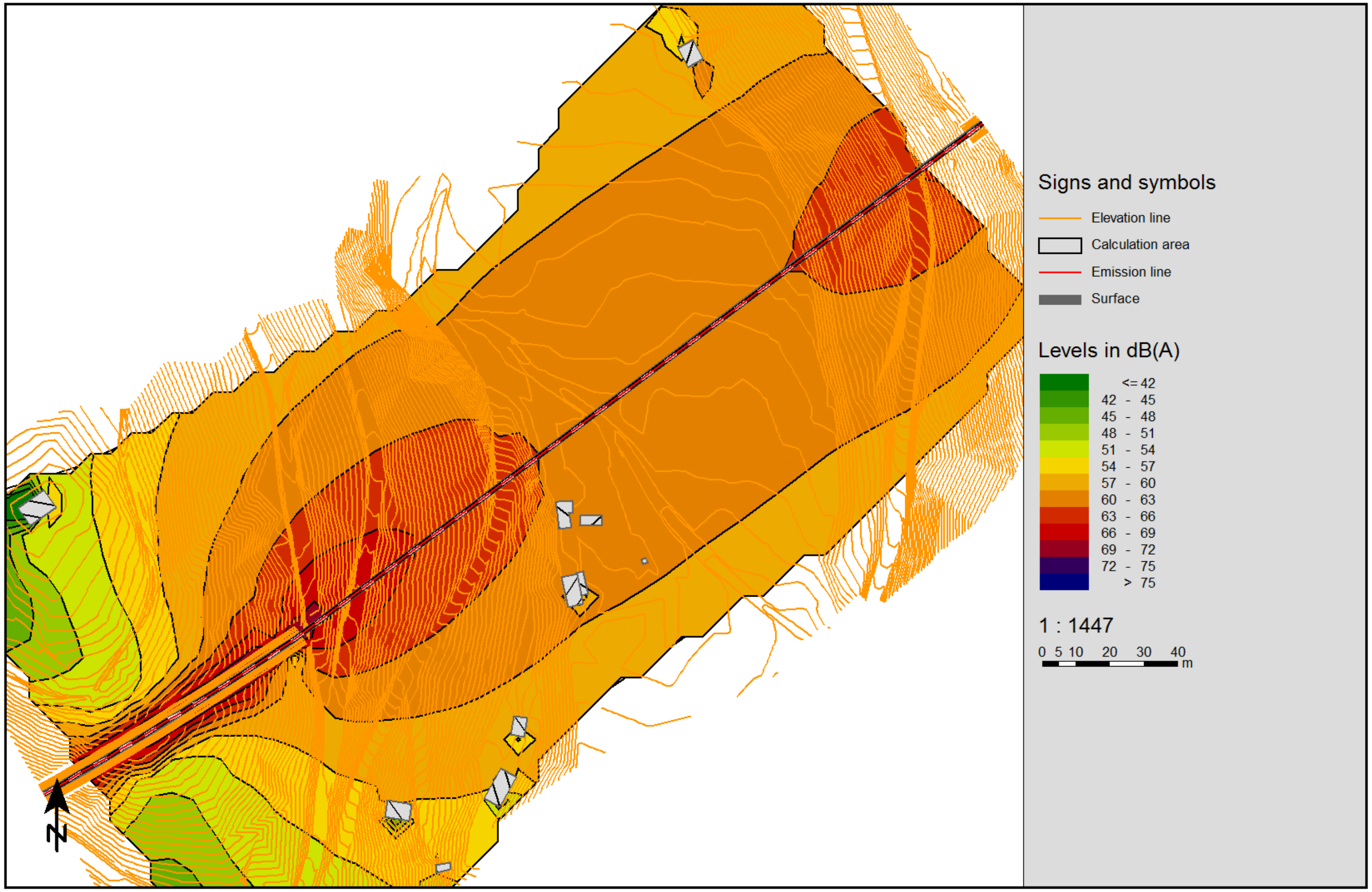


Figure 257 Map of the noise levels along the railway between the chainages 65 + 760 and 66 + 100 (village of Talminci) (Ln) resulting from the envisaged railway operation

Table 150 Data on noise emission between chainages 70+600 and 71+807 (station Kriva Palanka)

Km: 70+460		Lm,E25: 62.8 / 62.7 / 61.1									
Type of train	Share of disc brakes	Number of trains			Length of train	Speed	Correction for type of train	Max	Level of noise emission		
		Day	Evening	Night					Day	Evening	Night
	%				m	km/h	dB		dB(A)	dB(A)	dB(A)
Freight	-	11	4	5	500	70	-	-	61.5	61.9	59.8
Passenger	20	5	1	2	150	70	-	-	52.1	49.9	49.9
High-speed	100	6	2	4	150	80	-	-	47.8	47.8	47.8
Express	20	5	1	2	205	80	-	-	54.6	52.4	52.4

Table 151 Data on the railway between the chainages 70+600 and 71+807 (station Kriva Palanka)

Railway chainage	Railway axis coordinates			Type of railway	Curve radius	Reflexion	Correction for bridge	Correction for passage	Emission corrected value		
km	X	Y	Z								
				$D_{Drailway}$	D_{Curve}	D_R	Dbridge	Dpassage	day	evening	night
70+460	609041.5	4673519	645	2	-	-	-	2	66.8	66.7	65.1
70+527	609101.8	4673548	645	2	-	-	-	2	66.8	66.7	65.1
70+646	609207.9	4673600	645	2	-	-	-	2	66.8	66.7	65.1
70+893	609429	4673710	645	2	-	-	3	2	69.8	69.7	68.1
70+918	609451.5	4673721	645	2	-	-	-	2	66.8	66.7	65.1
71+032	609556	4673769	645	2	-	-	3	2	69.8	69.7	68.1
71+122	609640.3	4673800	645	2	-	-	-	2	66.8	66.7	65.1
71+337	609842.5	4673873	645	2	-	-	3	2	69.8	69.7	68.1
71+422	609922.4	4673902	645	2	-	-	-	2	66.8	66.7	65.1

71+562	610053.9	4673950	645	2	-	-	3	2	69.8	69.7	68.1
71+612	610100.1	4673969	645	2	-	-	-	2	66.8	66.7	65.1

Table 152 Noise impact from railway traffic between the chainages 70+600 and 71+807 (station Kriva Palanka)

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
1	North-West	Ground floor	65	60	55	-	41	39.2	39.1	45.8	-	-	-	-
2	North-West	Ground floor	65	60	55	-	39	37.2	37.1	43.8	-	-	-	-
2	North-West	First floor	65	60	55	-	40.8	38.9	38.9	45.5	-	-	-	-
3	North	Ground floor	65	60	55	-	45.3	43.5	43.4	50.1	-	-	-	-
3	North	First floor	65	60	55	-	46.4	44.6	44.6	51.2	-	-	-	-
4	North-West	Ground floor	65	60	55	-	38.8	37	36.9	43.6	-	-	-	-
4	North-West	First floor	65	60	55	-	40.8	39	38.9	45.6	-	-	-	-
4	North-West	Second floor	65	60	55	-	42.6	40.8	40.7	47.4	-	-	-	-
5	North-West	Ground floor	65	60	55	-	45.4	43.6	43.5	50.2	-	-	-	-
5	North-West	First floor	65	60	55	-	46.7	44.9	44.8	51.5	-	-	-	-
6	North-West	Ground floor	65	60	55	-	50.7	48.9	48.8	55.5	-	-	-	-
6	North-West	First floor	65	60	55	-	50.9	49.1	49	55.7	-	-	-	-
7	North-West	Ground floor	65	60	55	-	55.5	53.7	53.6	60.3	-	-	-	-
7	North-West	First floor	65	60	55	-	55.8	54	53.9	60.6	-	-	-	-
8	North	Ground floor	65	60	55	-	54.7	52.9	52.9	59.5	-	-	-	-
8	North	First floor	65	60	55	-	55	53.2	53.1	59.8	-	-	-	-
9	North	Ground floor	65	60	55	-	46.1	44.3	44.2	50.9	-	-	-	-
9	North	First floor	65	60	55	-	49.3	47.5	47.4	54.1	-	-	-	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
10	North	Ground floor	65	60	55	-	43.1	41.3	41.2	47.9	-	-	-	-
10	North	First floor	65	60	55	-	45.3	43.5	43.5	50.1	-	-	-	-
11	North	Ground floor	65	60	55	-	42.3	40.5	40.5	47.1	-	-	-	-
11	North	First floor	65	60	55	-	42.8	41	40.9	47.6	-	-	-	-
12	North	Ground floor	65	60	55	-	40.1	38.3	38.2	44.9	-	-	-	-
12	North	First floor	65	60	55	-	42.1	40.2	40.2	46.8	-	-	-	-
13	North	Ground floor	65	60	55	-	38.6	36.7	36.7	43.3	-	-	-	-
13	North	First floor	65	60	55	-	41.3	39.5	39.4	46.1	-	-	-	-
14	North	First floor	65	60	55	-	43.5	41.7	41.6	48.3	-	-	-	-
15	North	Ground floor	65	60	55	-	38.7	36.9	36.8	43.5	-	-	-	-
15	North	First floor	65	60	55	-	45.2	43.4	43.3	49.9	-	-	-	-
16	North-West	Ground floor	65	60	55	-	47.5	45.7	45.6	52.3	-	-	-	-
16	North-West	First floor	65	60	55	-	50.3	48.5	48.4	55.1	-	-	-	-
17	North-West	Ground floor	65	60	55	-	50	48.1	48.1	54.7	-	-	-	-
17	North-West	First floor	65	60	55	-	51.8	50	49.9	56.6	-	-	-	-
18	North-West	Ground floor	65	60	55	-	56	54.2	54.2	60.8	-	-	-	-
18	North-West	First floor	65	60	55	-	56.9	55.1	55.1	61.7	-	-	0.1	-
19	North-West	Ground floor	65	60	55	-	58.6	56.8	56.7	63.4	-	-	1.7	-
19	North-West	First floor	65	60	55	-	59	57.2	57.1	63.8	-	-	2.1	-
20	North-West	Ground floor	65	60	55	-	58.1	56.2	56.2	62.8	-	-	1.2	-
20	North-West	First floor	65	60	55	-	58.5	56.7	56.6	63.3	-	-	1.6	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
21	North	Ground floor	65	60	55	-	51.3	49.5	49.4	56.1	-	-	-	-
21	North	First floor	65	60	55	-	51.5	49.7	49.6	56.3	-	-	-	-
21	North	Second floor	65	60	55	-	51.6	49.8	49.7	56.4	-	-	-	-
22	North	Ground floor	65	60	55	-	48.6	46.8	46.7	53.4	-	-	-	-
22	North	First floor	65	60	55	-	49.1	47.3	47.2	53.9	-	-	-	-
22	North	Second floor	65	60	55	-	49.5	47.6	47.6	54.2	-	-	-	-
23	North	Ground floor	65	60	55	-	45.9	44.1	44.1	50.7	-	-	-	-
23	North	First floor	65	60	55	-	46.4	44.6	44.6	51.2	-	-	-	-
23	North	Second floor	65	60	55	-	47.3	45.5	45.4	52.1	-	-	-	-
24	North	Ground floor	65	60	55	-	45.1	43.3	43.2	49.9	-	-	-	-
24	North	First floor	65	60	55	-	45.6	43.8	43.8	50.4	-	-	-	-
24	North	Second floor	65	60	55	-	46.6	44.8	44.7	51.4	-	-	-	-
25	North	Ground floor	65	60	55	-	42.9	41	41	47.6	-	-	-	-
25	North	First floor	65	60	55	-	44.1	42.3	42.3	48.9	-	-	-	-
26	North	Ground floor	65	60	55	-	44.1	42.3	42.2	48.9	-	-	-	-
26	North	First floor	65	60	55	-	45.4	43.6	43.5	50.2	-	-	-	-
27	North-West	Ground floor	65	60	55	-	42.4	40.6	40.5	47.2	-	-	-	-
28	North-West	Ground floor	65	60	55	-	44.3	42.5	42.4	49.1	-	-	-	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
29	North	Ground floor	65	60	55	-	43.3	41.5	41.4	48.1	-	-	-	-
29	North	First floor	65	60	55	-	45	43.2	43.1	49.8	-	-	-	-
30	North	Ground floor	65	60	55	-	52.4	50.6	50.5	57.2	-	-	-	-
30	North	First floor	65	60	55	-	52.7	50.9	50.8	57.5	-	-	-	-
31	North	Ground floor	65	60	55	-	53.9	52.1	52	58.7	-	-	-	-
31	North	First floor	65	60	55	-	54.2	52.4	52.3	59	-	-	-	-
32	North	Ground floor	65	60	55	-	54.6	52.8	52.7	59.3	-	-	-	-
32	North	First floor	65	60	55	-	54.8	53	52.9	59.6	-	-	-	-
33	North-West	Ground floor	65	60	55	-	51.8	50	49.9	56.6	-	-	-	-
33	North-West	First floor	65	60	55	-	52.2	50.4	50.3	57	-	-	-	-
33	North-West	Second floor	65	60	55	-	52.8	50.9	50.9	57.5	-	-	-	-
34	North	Ground floor	65	60	55	-	47.3	45.5	45.4	52.1	-	-	-	-
35	North	Ground floor	65	60	55	-	50.6	48.8	48.7	55.4	-	-	-	-
36	North-West	Ground floor	65	60	55	-	31.5	29.7	29.7	36.3	-	-	-	-
37	North-West	Ground floor	65	60	55	-	43.6	41.8	41.7	48.4	-	-	-	-
38	North	Ground floor	65	60	55	-	55.9	54.1	54.1	60.7	-	-	-	-
38	North	First floor	65	60	55	-	58.2	56.4	56.3	63	-	-	1.3	-
38	North	Second floor	65	60	55	-	58.8	57	56.9	63.6	-	-	1.9	-
39	West	Ground floor	65	60	55	-	50	48.2	48.1	54.8	-	-	-	-
39	West	First floor	65	60	55	-	51.7	49.9	49.8	56.5	-	-	-	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
40	West	Ground floor	65	60	55	-	40.7	38.9	38.8	45.4	-	-	-	-
40	West	First floor	65	60	55	-	43.4	41.5	41.5	48.1	-	-	-	-
41	South-East	Ground floor	65	60	55	-	46.6	44.8	44.7	51.3	-	-	-	-
41	South-East	First floor	65	60	55	-	48.1	46.3	46.2	52.9	-	-	-	-
42	South	Ground floor	65	60	55	-	48.9	47.1	47	53.7	-	-	-	-
42	South	First floor	65	60	55	-	50.6	48.8	48.7	55.4	-	-	-	-
43	East	Ground floor	65	60	55	-	50.3	48.5	48.5	55.1	-	-	-	-
43	East	First floor	65	60	55	-	51.7	49.9	49.8	56.5	-	-	-	-
44	East	Ground floor	65	60	55	-	44.4	42.6	42.5	49.2	-	-	-	-
44	East	First floor	65	60	55	-	46.3	44.5	44.4	51.1	-	-	-	-
45	South-East	Ground floor	65	60	55	-	40.3	38.5	38.4	45	-	-	-	-
45	South-East	First floor	65	60	55	-	42.3	40.4	40.4	47	-	-	-	-
46	South	Ground floor	65	60	55	-	47.1	45.3	45.3	51.9	-	-	-	-
47	South-East	Ground floor	65	60	55	-	47.2	45.4	45.4	52	-	-	-	-
48	South-East	Ground floor	65	60	55	-	55.9	54.1	54.1	60.7	-	-	-	-
48	South-East	First floor	65	60	55	-	56.4	54.6	54.5	61.2	-	-	-	-
49	South-East	Ground floor	65	60	55	-	58.7	56.9	56.8	63.5	-	-	1.8	-
49	South-East	First floor	65	60	55	-	59	57.2	57.1	63.8	-	-	2.1	-
50	South	Ground floor	65	60	55	-	60	58.2	58.1	64.8	-	-	3.1	-
50	South	First floor	65	60	55	-	60.7	58.9	58.9	65.5	-	-	3.9	-
51	East	Ground floor	65	60	55	-	59.4	57.6	57.5	64.2	-	-	2.5	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
52	South-East	Ground floor	65	60	55	-	51.9	50.1	50.1	56.7	-	-	-	-
53	South-East	Ground floor	65	60	55	-	55	53.2	53.2	59.8	-	-	-	-
53	South-East	First floor	65	60	55	-	55.2	53.4	53.3	60	-	-	-	-
54	South	Ground floor	65	60	55	-	50.8	49	48.9	55.6	-	-	-	-
54	South	First floor	65	60	55	-	51.3	49.5	49.5	56.1	-	-	-	-
55	South	Ground floor	65	60	55	-	45.9	44.1	44	50.7	-	-	-	-
56	East	Ground floor	65	60	55	-	50.1	48.3	48.2	54.8	-	-	-	-
57	South-East	Ground floor	65	60	55	-	42.8	41	40.9	47.6	-	-	-	-
57	South-East	First floor	65	60	55	-	44.3	42.5	42.4	49.1	-	-	-	-
58	South-East	Ground floor	65	60	55	-	38.9	37.1	37	43.7	-	-	-	-
58	South-East	First floor	65	60	55	-	42.1	40.2	40.2	46.8	-	-	-	-
59	South-East	Ground floor	65	60	55	-	43	41.2	41.1	47.7	-	-	-	-
59	South-East	First floor	65	60	55	-	45.1	43.3	43.2	49.9	-	-	-	-
60	South-East	Ground floor	65	60	55	-	36.4	34.6	34.6	41.2	-	-	-	-
60	South-East	First floor	65	60	55	-	41.2	39.4	39.3	46	-	-	-	-
61	South-East	Ground floor	65	60	55	-	40	38.2	38.1	44.8	-	-	-	-
61	South-East	First floor	65	60	55	-	43.7	41.9	41.8	48.4	-	-	-	-

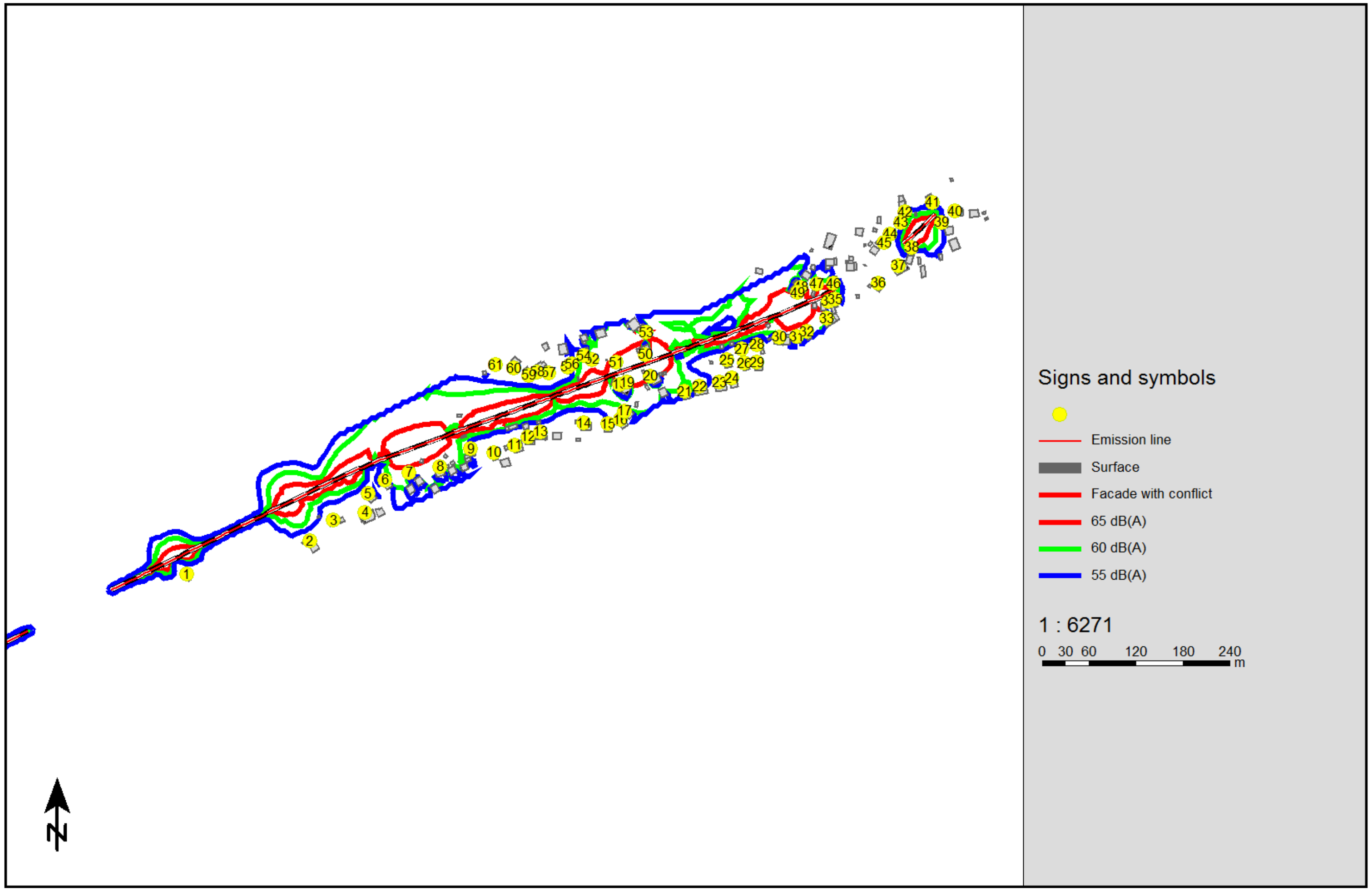


Figure 258 Noise levels at individual receptors resulting from the railway operation between the chainages 70+600 and 71+807 (station Kriva Palanka)

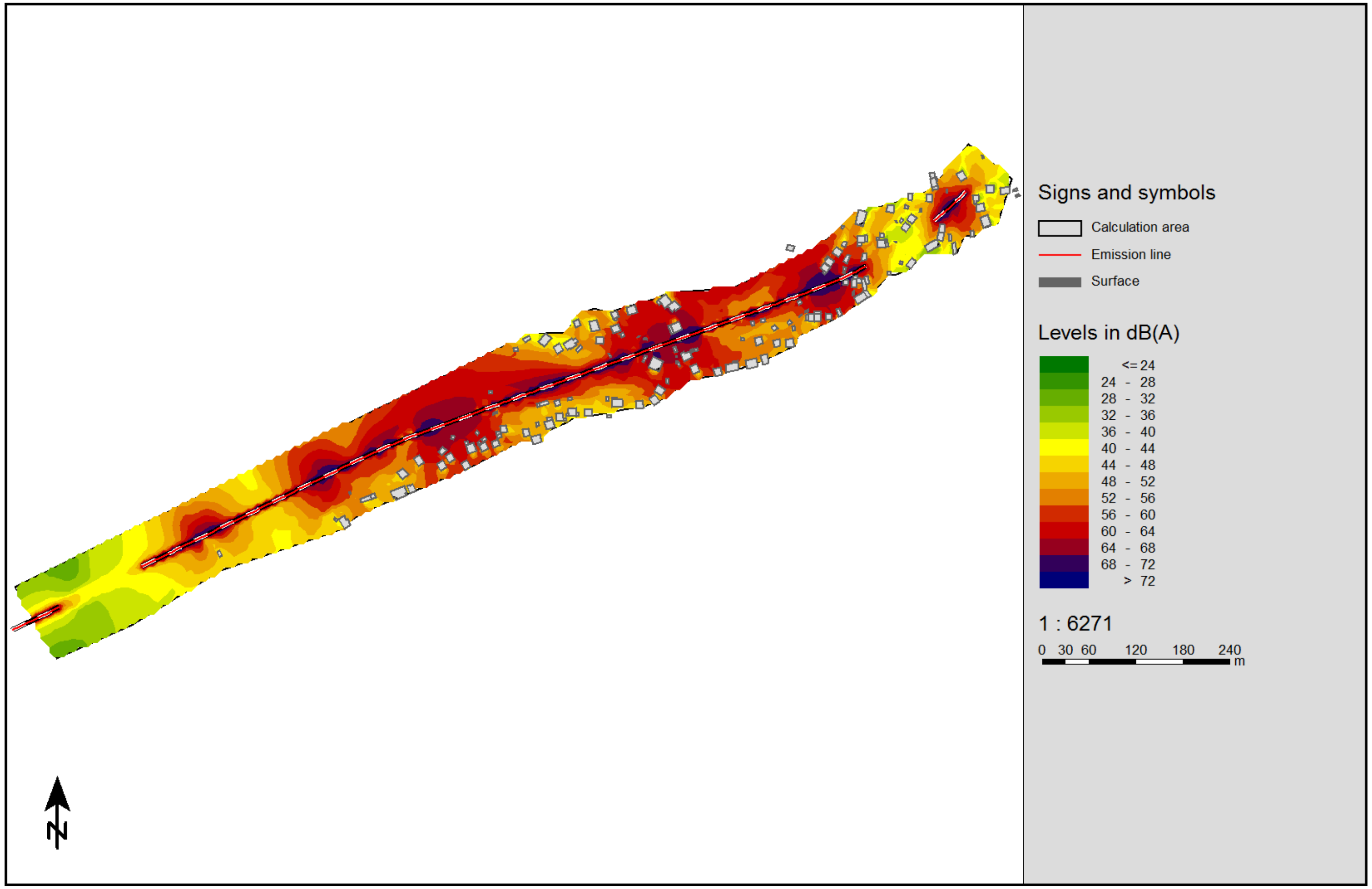


Figure 259 Map of the noise resulting from the railway operation during the day between the chainages 70+600 and 71+807 (station Kriva Palanka)

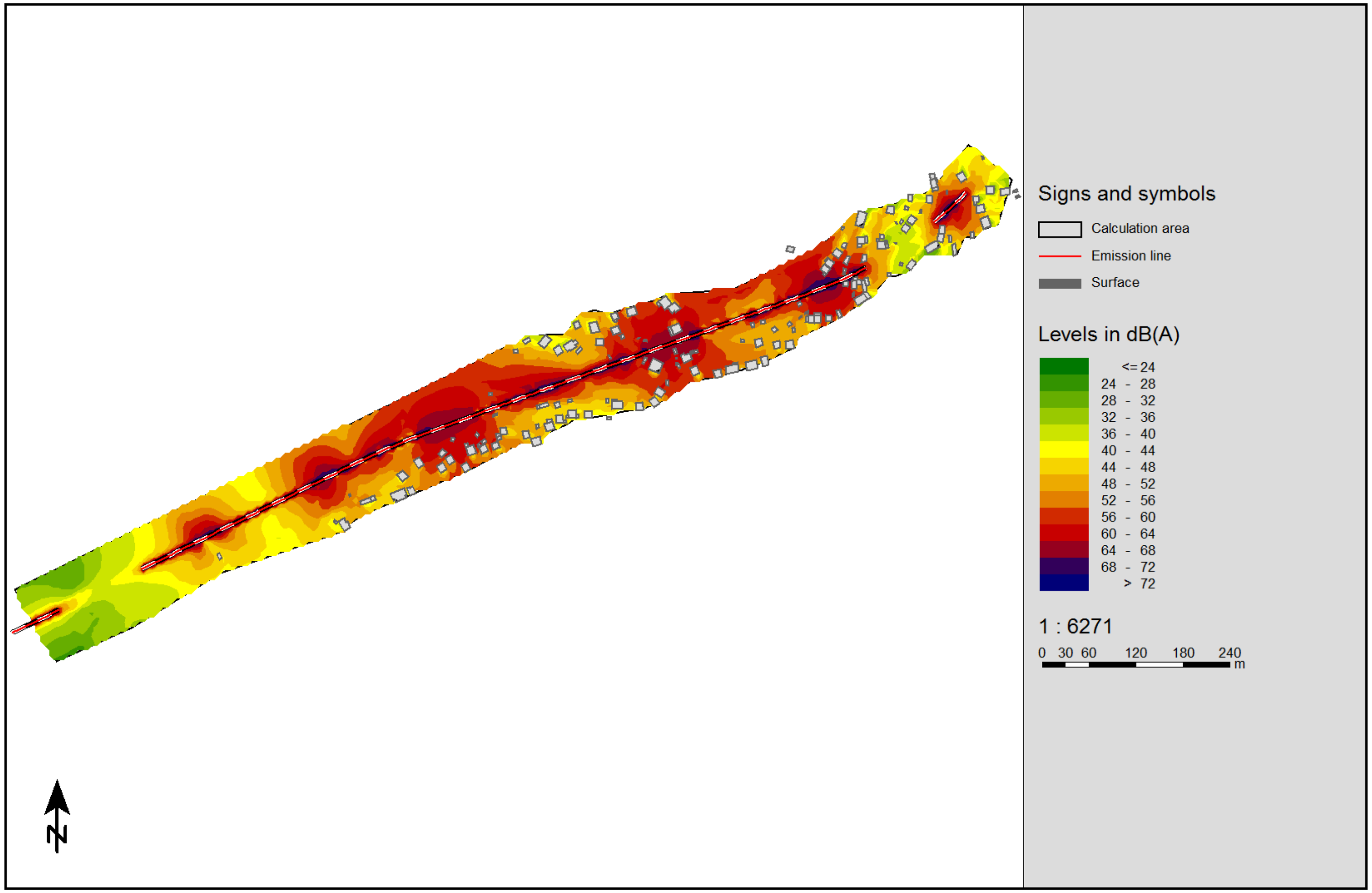


Figure 260 Map of the noise resulting from the railway operation during the night between the chainages 70+600 and 71+807 (station Kriva Palanka)

Table 153 Data on emission of noise from railway traffic between the chainages 72+774 to 73+840 (Kriva Palanka)

Km: 70+460		Lm,E25: 62.8 / 62.7 / 61.1									
Type of train	Share of disc brakes	Number of trains			Length of train	Speed	Correction for type of train	Max	Level of noise emission		
		Day	Evening	Night					Day	Evening	Night
	%				m	km/h	dB		dB(A)	dB(A)	dB(A)
Freight	-	11	4	5	500	90	-	-	63.7	64.1	62
Passenger	20	5	1	2	150	120	-	-	56.8	54.6	54.6
High-speed	100	6	2	4	150	100	-	-	49.8	49.8	49.8
Express	20	5	1	2	205	100	-	-	56.5	54.3	54.3

Table 154 Data on the railway between the chainages 72+774 to 73+840 (Kriva Palanka)

Railway chainage	Railway axis coordinates			Type of railway	Curve radius	Reflexion	Correction for bridge	Correction for passage	Emission corrected value		
km	X	Y	Z	$D_{Drailway}$	D_{Curve}	D_R	Dbridge	Dpassage	day	evening	night
72+774	610798.2	4674854	662.54	2	-	-	-	-	67.3	67.1	65.5
72+807	610827.5	4674868	663.11	2	-	-	3	-	70	69.9	68.3
72+942	610949.4	4674927	665.8	2	-	-	-	-	67	66.9	65.3
73+232	611210.5	4675053	671.87	2	-	-	3	-	70	69.9	68.3
73+262	611236.6	4675067	672.59	2	-	-	-	-	67	66.9	65.3
73+322	611286.5	4675101	673.86	2	-	-	3	-	70	69.9	68.3
73+402	611347.3	4675153	675.56	2	-	-	-	-	67	66.9	65.3
73+562	611449.9	4675275	678.95	2	-	-	3	-	70	69.9	68.3
73+742	611562.7	4675415	682.79	2	-	-	-	-	67	66.9	65.3

73+767	611580.2	4675433	683.31	2	-	-	3	-	70	69.9	68.3
73+822	611620.3	4675471	684.5	2	-	-	-	-	67	66.9	65.3

Table 155 Noise impact from railway traffic between the chainages 72+774 to 73+840 (Kriva Palanka)

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
1	South	Ground floor	65	60	55	-	71.1	71	69.4	76.3	6.1	11	14.4	-
1	South	First floor	65	60	55	-	72.6	72.5	70.9	77.7	7.6	12.5	15.9	-
2	South	Ground floor	65	60	55	-	60.6	60.5	58.9	65.8	-	0.5	3.9	-
3	West	Ground floor	65	60	55	-	68.4	68.3	66.7	73.6	3.4	8.3	11.7	-
4	East	Ground floor	65	60	55	-	67.6	67.5	65.9	72.7	2.6	7.5	10.9	-
5	North	Ground floor	65	60	55	-	67.1	67	65.4	72.2	2.1	7	10.4	-
5	North	First floor	65	60	55	-	67.4	67.3	65.7	72.5	2.4	7.3	10.7	-
6	North	Ground floor	65	60	55	-	64.6	64.5	62.9	69.7	-	4.5	7.9	-
6	North	First floor	65	60	55	-	65	64.9	63.3	70.2	-	4.9	8.3	-
7	North	Ground floor	65	60	55	-	63.7	63.6	62	68.9	-	3.6	7	-
8	North-West	Ground floor	65	60	55	-	64.1	64	62.4	69.3	-	4	7.4	-
9	North-West	Ground floor	65	60	55	-	63.6	63.5	61.9	68.8	-	3.5	6.9	-
9	North-West	First floor	65	60	55	-	64	63.9	62.3	69.1	-	3.9	7.3	-
10	North-West	Ground floor	65	60	55	-	67	66.9	65.3	72.1	2	6.9	10.3	-
11	North	Ground floor	65	60	55	-	51.6	51.5	49.9	56.8	-	-	-	-
11	North	First floor	65	60	55	-	57.7	57.6	55.9	62.8	-	-	0.9	-
12	North-West	Ground floor	65	60	55	-	49.2	49.1	47.4	54.3	-	-	-	-
12	North-West	First floor	65	60	55	-	52.6	52.5	50.9	57.7	-	-	-	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
13	North-West	Ground floor	65	60	55	-	42	41.8	40.2	47.1	-	-	-	-
13	North-West	First floor	65	60	55	-	43.7	43.6	42	48.9	-	-	-	-
14	North-West	First floor	65	60	55	-	43.4	43.3	41.7	48.5	-	-	-	-
15	North-West	First floor	65	60	55	-	45.5	45.4	43.8	50.7	-	-	-	-
15	North-West	Second floor	65	60	55	-	48.6	48.5	46.9	53.8	-	-	-	-
16	North-West	First floor	65	60	55	-	50	49.9	48.3	55.1	-	-	-	-
16	North-West	Second floor	65	60	55	-	56.8	56.7	55	61.9	-	-	-	-
17	North	Ground floor	65	60	55	-	43.6	43.5	41.9	48.8	-	-	-	-
17	North	First floor	65	60	55	-	45	44.9	43.2	50.1	-	-	-	-
18	North-West	Ground floor	65	60	55	-	44.1	44	42.4	49.2	-	-	-	-
18	North-West	First floor	65	60	55	-	45.5	45.3	43.7	50.6	-	-	-	-
19	North	Ground floor	65	60	55	-	44.5	44.4	42.8	49.6	-	-	-	-
20	North-West	Ground floor	65	60	55	-	55.8	55.7	54.1	60.9	-	-	-	-
20	North-West	First floor	65	60	55	-	64.8	64.7	63.1	69.9	-	4.7	8.1	-
21	West	Ground floor	65	60	55	-	58.1	58	56.4	63.2	-	-	1.4	-
21	West	First floor	65	60	55	-	67.1	67	65.3	72.2	2.1	7	10.3	-
22	North	First floor	65	60	55	-	47.3	47.1	45.5	52.4	-	-	-	-
23	North-West	Ground floor	65	60	55	-	45.9	45.8	44.2	51	-	-	-	-
23	North-West	First floor	65	60	55	-	50.8	50.7	49.1	56	-	-	-	-
24	North-West	Ground floor	65	60	55	-	51	50.8	49.2	56.1	-	-	-	-
24	North-West	First floor	65	60	55	-	54.7	54.6	53	59.8	-	-	-	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
24	North-West	Second floor	65	60	55	-	58.2	58.1	56.4	63.3	-	-	1.4	-
25	North-West	Ground floor	65	60	55	-	53.1	53	51.4	58.3	-	-	-	-
25	North-West	First floor	65	60	55	-	61.4	61.3	59.7	66.5	-	1.3	4.7	-
25	North-West	Second floor	65	60	55	-	63.3	63.2	61.6	68.5	-	3.2	6.6	-
26	North-West	Ground floor	65	60	55	-	47.3	47.2	45.6	52.4	-	-	-	-
26	North-West	First floor	65	60	55	-	58.7	58.6	57	63.9	-	-	2	-
26	North-West	Second floor	65	60	55	-	63.1	63	61.4	68.2	-	3	6.4	-
27	North-West	Ground floor	65	60	55	-	66.5	66.4	64.8	71.6	1.5	6.4	9.8	-
27	North-West	First floor	65	60	55	-	67.6	67.5	65.9	72.8	2.6	7.5	10.9	-
28	North-West	Ground floor	65	60	55	-	54.4	54.3	52.7	59.5	-	-	-	-
28	North-West	First floor	65	60	55	-	57.2	57.1	55.5	62.3	-	-	0.5	-
29	North-West	Ground floor	65	60	55	-	63.7	63.6	61.9	68.8	-	3.6	6.9	-
30	North-West	Ground floor	65	60	55	-	63.2	63	61.4	68.3	-	3	6.4	-
30	North-West	First floor	65	60	55	-	63.3	63.2	61.6	68.5	-	3.2	6.6	-
31	North-West	Ground floor	65	60	55	-	61.9	61.8	60.2	67	-	1.8	5.2	-
31	North-West	First floor	65	60	55	-	62.1	62	60.4	67.2	-	2	5.4	-
32	North-West	Ground floor	65	60	55	-	63.4	63.3	61.6	68.5	-	3.3	6.6	-
33	North-West	Ground floor	65	60	55	-	54.9	54.8	53.2	60	-	-	-	-
33	North-West	First floor	65	60	55	-	56.3	56.2	54.6	61.4	-	-	-	-
34	North-West	Ground floor	65	60	55	-	51.2	51.1	49.5	56.3	-	-	-	-
34	North-West	First floor	65	60	55	-	52.7	52.6	51	57.9	-	-	-	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
35	North-West	Ground floor	65	60	55	-	47.9	47.8	46.1	53	-	-	-	-
36	North	Ground floor	65	60	55	-	60.9	60.8	59.2	66.1	-	0.8	4.2	-
36	North	First floor	65	60	55	-	61.2	61.1	59.4	66.3	-	1.1	4.4	-
37	North	Ground floor	65	60	55	-	59.3	59.2	57.6	64.5	-	-	2.6	-
37	North	First floor	65	60	55	-	59.7	59.6	57.9	64.8	-	-	2.9	-
38	North	Ground floor	65	60	55	-	56	55.9	54.2	61.1	-	-	-	-
38	North	First floor	65	60	55	-	60.3	60.2	58.6	65.4	-	0.2	3.6	-
39	North-West	Ground floor	65	60	55	-	48.7	48.6	46.9	53.8	-	-	-	-
39	North-West	First floor	65	60	55	-	52.9	52.8	51.2	58	-	-	-	-
40	North-West	Ground floor	65	60	55	-	47	46.9	45.2	52.1	-	-	-	-
40	North-West	First floor	65	60	55	-	50.5	50.4	48.8	55.6	-	-	-	-
41	South-East	Ground floor	65	60	55	-	67.5	67.4	65.8	72.6	2.5	7.4	10.8	-
41	South-East	First floor	65	60	55	-	67.9	67.8	66.2	73.1	2.9	7.8	11.2	-
42	South	Ground floor	65	60	55	-	64.4	64.3	62.7	69.5	-	4.3	7.7	-
42	South	First floor	65	60	55	-	64.4	64.3	62.7	69.6	-	4.3	7.7	-
43	South	Ground floor	65	60	55	-	59.7	59.6	58	64.8	-	-	3	-
43	South	First floor	65	60	55	-	60.4	60.3	58.7	65.5	-	0.3	3.7	-

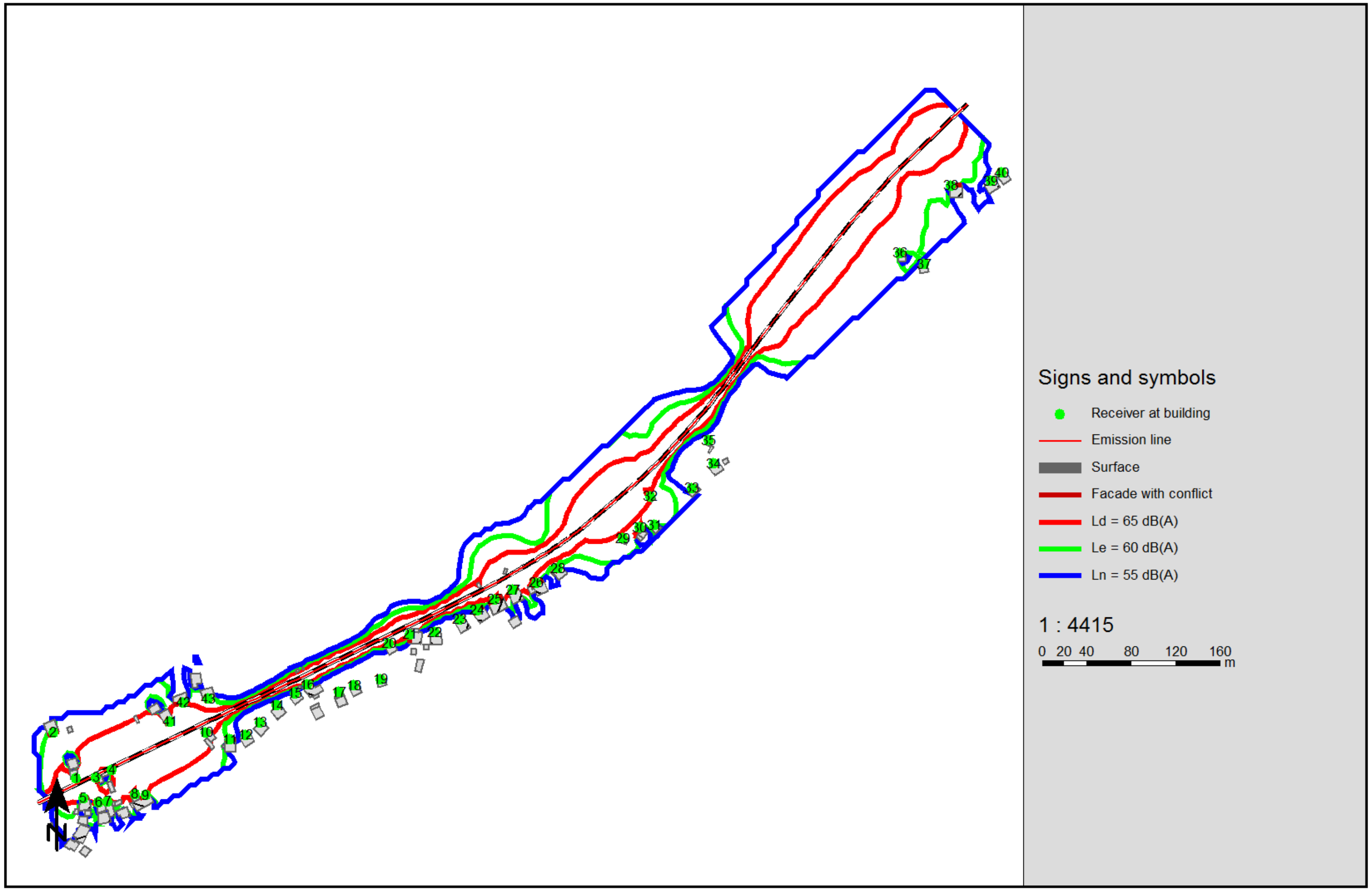


Figure 261 Noise levels at individual receptors resulting from the railway operation between the chainages 72+774 to 73+840 (Kriva Palanka)

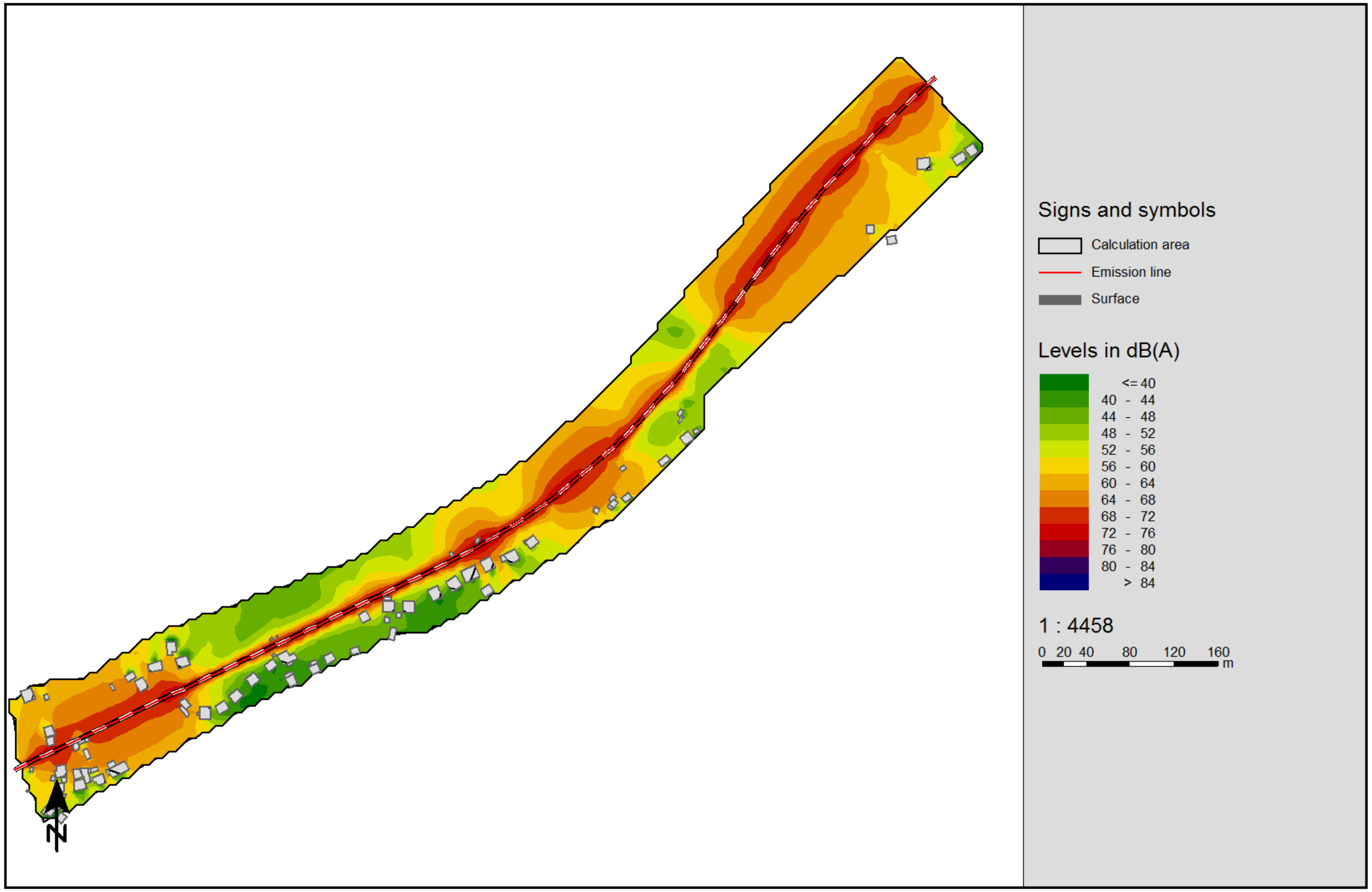


Figure 262 Map of the noise ***(Ld)*** resulting from the railway operation between the chainages 72+774 to 73+840 (Kriva Palanka)

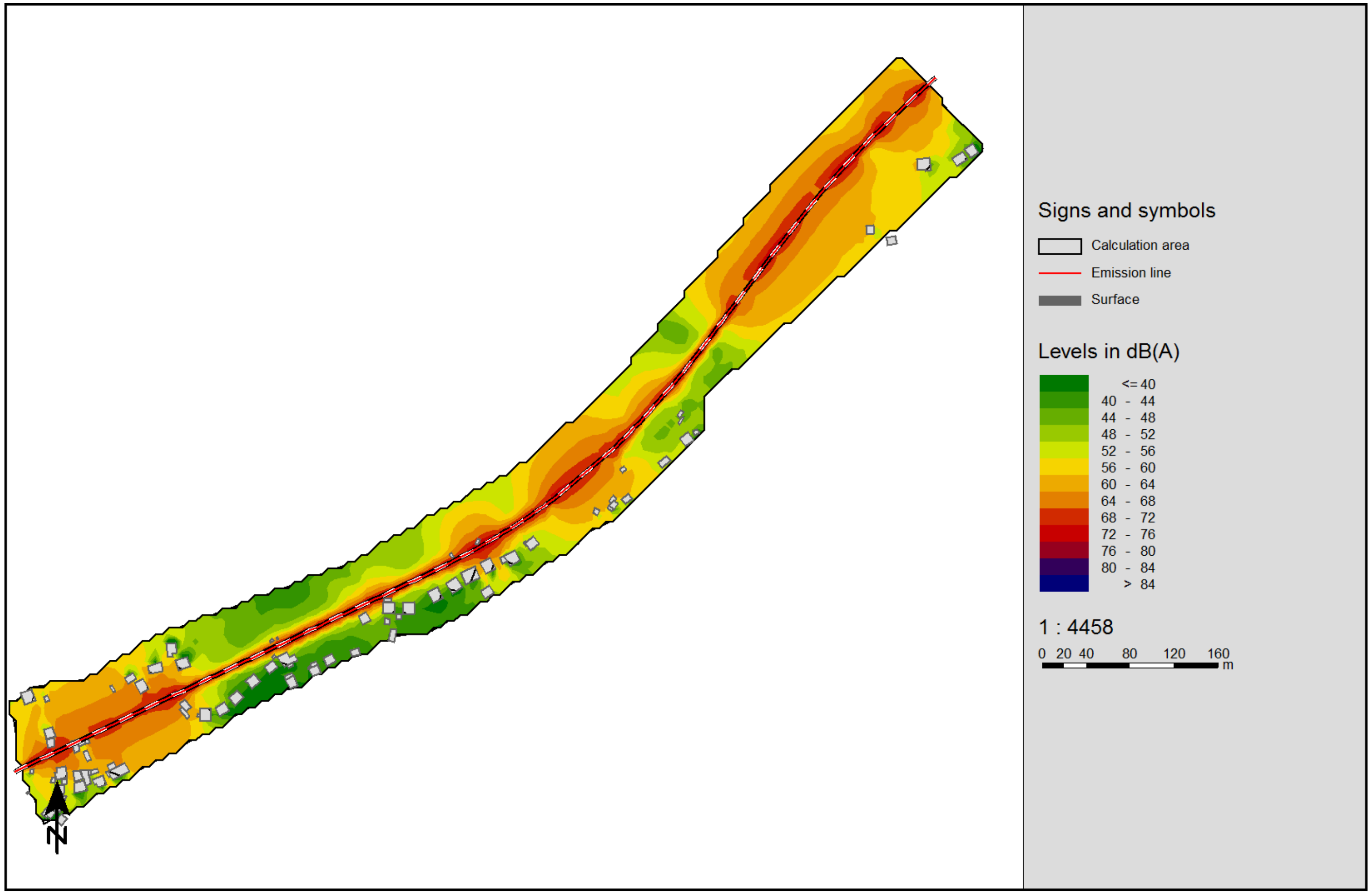


Figure 263 Map of the noise (Ln) resulting from the railway operation between the chainages 72+774 to 73+840 (Kriva Palanka)

Table 156 Data on emission of noise from railway traffic between the chainages 75+180 and 75+500 (Pashina Vodenica)

Km: 75+180		Lm,E25: 65.6 / 65.3 / 63.8									
Type of train	Share of disc brakes	Number of trains			Length of train	Speed	Correction for type of train	Max	Level of noise emission		
		Day	Evening	Night					Day	Evening	Night
	%				m	km/h	dB		dB(A)	dB(A)	dB(A)
Freight	-	11	4	5	500	90	-	-	63.7	64.1	62
Passenger	20	5	1	2	150	120	-	-	56.8	54.6	54.6
High-speed	100	6	2	4	150	100	-	-	49.8	49.8	49.8
Express	20	5	1	2	205	100	-	-	56.5	54.3	54.3

Table 157 Data on the railway between the chainages 75+180 and 75+500 (Pashina Vodenica)

Railway chainage	Railway axis coordinates			Type of railway	Curve radius	Reflexion	Correction for bridge	Correction for passage	Emission corrected value		
km	X	Y	Z								
				$D_{Drailway}$	D_{Curve}	D_R	D_{bridge}	$D_{passage}$	day	evening	night
75+180	612422.3	4676551	713.57	2	-	-	3	-	70.6	70.3	68.8
75+500	612537.8	4676849	720.45	2	-	-	3	-	70.6	70.3	68.8

Table 158 Noise impact from railway traffic between the chainages 75+180 to 75+500 (Pashina Vodenica)

Receptor no.	Side	Floor	Threshold				Noise level				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
1	South-East	Ground floor	65	60	55	-	63.3	63	61.5	68.3	-	3	6.5	-
1	South-East	First floor	65	60	55	-	64	63.7	62.2	69	-	3.7	7.2	-
2	North-West	Ground floor	65	60	55	-	63.4	63.1	61.6	68.5	-	3.1	6.6	-
3	North-West	Ground floor	65	60	55	-	63.1	62.7	61.3	68.1	-	2.7	6.3	-
4	North-West	Ground floor	65	60	55	-	62.7	62.4	60.9	67.8	-	2.4	5.9	-

Receptor no.	Side	Floor	Threshold				Noise level				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
5	North-West	Ground floor	65	60	55	-	63.1	62.7	61.3	68.1	-	2.7	6.3	-
7	North-West	Ground floor	65	60	55	-	62.7	62.3	60.9	67.7	-	2.3	5.9	-
8	North-West	Ground floor	65	60	55	-	62.6	62.2	60.8	67.6	-	2.2	5.8	-

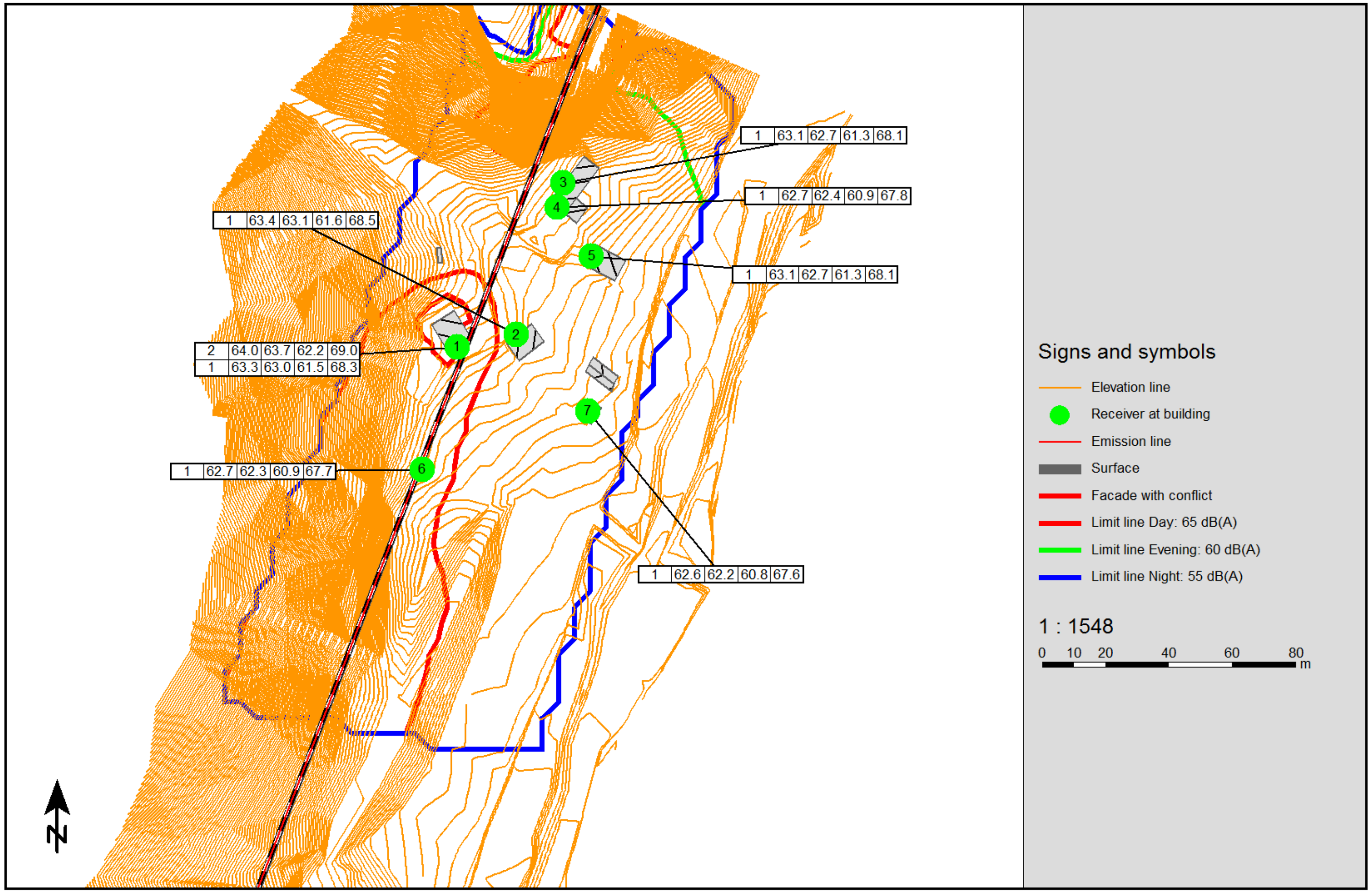


Figure 264 Allocation of the railway and the receptors in the vicinity of the chainages 75+180 to 75+500 (Pashina Vodenica)

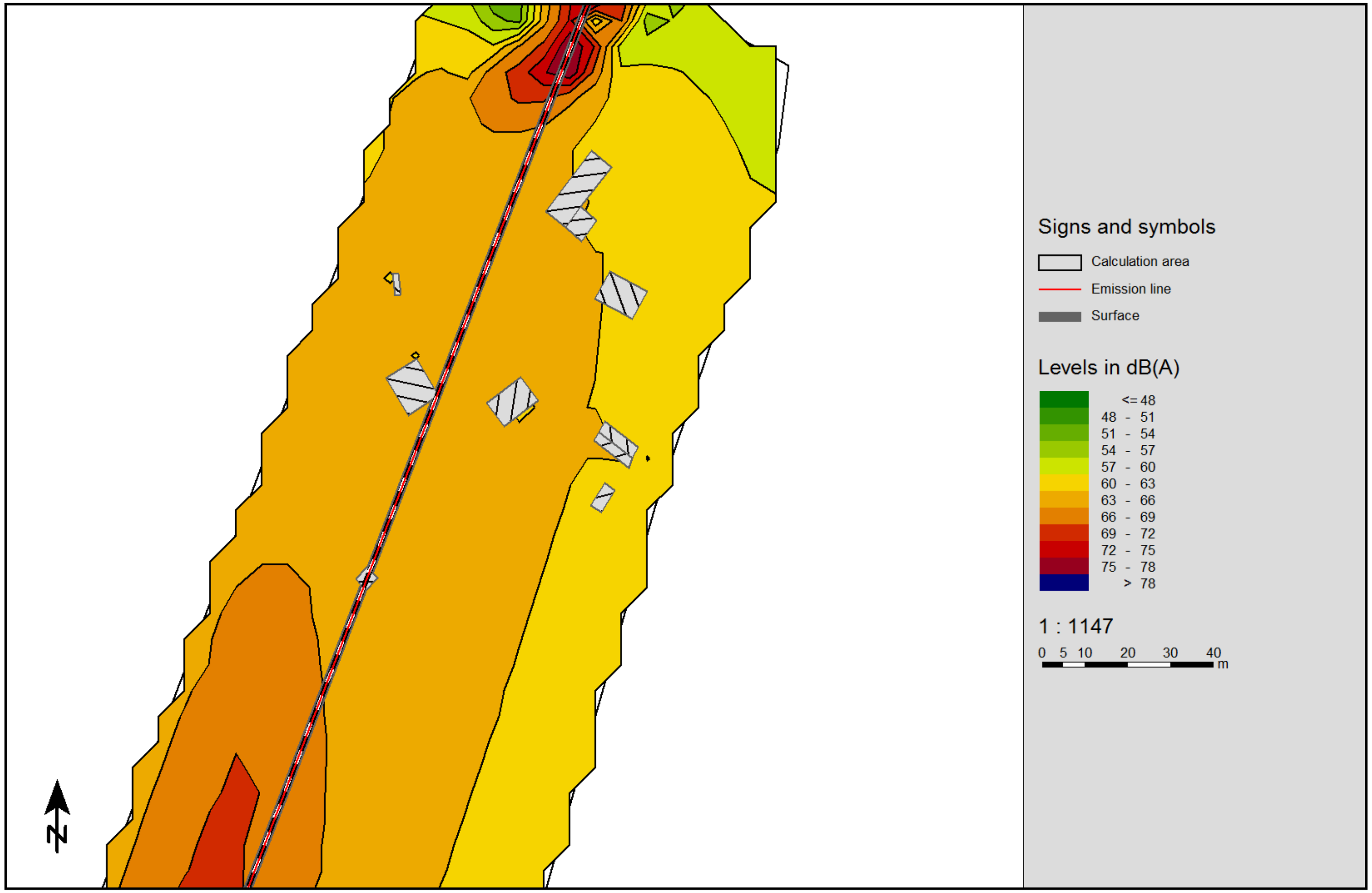


Figure 265 Map of the noise (Ld) resulting from the railway operation between the chainages 75+180 to 75+500 (Pashina Vodenica)

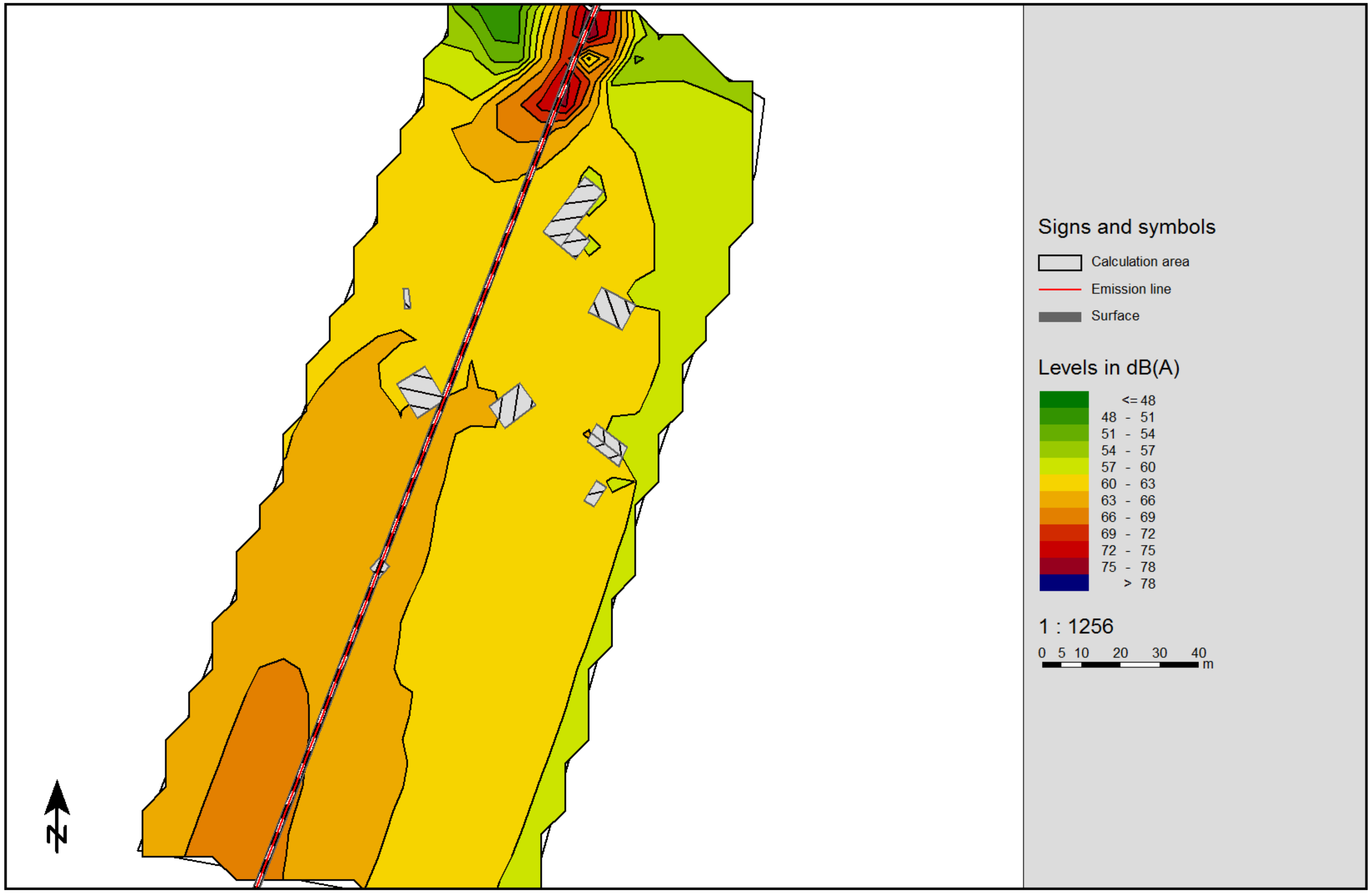


Figure 266 Map of the noise (Ln) resulting from the railway operation between the chainages 75+180 to 75+500 (Pashina Vodenica)

Table 159 Data on emission of noise from railway traffic between the chainages 79+731 and 80+080 (Zhidilovo)

Km: 65+760		Lm,E25: 65.1/ 64.9 / 63.3									
Type of train	Share of disc brakes	Number of trains			Length of train	Speed	Correction for type of train	Max	Level of noise emission		
		Day	Evening	Night					Day	Evening	Night
	%				m	km/h	dB		dB(A)	dB(A)	dB(A)
Freight	-	11	4	5	500	90	-	-	63.7	64.1	62
Passenger	20	5	1	2	150	100	-	-	55.2	53	53
High-speed	100	6	2	4	150	100	-	-	49.8	49.8	49.8
Express	20	5	1	2	205	100	-	-	56.5	54.3	54.3

Table 160 Data on the railway between the chainages 79+731 и 80+080 (Zhidilovo)

Railway chainage	Railway axis coordinates			Type of railway	Curve radius	Reflexion	Correction for bridge	Correction for passage	Emission corrected value		
km	X	Y	Z								
				$D_{Drailway}$	D_{Curve}	D_R	D_{bridge}	$D_{passage}$	day	evening	night
79+731	615789.934	4676542.382	808.71	2.0	-	-	-	-	67.1	66.9	65.3
79+793	615842.627	4676508.898	810.00	2.0	-	-	3.0	-	70.1	69.9	68.3
80+062	616100.695	4676446.672	814.35	2.0	-	-	-	-	67.1	66.9	65.3
80+080	616118.663	4676447.553	814.64	2.0	-	-	-	-	67.1	66.9	65.3

Table 161 Noise impact from railway traffic between the chainages 79+731 and 80+080 (Zhidilovo)

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
1	South	Ground floor	65	60	55	-	51.7	51.5	49.9	56.8	-	-	-	-
2	South-East	Ground floor	65	60	55	-	52	51.8	50.2	57.1	-	-	-	-
2	South-East	First floor	65	60	55	-	53	52.9	51.3	58.2	-	-	-	-
3	South-East	Ground floor	65	60	55	-	54.6	54.5	52.9	59.7	-	-	-	-
3	South-East	First floor	65	60	55	-	55	54.9	53.3	60.1	-	-	-	-
3	South-East	Second floor	65	60	55	-	55.3	55.2	53.6	60.4	-	-	-	-
4	South-West	Ground floor	65	60	55	-	61.6	61.5	59.9	66.7	-	1.5	4.9	-
4	South-West	First floor	65	60	55	-	61.8	61.7	60.1	66.9	-	1.7	5.1	-
5	South-West	Ground floor	65	60	55	-	51.3	51.2	49.6	56.5	-	-	-	-
5	South-West	First floor	65	60	55	-	60.1	60	58.4	65.2	-	-	3.4	-
5	South-West	Second floor	65	60	55	-	60.2	60.1	58.5	65.3	-	0.1	3.5	-
6	South-East	Ground floor	65	60	55	-	64.5	64.3	62.7	69.6	-	4.3	7.7	-
7	South-West	Ground floor	65	60	55	-	62.1	61.9	60.4	67.2	-	1.9	5.4	-
8	South-West	Ground floor	65	60	55	-	63.1	63	61.4	68.3	-	3	6.4	-
9	South-West	Ground floor	65	60	55	-	60.3	60.1	58.5	65.4	-	0.1	3.5	-
9	South-West	First floor	65	60	55	-	60.6	60.4	58.8	65.7	-	0.4	3.8	-
10	South-East	Ground floor	65	60	55	-	59.7	59.5	57.9	64.8	-	-	2.9	-
10	South-West	First floor	65	60	55	-	59.8	59.7	58.1	64.9	-	-	3.1	-
11	South	Ground floor	65	60	55	-	59.2	59	57.4	64.3	-	-	2.4	-

Receptor no.	Side	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
11	South	First floor	65	60	55	-	59.3	59.1	57.5	64.4	-	-	2.5	-
12	South	Ground floor	65	60	55	-	62.6	62.5	60.9	67.8	-	2.5	5.9	-
13	South	Ground floor	65	60	55	-	62.2	62.1	60.5	67.3	-	2.1	5.5	-
14	South-East	Ground floor	65	60	55	-	61.8	61.7	60.1	67	-	1.7	5.1	-
14	North-East	First floor	65	60	55	-	62.1	62	60.4	67.2	-	2	5.4	-

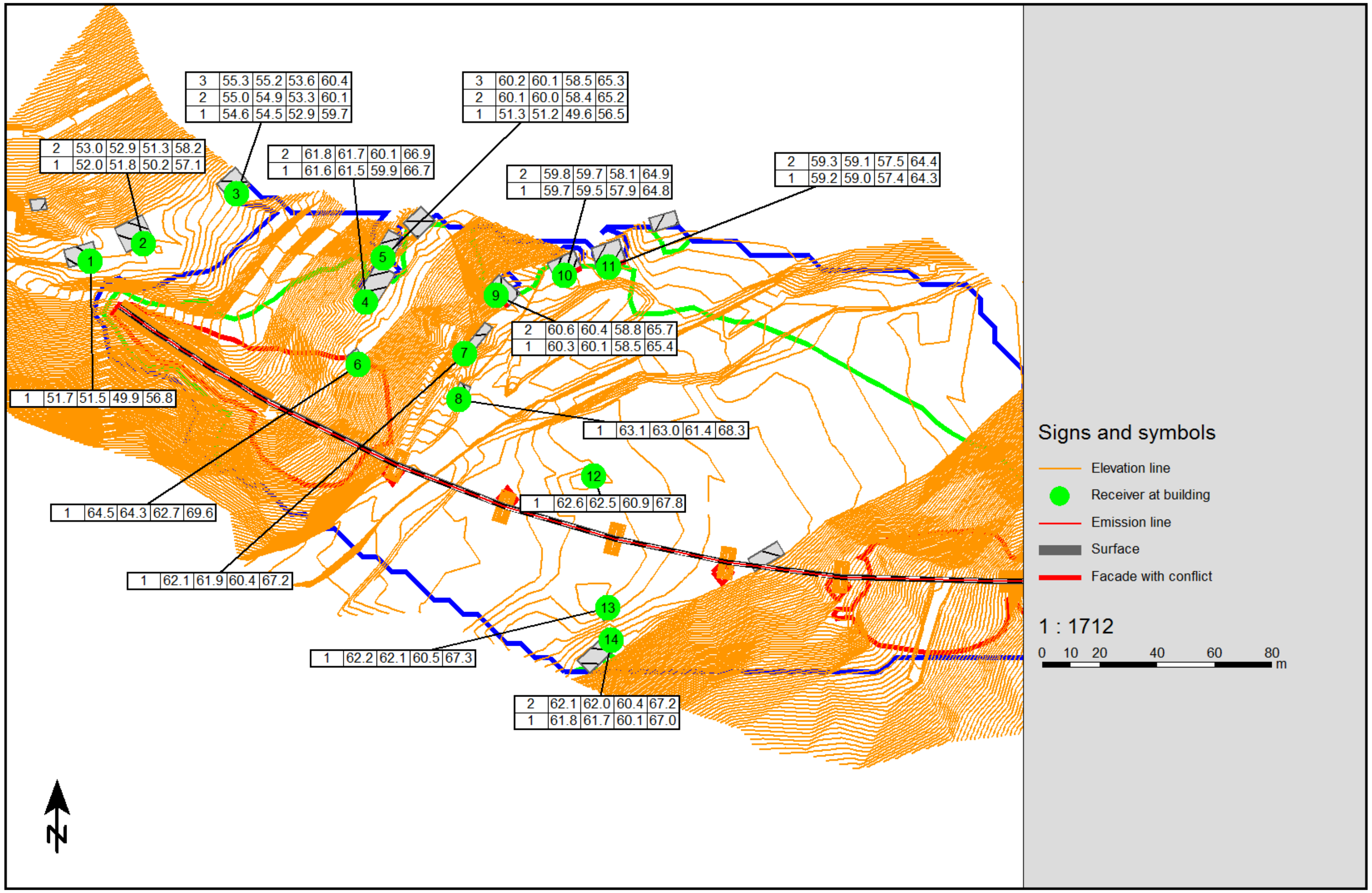


Figure 267 Map of the position of the railway and noise levels resulting from its operation at individual receptors between the chainages 79+731 and 80+080 (Zhidilovo)

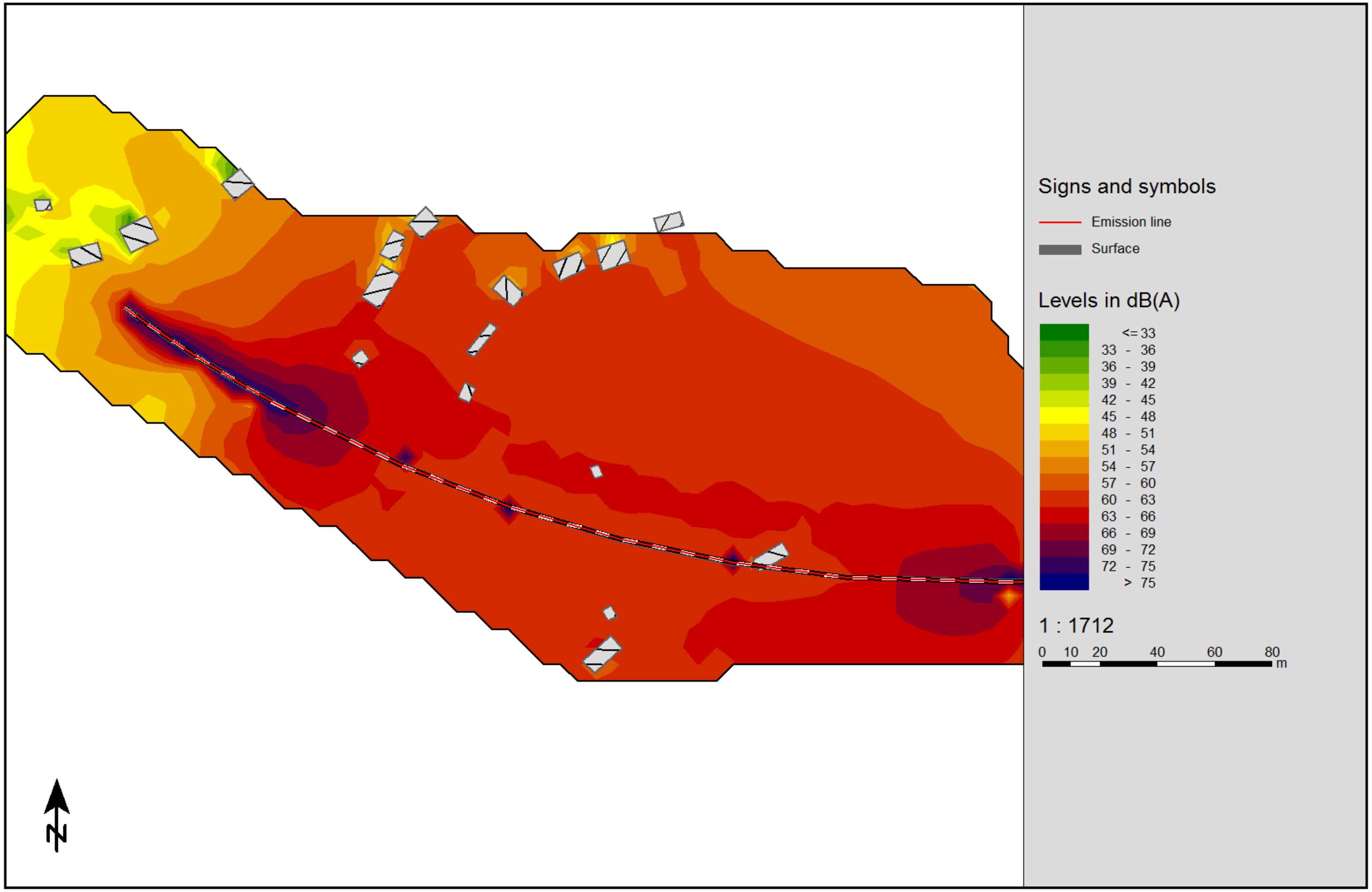


Figure 268 Map of the noise (Ld) resulting from the railway operation between the chainages 79+731 and 80+080 (Zhidilovo)

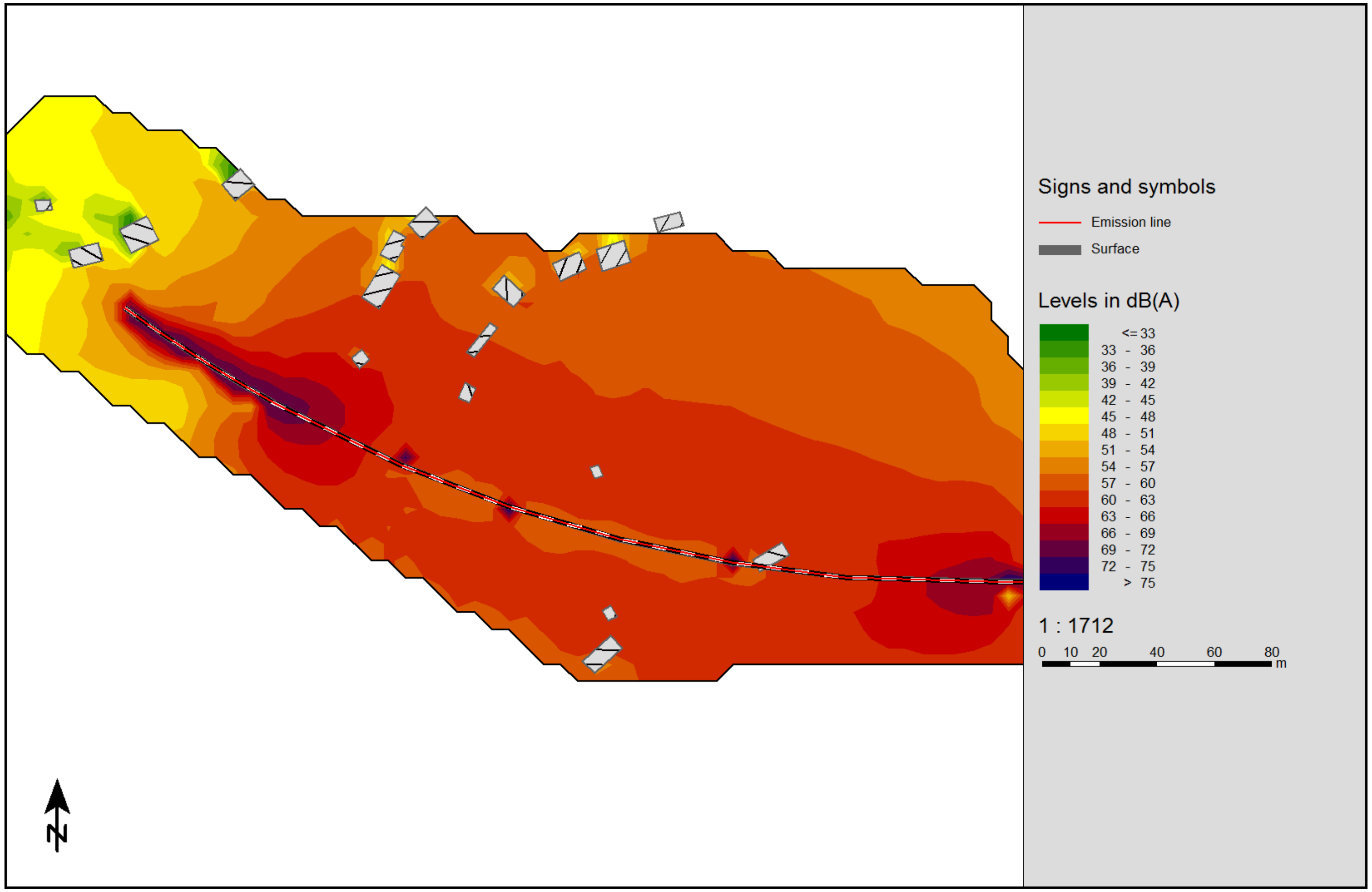


Figure 269 Map of the noise during the night between the chainages 79+731 and 80+080 (Zhidilovo)

Table 162 Data on emission of noise from railway traffic between the chainages 82+020 and 82+520 (Uzem)

Km: 82+020		Lm,E25: 65.0 / 64.9 / 63.3									
Type of train	Share of disc brakes	Number of trains			Length of train	Speed	Correction for type of train	Max	Level of noise emission		
		Day	Evening	Night					Day	Evening	Night
	%				m	km/h	dB		dB(A)	dB(A)	dB(A)
Freight	-	11	4	5	500	90	-	-	63.7	64.1	62
Passenger	20	5	1	2	150	100	-	-	55.2	53	53
High-speed	100	6	2	4	150	100	-	-	49.8	49.8	49.8
Express	20	5	1	2	205	100	-	-	56.5	54.3	54.3

Table 163 Data on the railway between the chainages 82+020 and 82+520 (Uzem)

Railway chainage	Railway axis coordinates			Type of railway	Curve radius	Reflexion	Correction for bridge	Correction for passage	Emission corrected value		
km	X	Y	Z	$D_{Drailway}$	D_{Curve}	D_R	D_{bridge}	$D_{passage}$	day	evening	night
82+020	617971.2	4676178	832.13	2	-	-	-	-	67	66.9	65.3
82+047	617995.2	4676166	832.76	2	-	-	3	-	70	69.9	68.3
82+167	618101.7	4676111	835.58	2	-	-	-	-	67	66.9	65.3
82+520	618395.7	4675920	843.88	2	-	-	-	-	67	66.9	65.3

Table 164 Noise impact from railway traffic between the chainages 82+020 and 82+520 (Uzem)

Receptor no.	Side of house	Floor	Threshold				Level of noise				Conflict			
			Day	Evening	Night	Lday	Day	Evening	Night	Lday	Day	Evening	Night	Lday
			dB(A)				dB(A)				dB(A)			
1	South	Ground floor	65	60	55	-	68.2	68.1	66.5	73.4	3.2	8.1	11.5	-
2	South-East	Ground floor	65	60	55	-	67.7	67.6	66	72.8	2.7	7.6	11	-

3	South	Ground floor	65	60	55	-	66.4	66.3	64.7	71.6	1.4	6.3	9.7	-
4	South	Ground floor	65	60	55	-	59.8	59.7	58.1	65	-	-	3.1	-
5	West	Ground floor	65	60	55	-	53.1	53	51.4	58.3	-	-	-	-
6	South	Ground floor	65	60	55	-	53.3	53.3	51.6	58.5	-	-	-	-
7	West	Ground floor	65	60	55	-	55	54.9	53.3	60.1	-	-	-	-
7	West	First floor	65	60	55	-	59.9	59.8	58.2	65	-	-	3.2	-
8	South	Ground floor	65	60	55	-	56.5	56.4	54.8	61.6	-	-	-	-
8	South	First floor	65	60	55	-	61.4	61.3	59.7	66.5	-	1.3	4.7	-
9	South	Ground floor	65	60	55	-	55.1	55	53.4	60.3	-	-	-	-
10	South	Ground floor	65	60	55	-	55	55	53.3	60.2	-	-	-	-
11	South	Ground floor	65	60	55	-	53	52.9	51.3	58.1	-	-	-	-
12	South-West	Ground floor	65	60	55	-	52.9	52.8	51.2	58	-	-	-	-
12	South-West	First floor	65	60	55	-	53.5	53.5	51.8	58.7	-	-	-	-
13	South-West	Ground floor	65	60	55	-	52.8	52.7	51.1	57.9	-	-	-	-
13	South-West	First floor	65	60	55	-	53.6	53.6	51.9	58.8	-	-	-	-
14	West	Ground floor	65	60	55	-	53	52.9	51.3	58.1	-	-	-	-
15	South	Ground floor	65	60	55	-	49.3	49.3	47.7	54.5	-	-	-	-
16	South	Ground floor	65	60	55	-	36.2	36.1	34.5	41.3	-	-	-	-
17	West	Ground floor	65	60	55	-	41.4	41.4	39.7	46.6	-	-	-	-
18	South-West	Ground floor	65	60	55	-	41.6	41.5	39.9	46.7	-	-	-	-

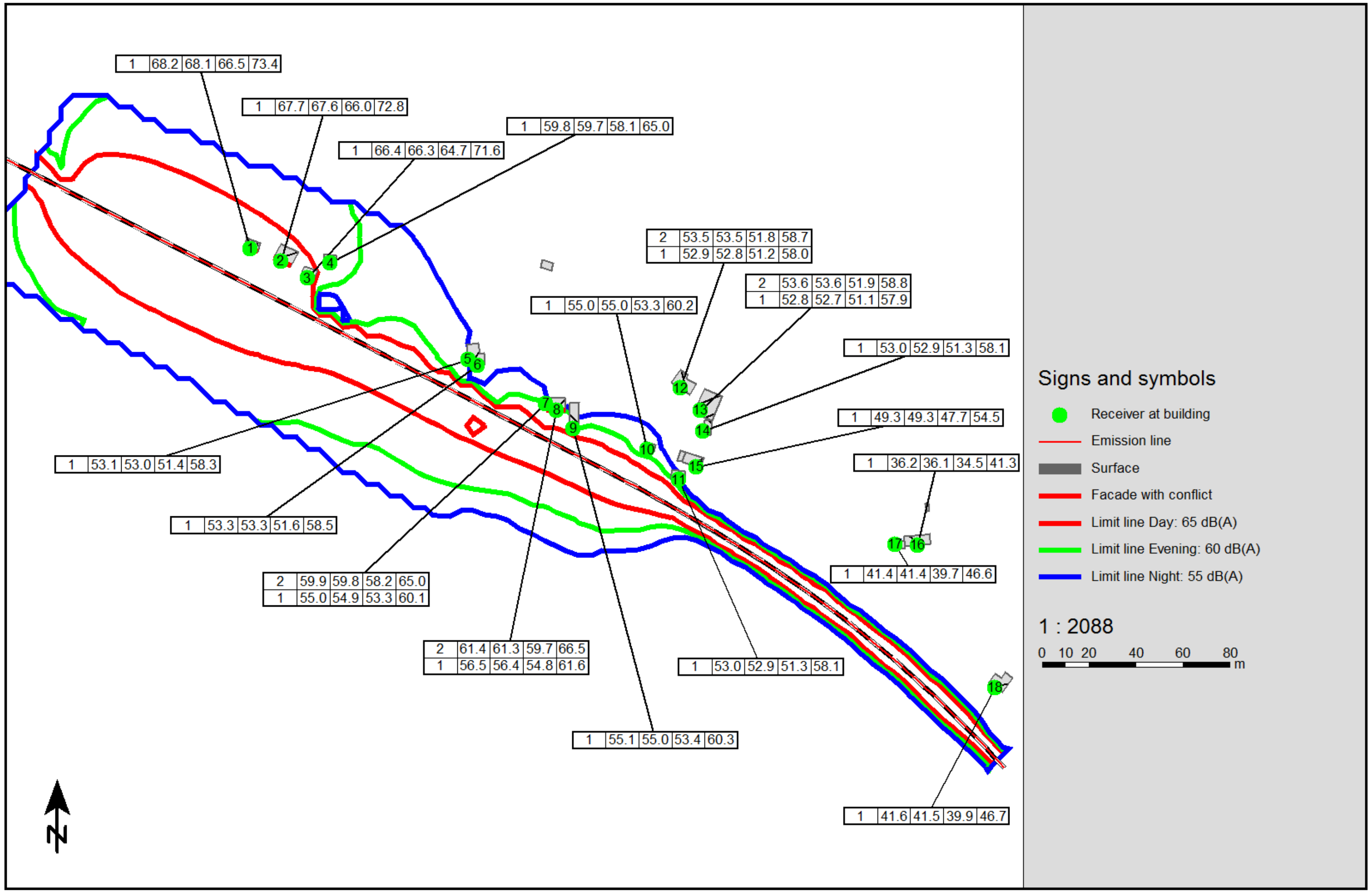


Figure 270 Noise levels resulting from the railway operation at individual receptors between the chainages 82+020 and 82+520 (Uzem)

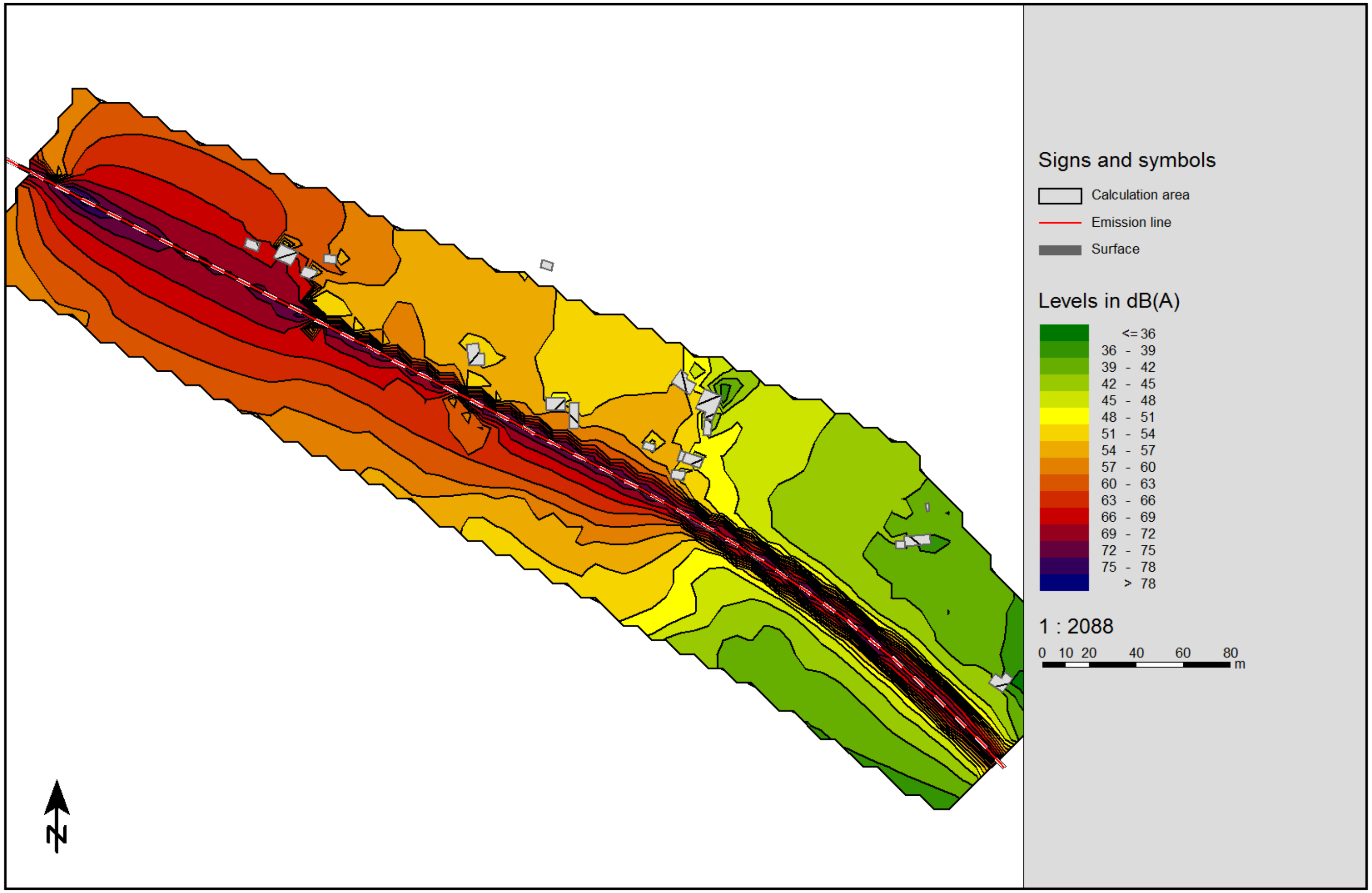


Figure 271 Map of the noise (Ld) resulting from the railway operation between the chainages 82+020 and 82+520 (Uzem)

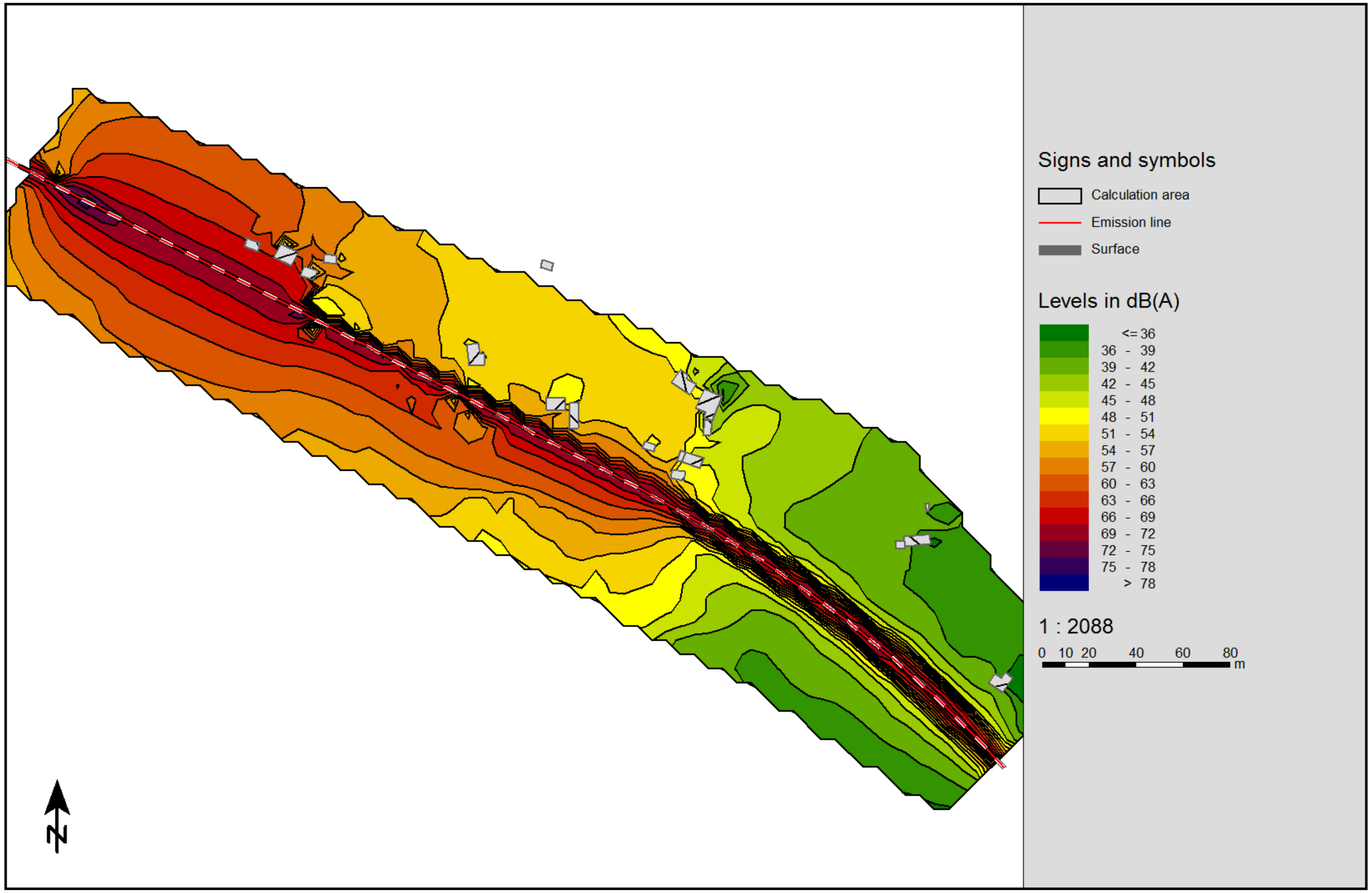


Figure 272 Map of the noise (Ln) resulting from the railway operation between the chainages 82+020 and 82+520 (Uzem)

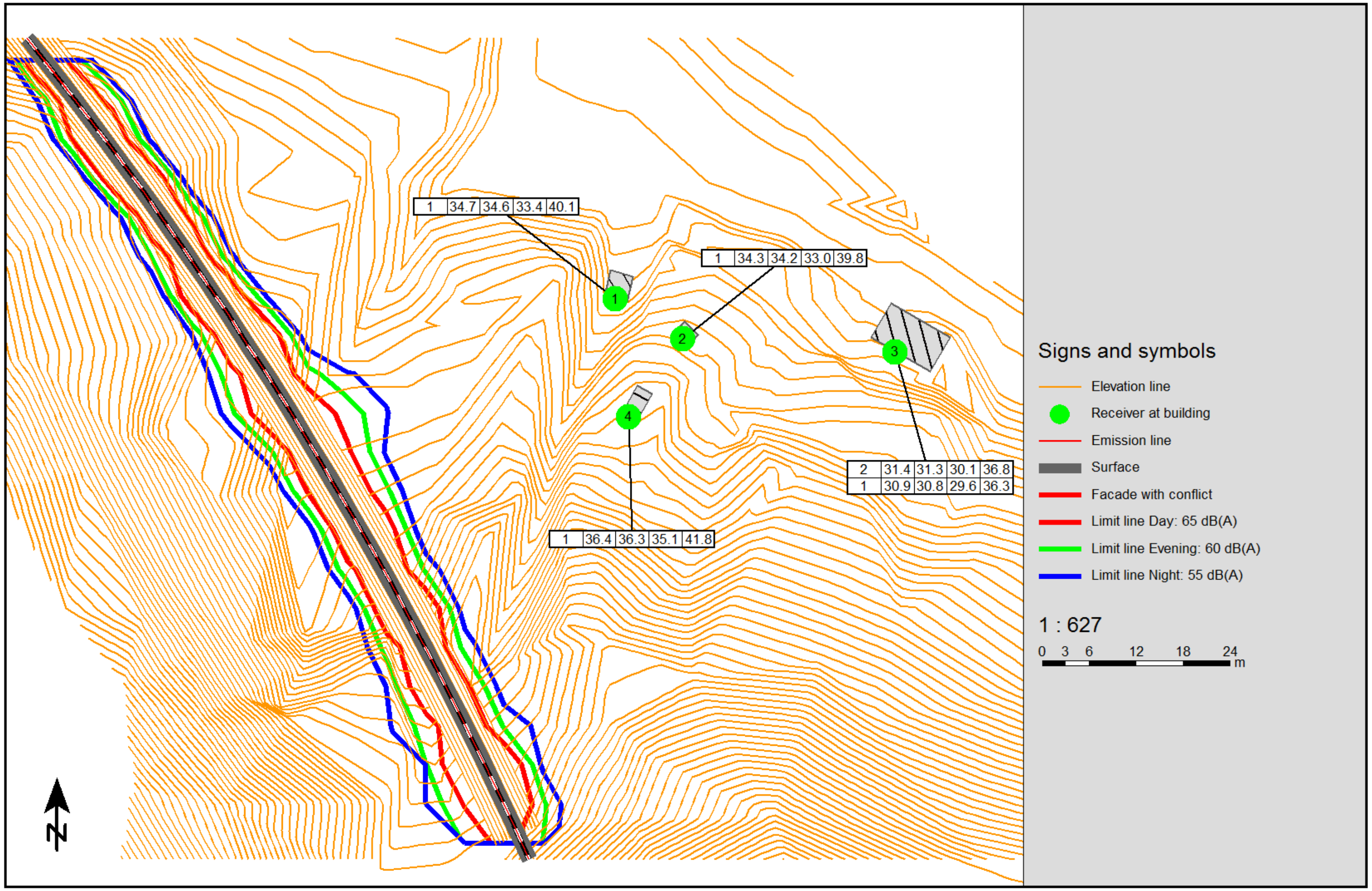


Figure 273 Contours of the limit values and noise level resulting from the railway operation between the chainages 82+610 and 82+640 (Uzem)

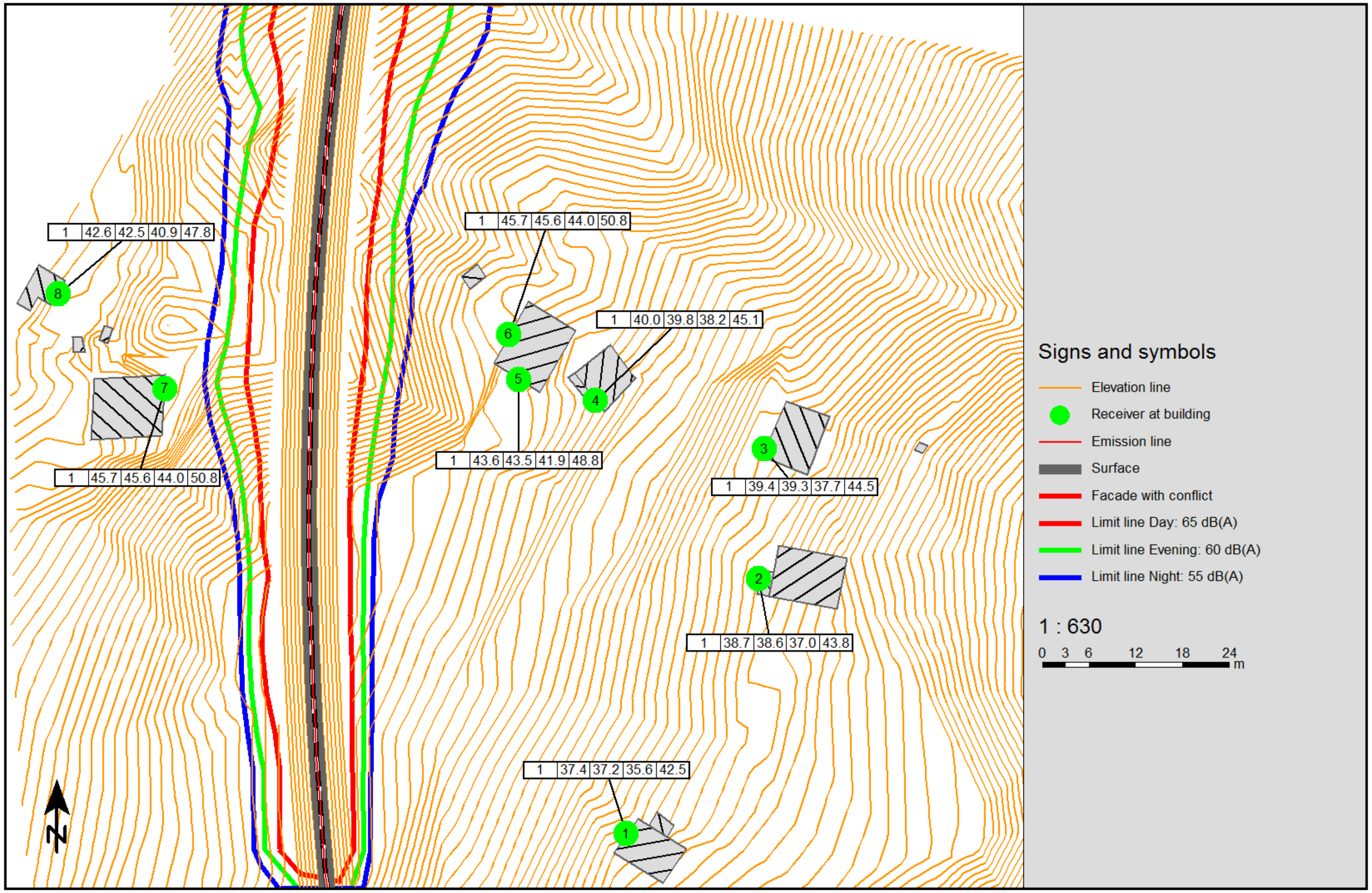


Figure 274 Contours of the limit values and noise level resulting from the railway operation between the chainages 86+141 and 86+260 (Uzem)

Annex 19 Criteria for seismic safety during blasting

The assessment of the harmful effects of seismic waves on objects (structures) is performed on the basis of the measured values of displacements, speed and acceleration of ground vibration. However, in practice, the criterion based on the critical speed of vibrations is usually applied. The size of the critical speed depends on several factors, and above all the characteristics of the construction itself and the strength of the materials from which it is built. The critical speed values are estimated based on:

- Condition of the object;
- The strength of the material from which the object is made;
- The duration and character of the seismic oscillations;
- The presence of sensitive devices and equipment in the facility;
- The method of foundation and its quality;
- The velocity of propagation of the longitudinal waves (Vp) in the rock and the ground where the object is located and

The velocity of longitudinal wave propagation (Vp) in the material from which the object is made.

Experiences and regulations from other countries with a longer mining tradition are used to assess seismic impacts on buildings. In domestic practice, the critical velocity of seismic oscillations is taken to be 1.5 cm / s. It is a transition from the 4th to 5th degree of earthquake intensity according to the scale of Medvedev (1975), which in world practice has been adopted as real. Medvedev's seismic scale is given in the following table.

Table 165 Degree (magnitude) of the earthquake manifested speeds and damage to buildings

Degree (magnitude) of the earthquake (O)	Speed of oscillations (Cm / s)	Manifestations in facilities
1	<0.2	Oscillations can only be recorded by instruments
2	0.2-0.4	Oscillations can be felt only in total silence
3	0.4-0.8	Oscillations may be felt by persons notified of the blasting
4	0.8-1.5	Oscillations are felt by many persons
5	1.5-3.0	The mortar starts to destroy, damages to older buildings occur
6	3-6	Bigger cracks appear in the mortar and perceptible damage to the buildings
7	6-12	Damage to the buildings occurs, the mortar falls, small cracks occur on the walls and chimneys
8	12-24	Significant damage to the buildings occurs, large cracks appear on the walls and constructions, and the chimneys break down
9	24-48	The buildings are crumbling and large cracks appear on the walls
10	48-96	Large-scale destruction and demolition of buildings are taking place

To determine the permissible critical speed of vibration, the substrate on which a building is funded and the visible damage occurring during stronger fluctuations in soil are taken into account in Sweden (Karlheinz-Arnold) (Table 166 and Table 167).

Table 166 Criteria according Karlheinz-Arnold, where damages are related to the type of substrate

Type of substrate	Sand, dust, clay	Soft limestone	Hard limestone
Wave velocity (Vp) m / s	1000-1500	2000-4000	4000-6000
No visible cracks	18 (mm / s)	35 (mm / s)	70 (mm / s)
Cracks in the mortar	30 (mm / s)	55 (mm / s)	100 (mm / s)
Larger cracks	40 (mm / s)	80 (mm / s)	150 (mm / s)
Harmful cracks	60 (mm / s)	115 (mm / s)	225 (mm / s)

Table 167 Criteria in accordance with Karlheinz-Arnold, objects of particular importance

Object category	Type of object	Permissible resultant oscillation speed (mm / s)
I	Reinforced concrete industrial buildings	30-40
II	Well-built objects, cracks in the mortar	10
III	Well built objects, with visible damage	5
IV	Ruins and cultural monuments	2

In the case of older buildings, the allowed critical speeds are reduced by 20%, and for buildings constructed of worse material by 50%.

In Germany, the criteria for the allowed critical speeds of seismic oscillations are stricter. Criteria includes frequencies of seismic oscillations on the ground according to DIN standard 4150 (Table 168).

Table 168 Values of the maximum speed of oscillation depending on the frequency in accordance with DIN 4150

Class of object	Type of construction	Values of the oscillation speed (mm / s)			
		Foundation		Cealing on the highest floor	
		<10 Hz	10-15 Hz	50-100 Hz	All frequencies
1	Halls, earthquake resistant structures	20	20-40	40-50	40
2	Residential buildings	5	5-15	15-20	15
3	Monuments of culture	3	3-8	8-10	8

Annex 20 Data on the impact of construction of the railway within the contact zone bordering the corridor with a width of 500 m left and right of the axis of the track, with quantitative indicators of the direct and indirect impact on the forest and forest land for each subsection and commercial unit

Table 169 Direct and indirect impact on forests from the construction of the railway

Forest section / Subsection	Covered area 500 m left and right of the track axis	Indirect impact on forest and on the amount of wood mass	Direct impact from the excavation of the alignment and the permanent destruction of forest and forest land	
	(Ha)	(M³)	(Ha)	(M³)
Forest commercial unit (FCU) Dlabocica-Kiselica (km 64 + 492 to km 72 + 900)				
10b	8.01	160.20	-	-
10d	5.19	269.88	-	-
10	61.68		0.32	6.36
11	46.82		0.28	
23	25.38		0.10	
23a	0.89	17,80	-	-
24l	3.14	62,80	-	-
24a	42.87	857.40	0.31	6,20
27a	12,50	250,00	-	-
27g	2.02	135.34	-	-
27	7.36		-	-
28a	7.90	158,00	0.07	1.40
28g	7.91	529.97	0.03	2.01
28	35,29	2364.43	0.01	0.67
29a	7.78	155.60	0.01	0.20
29g	1.31	87.77	-	-
29	1.31	26,20	-	-
30a	12.74	254.80	-	-
30g	12.68	1635,72	0.27	34.83
30d	4,7259	411.15	0.07	6.09
30f	4.41	568.89	0.07	9.03
30e	5,09	442.83	0.07	6.09
30	154,18		0.91	18,20
31a	18,30	2177,70	0.45	53.55
31б	4.81	572.39	-	-
31в	20.66	784,91	0.22	8.36
31	44.21		-	-

32а	1.46	173.74	0.07	8.33
33б	0.95	137.75	-	-
34	8,534		0.05	-
35	76.71		0.18	-
35б	6.19	736,61	-	-
35g	16,2194	616.34	-	-
40	6.47		-	-
40ж	9.17	348.46	0.10	4.00
FCU Kriva Palanka-Anishte (km72 + 900 to km 76 + 900)				
1a	47.40	7299.60	0.63	97.02
1b	15.46	618.40	-	-
1в	18.85	376.99	0.14	2.8
1д	1.40	215.60	-	-
2a	11,60	1856,00	0.12	19,20
2b	29.99	4798.40	0.27	43.20
2в	3,7158	92.89	0.01	0.25
3a	23.31	3962.70	0.12	20.40
3б	15,3376	690.19	0.25	11.25
4a	13,9376	1003.51	0.19	13.68
4b	17.37	2883,42	-	-
4	15.88		-	-
90a	26.73	3875,85	0.02	2.90
90	20.98		-	-
FCU Kriva Reka-Stanechka Reka (north side of km 76 + 900 to km 89 + 280, from the south side from km 72 + 900 to km 83 + 700)				
1a	6,3844	242.61	-	-
1b	29.53	1004.02	0.02	0.68
6a	14,7416	218.76	0.02	0.90
7d	6,7032	46.25	0.02	1.38
7в	13.75	385,00	0.23	6.44
7б	3.24	223.56	-	-
8g	36,763	1263,10	0.01	0.34
8в	22,0961	618.69	0.24	6.72
8b	6,8961	448.25	0.04	2.60
9g	30.79	1323.97	0.01	0.43

9b	5.35	636,65	-	-
9в	5.61	667.59	-	-
86a	34,8079	1253.08	0.41	14.76
85б	42.57	1787,94	0.56	23.52
84a	39,4372	4101.47	0.21	21.84
83б	12,3186	1022.44	-	-
83a	14,7386	2505,56	-	-
82a	22,8772	2402.10	-	-
22b	33.61	1512.45	-	-
21b	3,8836	174.74	-	-
21a	27.04	1216,80	-	-
22a	8.31	764.52	-	-
20a	81.70	3104,60	0.54	20.52
19b	29.12	873,60	0.16	4.8
19a	6.16	480.48	-	-
19в	16.66	1599,36	-	-
18a	18.67	1026.85	-	-
16в	10.48	293.44	-	-
16g	5.28	765,60	-	-
16d	20,19	908.55	-	-
15в	7.97	757.15	-	-
9в	5.61	504.90	-	-
100в	3.22	48.30	-	-
101б	1.36	21.76	-	-
102б	18.98	303.68	-	-
103в	7.81	124.96	-	-
104в	14.26	228.16	-	-
105в	5.59	89.44	-	-
106b	8.18	130.88	-	-
106a	1,80	156.60	-	-
107a	4.11	415.11	-	-
107б	24.28	1044.04	-	-
108b	30,00	1560	-	-
108a	9.60	595.20	-	-
114б	4.88	219.60	-	-

115в	13.43	604.35	-	-
115а	1.72	122.12	-	-

Annex 21 Assessment of the risk of possible dangers and hazards during the construction and operation of the railway section Kriva Palanka-Bulgarian border, as part of Corridor VIII

Table 170 Likely sources of risk

PROBABILITY (P)	
RANG	**DESCRIPTION OF CRITERIA**
A **Surely**	80% probability to occur; Can happen more than once a year
B **Most likely**	50% probability to occur; Can happen once in a few years; It's easy going
C **Probably**	20% probability to occur; Can happen once in 5 years; Has happened
D **Not likely**	10% probability to occur; Can happen once in 10 years; Is considered possible
E **Rarely**	2% probability to occur; Can happen once in 50 years; Is considered feasible

Table 171 Categorizing the severity of the consequences

RANK OF CONSEQUENCE	ENVIRONMENT
5 **CATASTROPHIC**	Unplanned serious or extensive impact on the ecosystem or endangered species
4 **MAJOR**	Unplanned major impact on the ecosystem or endangered species
3 **MODERATE**	Unplanned moderate impact on the ecosystem or non-threatened species
2 **MINOR**	Unplanned minor impact on non-threatened species and their habitats.
1 **INSIGNIFICANT**	Unplanned, low impact on the environment

Table 172 Matrix for Risk Assessment

		CONSEQUENCE				
		1	2	3	4	5
PROBABILITY	A	HIGH	HIGH	EXTREMELY HIGH	EXTREMELY HIGH	EXTREMELY HIGH
	B	MODERATE	HIGH	HIGH	EXTREMELY HIGH	EXTREMELY HIGH
	C	LOW	MODERATE	HIGH	EXTREMELY HIGH	EXTREMELY HIGH
	D	LOW	LOW	MODERATE	HIGH	EXTREMELY HIGH
	E	LOW	LOW	MODERATE	HIGH	HIGH

Table 173 Risk Assessment - railway Kriva Palanka-Bulgarian border – construction

DANGERS	FACTORS	IMPACTS	ASSESSED ENVIRONMENTAL RISK			MITIGATION MEASURES	CONTROL PERSON
			C	P	RISK		
Spill / leakage of fuel, grease, oils, chemicals. Leakage of leachate from waste.	Improper allocation of warehouses and storage containers; Irregular storage; Inadequately arranged storage sites for hazardous substances;Absence of tanks or other protective containers for the collection of an eventual leaked hazardous substance; Failure / damage to storage tanks for hazardous substances; Vehicle collision; Spillage during maintenance or refueling; Inadequate waste management, etc.	Disruption of the quality of surface and groundwater and soil and other environmental media and areas; Disruption of the health and safety of the community.	3	B	**HIGH RISK**	Preparation and full implementation of the Hazardous Substances Management Plan and Leakage Control; Selecting locations and allocation of warehouses, storage sites or storage tanks for flammable liquids and gases, refueling station, fuel station, etc. to be performed on the basis of a previously obtained consent by the Ministry of Internal Affairs. Construction of a secondary system (tanks), around storage containers, in order to capture unwanted leakages; Training workers on possible hazards and harmful effects of chemicals / hazardous substances; Preparation of a plan for evacuation and rescue in	Contractor-designated person for the environment

						case of fire, explosion; Possession of appropriate equipment in case of fire, explosion, leakage.	
Fire and explosion.	Inadequately stored and / or disposed highly flammable building material; Improper use and storage of hazardous materials; Use of hazardous materials (use of explosives, flammable liquids, liquified and pressurized dissolved gases); Work in close proximity to existing underground installations for electricity supply, gas pipeline, water supply and sewage network and others; Inadequate insulation, protection and / or overload of electrical installations; Inadequate selection of the grinding and welding site, where sparks appear; Smoking and reckless removal of the bites; Deliberate firing; Movement and presence at the site of uninvited persons; Lack of fire protection system and / or inadequate	Impact on air quality – fire gasses; Wildfire in forests; Loss or damage of property, equipment and human lives;	3	B	**HIGH RISK**	Preparation of Fire, Explosion and Hazardous Materials Management Plan; Preparation and application of the procedure for reporting in the event of a state of emergency - occurrence of a fire during the execution of the construction activities; Preparation and application of emergency evacuation procedures, including type of evacuation during incidental situations during the construction phase; Training of workers engaged in construction activities for fire protection, explosions and hazardous materials; Placing appropriate fire extinguishing equipment at the construction site and training workers (and supervision) for handling	Contractor-designated person for the environment

	maintenance of the system. Damage to the pipeline during construction activities, which may result in gas leakage and explosion.					it; Locating the alignments of all underground installations (electricity, water, gas and sewage networks, etc.) in the pre-construction phase and their drawing on a map (which will be available in a prominent place at the construction site); Designation of the pipeline with signs of occupational safety and health; Informing all workers on the exact location of the pipeline; Mechanical excavations by mechanization and storage of building materials and tools must not be carried out in the vicinity of a gas pipeline, ie at a distance of 15 meters; All activities must take place in the presence of supervision.	

Table 174 Risk assessment - railway Kriva Palanka-Bulgarian border - operation

DANGERS	FACTORS	IMPACT	ASSESSED ENVIRONMENTAL RISK			MITIGATION MEASURES	CONTROL PERSON
			C	P	RISK		
Rail accidents	Inadequate allocation of signaling equipment; Careless handling of vehicles; Careless crossing of the railway;	On the environment (the collision can lead to incidental spills of fuels, fats and oils); On the safety of car drivers, passengers and transport vehicles, etc.; On the pedestrian safety;	3	D	**MODERATE RISK**	Establishment of the European Train Control System, which includes: • The proper functioning of the station and the interstate parts of the railway line; • "In fill" function to be realized through balise[88] groups; • These balise groups will be installed 400 m in front of the incoming signals (between warning signals and input signals) and between the input and output signals of the stations; • Defining the technical operation of the proposed equipment; • The operation of single track and multi-track sections, which would allow two-way traffic;	Appointed persons at the operator

[88] Balise is a designation (marker) located between the rails, as part of the European Train Control System

						• The proper functioning of the section does not depend on the type of: ballast, sleepers and rails; • Operation with several levels of adhesion, between the wheel set and the rail and • Implementing all modes of operation, during the train stop (depending on the type of train). Execution of regular inspections and maintenance of the railway line and facilities in order to ensure and monitor the stability and integrity in accordance with national and international safety standards for railways; Preparation and implementation of a Security Program, which is equivalent to internationally recognized safety programs for railways; At railway lines with sparse traffic, a person with a flag can be used to stop all road traffic at the crossroads until the train arrives; Setting automatic warning with lights and bells as well as railway barriers on roads and	

						crossings; Installation of unbiased and prominent warning signs; Installing a fence or other barriers at the point where the train station ends to prevent access of unauthorized persons on trains; Education, especially for young people for the dangers of crossing at non-designated points; Use of pedestrian bridges near the crossings; Use a system of screens for monitoring of railway stations and other areas where trains often pass and alarm system to detect illegal crossers.	
Incidentally leakage of hazardous substances	When transporting hazardous substances, leakage from the safety valves of the wagon tanks and other containers for hazardous materials may occur. In intermodal containers, leakage and seepage may occur as a result of inadequate packaging and excessive load during transport. Leakage of diesel fuel	Environmental impacts (contamination of soil, surface and groundwater).			**MODERATE RISK**	Implementation of a system for proper checking, acceptance and transport of hazardous materials in accordance with the international and national standards for packaging, marking and labeling of containers, as well as the necessary certificates; The use of wagon tanks that meet national and international standards for the transport of dangerous goods; Preparation of the Hazardous	Appointed persons at the operator

	during the supply of fuel trains.					Materials and Leakage Management Plan and emergency preparedness plans based on the analysis in case of accidents; Preventive and control measures include: • Proper planning of the time of transport of hazardous materials, to minimize the risk for the community (for example, limiting the transport of hazardous materials on some alignments); • Construction of protective barriers and other technical measures (drainage) at sensitive locations (near water resources, settlements, etc.); • Application of emergency systems and evacuation procedures; Implementation of the Hazardous Materials Management Plan and Leakage Control, including the provisions for the safety of persons, prevention of unauthorized access and measures to reduce risks	

						during the storage and transport of hazardous materials; Using a standardized system for filling the fuel locomotive, including automatic shutdown systems.	
Fire and explosion	Fires may occur as a result of: the derailing of the wagon tanks and the leakage / dispersion of explosive and / or flammable materials. Inadequate maintenance of the vegetation of the railway and in its right of way.	Loss or damage to equipment; Fire gases; Forest fires;	3	B	**HIGH RISK**	Preparation of Assessment of the threat from natural disasters and other accidents with a Plan for protection and rescue from natural disasters and other accidents; Monitoring the vegetation along the railway line; Timely clearing and maintenance of vegetation, to avoid the risk of fires especially in seasons when the risk is high (summer and early autumn); Planting and managing fire-resistant tree species within, and adjacent to the railway. In accordance with EU Regulation No. 1303/2014[89],	Appointees from the operator

[89] Commission Regulation (EU) No 1303/2014 of 18 Novembar 2014,concerning the technical specification for interoperability relating to “safety in railway tunnels’“ of the rail system of the European Union

						the technical specifications for interoperability relating to "safety in railway tunnels" in the railway system in the European Union (TSI), an assessment of sites where fire equipment needs to be installed. Fire protection equipment should be installed as follows: The entrance to the tunnel T01; At the exit of the tunnel T04; The entrance to the tunnel T07; At the exit of the tunnel T08; The entrance to the tunnel T09; At the exit of tunnel T12; The entrance and exit of tunnel T13; The entrance to the tunnel T14; At the exit of the tunnel T16; the entry and exit tunnel T19; the entry and exit tunnel T20; the output of the tunnel T21; entry and exit of the tunnel Deve Bair.	

Table 175 Risk assessment of natural disasters for the railway Kriva Palanka-Bulgarian border - construction and operation

DISASTER TYPE	FACTORS	IMPACTS	ASSESSED ENVIRONMENTAL RISK			MITIGATION MEASURES	FACE CONTROL
			C	P	RISK		
Earthquake	Natural phenomenon-tectonic plates movement, movement of the earth's crust.	Impacts on the environment (pollution of soil, surface and ground water); Impact on railway	3		**HIGH RISK**	Preparation of a Plan for evacuation and rescue in case of emergency; Employee training and development of guidelines in the event of an earthquake.	Contractor-appointed expert for occupational safety and trained staff for evacuation and rescue; Operator-appointed expert for occupational safety and trained staff for evacuation and rescue.
Floods	Torrential rains in times of sharp, cold and snow abundant winters	Impacts on the environment (pollution of soil, surface and ground water); Impact on railway	3	C	**HIGH RISK**	Implementation of the measures provided in the chapter on Hydrology and surface water; Maintenance and regular cleaning of riverbeds, especially Kriva Reka Toranichka River, Kiselicka River etc.; Preparation of a Plan for evacuation and rescue during the construction phase; Training of all staff for evacuation and rescue.	Contractor-appointed expert for occupational safety and trained staff for evacuation and rescue; Operator-appointed expert for occupational safety and trained staff for evacuation and rescue.

Landslides	Landslide is a geological phenomenon which includes a wide range of movements on the ground as rockfall, rockslide, mudslide.	Impacts on the environment (pollution of soil, surface and ground water); Impact on railway and other material assets	3	C	**HIGH RISK**	Before starting the construction phase, it is necessary to develop a Soil, Erosion and Sedimentation Management Plan, which would include: identifying critical points where landslides may appear during the construction and operational phases, most effective protection methods against erosion, suitable measures for drainage, the most efficient methods for retaining sediment etc. During the construction phase to prepare a Plan for evacuation and rescue in case of an emergency situation and it should be familiarized to all staff.	Contractor-appointed expert for occupational safety and trained staff for evacuation and rescue; Operator-appointed expert for occupational safety and trained staff for evacuation and rescue.
Hazards	Cracking of the Tailings Storage Facility (dam) and leakage of tailings	Impact on railway and other material assets Impacts on the safety of workers and passengers	5	E	**HIGH RISK**	During the preparation of project documentation to take into account the proximity of the Tailings Storage Facility to the alignment of the railway and to provide appropriate protection measures against possible major accidents in the construction and operational phase.	The contractor and the competent inspection authorities

Annex 22 Environmental measures checklist

<table>
<tr><th colspan="2">Environmental component-Geology and geomorphology</th><th rowspan="3">IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY</th></tr>
<tr><th colspan="2">Construction and operation</th></tr>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>Geology and geomorphology
During construction, due to the envisaged activities, contemporary geomorphological processes may occur (erosion, landslides). The increased erosion sedimentation can cause riverbed filling and elevation, meanderings, floods etc.</td><td>Application of mitigation measures is necessary in order to reduce the erosion impacts listed in the Chapter on soil impacts-soil erosion.
In order to reduce the occurrence of landslides, the following measures are recommended:
• Careful performance of construction activities in areas with steep slopes or where cuts and fills with high angle are envisaged (avoid blasting on a larger scale),
• Avoid sharp incisions in the foothills of slopes,
• Careful dig of drainage and channels,
• Avoidance of excess grounwater pumping or diversion of surface water,
• Stabilization of steep slopes in sediments and shales with biotechnical and civil engineering activities.
In order to reduce the risk of riverbed filling, the following is recommended:
• Avoid disposal of excavated material by the riverbeds,
• Do not use the gravel and sand from the riverbed and the alluvial plain,
• Minimising the initial and operational erosion effect from construction activities in the vicinity of valleys etc.
• Special attention should be put on the construction activities in the area of the inundation valley of the river of Kiselichka, Gradechka, and Kriva Reka (especially Kriva Reka) and implementation of appropriate measures.</td><td>YES.
YES.
YES.
YES.
YES.
YES.
YES.
YES.
YES.</td></tr>
<tr><td>Geo-heritage
The construction of the railway will cause certain negative impact on the geo-heritage, especially on the most impressionable part of the gorge of the river of Kiselichka (76+0 to 77+0), mostly during construction, as well as the attractive part of the gorge of Kriva</td><td>Due to the inevitability of the construction activities at this section, careful scoping of construction work is necessary in order to maximally avoid the disturbance of this landscape. It is also recommended to:
• Avoid direct embankment of the slopes with the excavated material from cuts and tunnels,
• Avoid disposal of excavated material at the sides of gorges in this area and forming of man-made rock creeps,
• Continuous replantation of the area in order to maximally “mask” the construction</td><td>YES.
YES.
NO.</td></tr>
</table>

Reka between the village of Zhidilovo and the village of Uzem.	interventions within the landscape, • Appropriate landscape-integrated technical construction and "decoration" of the bridges until mitigation of the negative visual impact (on the other hand, the bridges will provide an excellent view towards the surrounding mountainous terrain during travelling, and can be attractive not only for adrenaline adventurism, but also for the overall tourism in the Municipality).	***YES.*** √
Residual impacts: In normal operational conditions, even after the application of the recommended measures, residual impacts on geology and geomorphology are possible.		
Mitigation of residual impacts: If the intensity of the residual impacts on geology and geomorphology is evident, additional analyses will be carried out and mitigation measures will be proposed.		

Environmental component-Soil		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction		
Impacts	**Mitigation measures**	
Soil impacts The railway construction will cause negative impacts on soils due to construction, transport, waste storage etc.	-The Contractor should prepare Soil Management Plan as well as Erosion and Sedimentation Management Plan for the construction and operation of the railway in order to provide: • Protection of the topsoil and the subsoil during excavation, • Protection of the soil from contamination, erosion and sedimentation during construction and operation, The Soil Management Plan should be compliant with the Water and Waste Management Plans. -Good planning of the material balance per sections, i.e. reuse of the excess earth resulting from cut and fill and tunnels. This measure will reduce the need of borrow pits and dumping grounds, and simultaneously will reduce the costs for manipulation with materials and transport; -Preparation of Slope Geostabilization Report in accordance with the Law on civil engineering and bylaws; Preparation of technical documentation at the level of Detailed Design regarding: ✓ Biotechnical stabilization of the slopes near the alignment, ✓ Anti-erosion structures design and anti-downpour structures design,	***NO. We believe these tasks belong to the contractor of the construction.***

	✓ Recultivation of the borrow pits and landfills. -Taking samples from the topsoil and subsoil of the identified critical area near the v. Uzem in order to propose appropriate measures for avoidance of the possible impacts of historically polluted soils to the environmental media during earth work in construction phase.. -Determining procedures for appropriate sorage of contaminated soil and possible disposal as excess material, in accordance with the relevant standards[90].	
Construction		
Impacts	**Mitigation measures**	
Soil impacts (destruction of the topsoil, compaction, erosion, contamination etc.) The removal of vegetation, the tracing of new access roads, excavation, material and waste storage, movement of mechanization, accidental spills etc. can cause soil degradation.	***General soil protection measures:*** • Application of measures that will result from the Soil Management Plan and the Erosion and Sedimentation Management Plan; • Reuse of part of land masses from the excavations in constructing embankments in water flows with low banks and in locations where overflows occur, based on previously prepared project documentation; • Strict protection of all the zones outside the narrowest construction zone in order to avoid occupation of additional area for temporary or permanent use (construction material storage, parking lot or vehicle repair workshops); • If not designed in the technical documentation, the tracing of new access roads is not allowed	***NO. We believe these tasks belong to the contractor of the construction.***
Destruction of the topsoil The removal of the topsoil (at the alignment, in storage sites, borrow pits, landfills) can eliminate the topsoil	***Mitigation measures for the destruction of the topsoil*** • The topsoil (humus) should be properly removed before the construction begins, to be stored and used after the completion of the construction activities, for the purpose of recultivation and stabilization of the slopes • The removed soil heaps to be stabilized or covered (with textile) and to be temporary stored in places located away from the river banks or erosion-prone sites; • During the manipulation of the soil (excavation, transport, storage), special attention should be given to the soil moisture level, i.e. the soil should not be either very dry or very moist.	***NO. We believe these tasks belong to the contractor of the construction.***
Soil compaction	***Soil compaction mitigation measures***	***NO. We believe these tasks belong to***

[90] In close communication with the Ministry of Environment and Physical Planning

Movement of heavy machines and mechanization, storage of topsoil, temporary site storage (of materials, waste, equipment, worker camp etc.), haulage road tracing (earthworks), reapplying of topsoil can cause soil compaction.	• Mechanization and technology that causes minimal tremors and harmful impacts that can lead to soil compaction (and indirectly can interfere with the spring water regime in the scope of the corridor and downstream) should be used during railway construction.	***the contractor of the construction.***
Soil contamination The temporary storage of material, hazardous substances, waste, equipment, worker camps etc. can cause soil contamination.	***Soil contamination mitigation measures*** • Washing of equipment and vehicles to be done only at special sites designed to avoid soil and groundwater contamination. The resulting quantities of washed concrete can be further disposed as inert solid waste or to be further reused as filler in certain construction activities • The storage and handling of fuels should be a rigorously controlled process that includes taking measures for prevention of soil contamination. The fueling of the machines and generators should be done at least 50 m of watercourses, channels or drinking water wells • The machines should be parked at appropriately envisaged and arranged sites (camps) that fulfill the necessary requirements for soil protection (accidental leaks of fuel and oil) • During the appliance of dyes or other type of chemical protection, appropriate protective measures should be undertaken, e.g. covering of the surrounding soil • Appropriate waste management, in accordance with the legal prescriptions and requirements • In case of soil contamination with accidentally spilled fuels or a derivative, the contaminated soil sample should be removed and disposed at an appropriate location • Appropriate management with the potential contaminated soils during construction • Compliance with the measures from the Hazardous Materials Management Plan and Leak Control Management Plan	***NO. We believe these tasks belong to the contractor of the construction.***
Soil erosion Removal of vegetation (along the alignment, borrow pits, haulage roads, storage sites), earthworks,	***Soil erosion mitigation and protection measures*** Implementation of the erosion protection measures from the documentation prepared in the pre-construction phase, i.e.: • Geostabilization of slopes (construction of berms in case of deep cut, construction of	

construction of borrow pits, storage of topsoil, construction of embankments, haulage roads, regulation and diversion of watercourses etc. can lead to soil erosion	retaining walls at steep slopes, covering the slope with montage elements, geosynthetics, stone slabs: shotcrete etc.) • Biostabilization of slopes (different types of degradable biomaterials can be used, but grassing and wood and shrub plantation is mandatory). At the embankment slopes, if the toe of the slope is jeopardized due to the proximity of a watercourse, the toe should be strengthened by use of different geotechnical and biotechnical mesures • Drainage of the formation width to be done with ditches and gutters set along the alignment which at certain points will drain into the watercourses • Dewatering of sites located above the cut slopes to be done with gutters located above the slopes, as well as slope downward gutters that will drain into the ditches. In case of longer slopes, contour gutters in order to break the flow of waters at the slope and redirecting to the existing drains • Temporary and permanent measures must be taken at the dumping grounds and landfills. The temporary measures are represented with different types of covers as well as grassing, while the permanent measures are applied after the finishing of construction activities: biotechnical stabilization of slopes (based on Detailed Design for restoration) • Avoiding sites located near watercourses (gullies, seasonal watercourses etc.) for establishment of dumping grounds and landfills.	***YES.*** ***YES.*** ***YES.*** √ √ ***YES.*** ***NO. We believe these tasks belong to the Contractor of the construction.*** ***YES.***
Residual impacts: In normal operational conditions, even after the application of the recommended measures, residual impacts on soils (compaction, erosion) are possible.		
Mitigation of residual impacts: If the intensity of the residual impacts on soils is evident (soil erosion), additional analyses will be carried out and mitigation measures will be proposed.		
Operation		
Impacts	**Mitigation measures**	
Soil erosion Inadequate maintenance of the culverts and vegetation along the alignment can lead to soil erosion	• Regular monitoring of possible erosion • Regular maintenance of the vegetation and (if applicable) increase of the vegetation-covered area • Regular maintenance of the objects/structures • Implementation of additional measures (if applicable)	***NO. We believe these tasks belong to the Railway Operator.***

Soil contamination Deposition of air sediment, application of herbicides, leakage of oil and other liquids from the trains can lead to soil contamination	• Compliance with the European standards for transport of goods • Compliance with the measures of the Accident and Natural Disaster Protection and Rescue Plan • In case of risk of serious soil contamination, a detailed analysis and assessment of scope and intensity of contamination is recommended, and if the outcomes of the assessment require, a Plan for Remediation of Contaminated Soil should be prepared or the contaminated soil should be stored in special landfills and replaced with an uncontaminated one • Preparation of Weed and Ruderal Vegetation Management Plan. This plan should contain the necessary protective measures, i.e.: active substances, concentrations, time and mode of application of the herbicides in order to avoid soil contamination due to their long-term appliance	***NO. We believe these tasks belong to the Railway Operator.***
Residual impacts: In normal operational conditions, if the recommended measures are applied, no residual impacts are expected.		
Residual impacts mitigation measures: /		

Environmental components-Hydrology and surface waters		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction		
Impacts	**Mitigation measures**	

Impacts on bridge and viaduct stability, culverts and railway -The inadequate design of the bridges, viaducts and culverts in relation to the hydrological characteristics of the project area may jeopardize their stability as well as the stability of the railway, which will lead to negative impacts on the hydrology and the quality of surface waters and indirect impact on the other environmental media	• Preparation of hydrological and meteorological layouts for the project area that include detailed information on the hydrological and meteorological parameters for each profile of Section 3, which will provide a starting point for dimensioning of the hydrotechnical structures, regulation of rivers and protection from natural disasters[91] • Establishment of adequate correlation links between the flows of the measuring profiles and the flows measured at the existing hydrological stations (which are part of the country's network). This will save a lot of funding during the execution of the control series of measurements of the quantitative characteristics. For this purpose, previous simultaneous hydrological measurements of the flow quantities are necessary at all points (hydrotechnical structures-bridges, viaducts, culverts), together with the previously surveyed measuring points in the period of 1980-1996 that were executed for the purpose of preparation of the hydrological layout of the region of Osogovo • Preparation of Water and River Crossings Management Plan • Preparation of Flood and Flash Flood Management Plan for the construction phase • Compliance with the best available practices and experiences during the designing in order to avoid flooded areas upstream of bridges	***NO.*** ***NO.*** ***NO.*** ***NO.*** ***YES.*** √
Impacts on the ecological status of rivers -Water pumping and drainage of the construction site -River diversion -Execution of construction activities within riverbeds or in the vicinity of riverbeds -Use of water and management of	• Prior commencing the construction activities the Contractor (in cooperation with the PUC "Macedonian Railways-Infrastructure") should establish communication with the Ministry of Environment and Physical Planning (MOEPP) in order to inform the Ministry about the envisaged activities for the drainage of sites with high level of groundwater, modes of drainage, points of discharge into recipients, for the purpose of obtaining directions and/or consent/permits for the execution of these activities and discharge of the pumped groundwater into surface water, in accordance with Article 19 of the Law on waters • Obtaining a Water Management Consent prior of the commencement of construction.The construction activities carried out within a water body/river as well	***NO. We believe these tasks belong to the Contractor of the construction.*** ***NO. We believe these tasks belong to the Contractor of the construction.***

[91] An in-depth analysis of floods during a longer period of time is required (some parts of Macedonia have a recurrence period of 80-100 years). This analysis will align the historical floods with the calculated 100-year floods, which in accordance with the legal requirements are competent for the dimensioning of the hydrotechnical structures. Also, the hydrological and meteorological layouts should consider the snow drifts, the direction and magnitude of winds recorded as per local inhabitant testimonies, and should be compared with the recorded data from the main meteorological station in Kriva Palanka.

wastewater	as in the vicinity of rivers should be performed in compliance with the Water Management Consent, issued by the MOEPP (in accordance with Article 174 of the Law on waters), where the water management requirements that should be fulfilled during construction are elaborated • If river water is used for technical purposes (spraying of the construction site in order to reduce the dust emissions, or for the purpose of material preparation), it should be done based on granted Water Use Permit (right of water), issued by the Department of waters within the MOEPP, in accordance with the Article 23, Chapter II.3 Right of water from the Law on waters, or the Contractor should engage/contract an authorized company for industrial water supply • The possible wastewater discharge into rivers should be performed in accordance with the Right of Water Permit, i.e. Discharge Permit issued by the MOEPP in accordance with the aforementioned law	***NO. We believe these tasks belong to the Contractor of the construction.*** ***NO. We believe these tasks are out the project scope.***
Construction		
Impacts	**Mitigation measures**	
Surface water regime and quality Watercourse diversion and regulation, construction site dewatering, clearing of riparian vegetation, execution of construction activities within riverbeds and their vicinity, establishment of borrow pits, landfills etc. may lead to change in the flow of rivers, higher sedimentation level, erosion, disturbance of the morphology of watercourses and deterioration of water quality in rivers	• Compliance with the good construction practice during construction • The execution of the construction activities within riverbeds or near a watercourse should be performed in accordance with the requirements of the issued Water Management Consent • Construction zones in the vicinity of surface waters should be formed at an adequate distance (10-15 m from the top of the side slope of the embankment in case of regulated riverbeds or 150 m from the level of 50-year flood in non-regulated riverbeds), or in case of absence of area for construction zone establishment, the surface waters should be adequately channeled • Mounting of portable bridges in order to avoid direct contact of the surface water with the vehicles • The perimeter of the area where vehicle, worker or machine movement will be prohibited should be marked with signal belts • Minimize the possibility of sediment discharge (muddy water) into watercourses during construction activities that take place within the riverbed, i.e. protection techniques like construction of embankments or stream diversion • If there is a risk of discharge of high quantity of sediment into watercourses, to install	***NO. We believe these tasks belong to the Contractor of the construction.*** ***NO. These assumptions are about the Contractor of the construction way of working.*** ***NO.*** ***NO. These assumptions are about the Contractor of the construction way of working.*** ***NO. We believe these tasks belong to the Contractor of the construction.***

	clarifiers (sediment traps) • During construction to maintain the biological minimum of water continuously • Construction activities to be carried out in dry season, i.e. periods when the waterflow is reduced • It is not allowed to carry out construction within the riverbed or river banks, except when there is no reasonable alternative for construction activities • Bridges to be designed and constructed in a way that will provide minimal intervention and impact on the riverbed • The possible dewatering of the excavated ditches, holes etc. (where there is occurrence of groundwater or accumulated surface runoff) to be discharged in a controlled manner , i.e. in a way that will minimize the physical impacts on the morphology of the recipient • In points where culverts are envisaged, whose dimensions are based on calculations for a certain amount of 100-year flood, to check whether the sediment (earth and mud) carried by the flood waves is included within the calculations, which is very dangerous and a reason for culvert clogging • Taking measures for protection of the forest vegetation which is sparse in the area of the right tributaries of Kriva Reka and encouraging of a new forestation with native vegetation that will contribute to the protection from floods and sediment deposition (water erosion) • At points where the natural flow in the watershed will be disturbed due to construction, to be built additional culverts or channels for integrated railway protection and its protection from flooding • If water is pumped out from rivers for the purpose of construction, this activity should be performed in accordance with the requirements from the Water Use Permit • The borrow pits and landfills to be as far as possible from rivers in the project area • Complete implementation of the measures that will arise from the permits and the management plans for: water and river crossings, floods, soil, waste, vegetation etc. All of the aforementioned measures should be implemented along the whole alignment, in particular at: • Bridge no. 1, at km 65+095,735 to km 65+155,280, where protection works are also envisaged; • Bridge no. 3 on Gabarska Reka, at km 65+841,065 to km 66+106,750 where	***NO.*** ***NO. We believe these tasks belong to the Contractor of the construction.*** ***NO. We believe these tasks belong to the Contractor of the construction.*** ***NO.*** ***YES.*** ***NO. We believe these tasks belong to the Contractor of the construction.*** ***There are no available data to estimate sediment transport in culverts but there is always sufficient freeboard (>50%) and in most cases a rectangular box where the water is overflowing to the culvert*** ***NO.*** ***YES.*** ***NO. These assumptions are about the Contractor of the construction way of working.*** ***YES.*** ***NO. These assumptions are about the Contractor of the construction way of working.***

	protection works are also envisaged; • Bridge no. 5 on Gradechka Reka, at km 66+742,660 to km 66+884,280 where protection works are also envisaged; • Bridge no. 7 on Rangel, at km 67+360,246 to km 67+455,813 where protection works are also envisaged; • Bridge no. 18, at km 70+889,500 to km 70+923,000, where protection works are envisaged; • Bridge no. 23, at km 72+804,013 to km 72+935,520, where protection works are envisaged; • Bridge no. 27, at km 73+766,218 to km 73+815,775, where protection works are envisaged; • Bridge no. 28, at km 74+195,656 to km 74+409,944, where protection works are envisaged; • At km 70+521.72, where permanent diversion of a seasonal watercourse is envisaged, near Kriva Reka; • At km 74+012.35, where temporary diversion of a seasonal watercourse is envisaged, near Kriva Reka; • At km 74+585.44, where temporary diversion of a seasonal watercourse is envisaged, near Kriva Reka; • Bridge no. 32 on Kiselichka Reka, at km 76+402.00 to km 76+612.00, where protection works are envisaged; • Bridge no. 37, at km 79+785.906 to km 80+068.737, where protection works are envisaged; • At km 79+088.78, where permanent diversion of a seasonal watercourse is envisaged, near Kriva Reka; • Bridge no. 37 on Kriva Reka, at km 79+785.91 to km 80+068.73; • Bridge no. 40 on a stream, at km 80+959.86 to km 81+164.75, in whose vicinity a regulation of the riverbed of Kriva Reka is envisaged, and protection works are foreseen; • Bridge no. 41, at km 81+947.750 to km 81+971.250, where protection works are envisaged; • Bridge no. 43 on Kriva Reka (here known as „Kozja Reka“), at km 84+094.529 to km	

	84+107.459, where protection works are envisaged; • Bridge no. 51, at km 87+023.890 to km 87+032.970, where protection works are envisaged.	
Quality of surface water Inadequate management with: wastewater (fecal and industrial), waste, chemicals and auxiliary materials, fuels, maintenance and servicing of the equipment and vehicles etc. can lead to deterioration of the quality of surface water	Water bodies have a capacity of self-purification which enables their restauration, but only when the contamination is accidental/short-termed and doesn't disrupt the water regime at large. Due to the fact that the alignment is located within the watershed of Kriva Reka, which has a good hydrological potential, the following measures are proposed: • The uncontrolled discharge of wastewater generated from the worker camps is not allowed. It is recommended to set mobile systems for wastewater treatment at these points • Mobile toilets should be placed at the construction sites that will be managed appropriately by a certified company. The mobile toilets should be placed on a distance larger than 100 m from the drainage infrastructure or the watercourse • Wastewater from the construction activities to be collected and treated prior their final discharge in the recipient, i.e. to be managed in accordance with the requirements from the Wastewater Discharge Permit, issued by the MOEPP • Storing, servicing or maintenance of the equipment or any kind of fueling is not allowed at a distance less than 100 m from drainage systems and watercourses • Washing of mixers for prefabricated concrete that contain concrete with alkali cement or cement residues is not allowed as well as washing of the equipment and vehicles in the rivers or in their vicinity • Regular preventive maintenance of the vehicles and the macninery in order to reduce oil, motor oil and fuel leakage • Securing adequate sites for material, fuel, excavated earth and waste storage and their appropriate treatment • Complete implementation of the measures from the management plans for: water and river crossings, floods, waste, hazardous materials and control of leakage and emergency procedures	***NO. These assumptions are about the Contractor of the construction way of working.***
Residual impacts: In normal operational conditions, even if all the proposed measures are implemented, residual impacts are possible. The significance of the residual impacts on surface waters will depend on the level of implementation of the mitigation measures. Small erosion will remain even after the mitigation of impacts and will lead to temporary elevated turbidity of the rivers.		
Residual impacts mitigation measures: If residual impacts are evident, additional analysis will be carried out and mitigation		

measures will be proposed.		
Operation		
Impacts	**Mitigation measures**	
Surface water regime and quality Inasequate maintenance of the drainage systems, train leaks, use of herbicides for vegetation management, generation of municipal wastewater can lead to negative impacts on the regime and quality of surface waters	• Regular control and maintenance of the drainage systems in order to avoid clogging with waste and sediment • Regular monitoring of the surface runoff control structures (channels, ditches etc.) • Adequate management of the wastewater generated within the train stations (connection with the town's sewerage grid or if that's not possible, the wastewater should be collected within a impervious septic tank that will be managed by a certified company) • Complete implementation of the measures from the management plans for: soil, waste, vegetation, accidental leakage etc. • In case of accidental leaks, notice all the stakeholders downstream of the leak point and the authorized institutions for coming of hazardous substances along with the water (if their quantities are sufficiently large), or construct special ditches for diversion of the water during dry periods, when the water quantity is minimal	***NO. We believe that assumptions about the railway operation are out of project scope.***
Residual impacts: In normal operational conditions, if all the measures are implemented, no residual impacts are expected.		
Residual impacts mitigation measures: /		

Environmental components-Groundwater		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction and construction		
Impacts	**Impact mitigation measures**	
On groundwater regime due to: – Blasting, when building tunnels; – Earth excavation; – Soil compaction, when building retaining walls, storage of building materials and waste;	• Before starting the activities for temporary pumping of emerging groundwater (construction site dewatering), to inform MOEPP and act according the provided measures and obligations (according to Art 18 from Law on waters); • Not to perform construction activities in conditions of high groundwater level.	***NO. We believe these tasks belong to the Contractor of the construction.*** ***NO. These assumptions are about the Contractor of the construction way of working.***

– Pumping of groundwater for site dewatering (during construction activities) etc.		
On groundwater quality (chemical, physical and bacteriological) due to: – Accidental leakage or spill of fuels, oils, fats etc.; – Improper management with sanitary waste waters, their direct discharge into the soil; – Improper storage and handling with chemicals on the construction site; – Spills of crude oil, oils and fats on inadequate locations for that purpose; – Improper management with liquid waste and waste with hazardous characteristics; – Washing and maintenance of mechanization and equipment on locations inadequate for that purpose and spraying of construction sites due to reduction of clouds (dispersal) of dust; – Use of industrial water with inadequate quality etc.	• Placing mobile toilets for collection of waste sanitary waters and contracting with authorized company; • The storage of oils, fats and chemicals to be done in appropriate containers, placed in indoor facilities, secured with waterproof base and system for leachate collection; • Spills of crude oil and fats to be done on locations secured with waterproof base; • To comply with the envisaged measures for proper management of generated waste; • The waste, with hazardous characteristics (waste oils, oils packaging waste, fats, paints and other chemicals), to be selected and collected in appropriate containers, that are kept on waterproof base, secured with a system for leachate collection in case of incidental leakage; • To regularly submit the waste to an authorized company, that has permit for further treatment based on a Contract; • Washing of vehicles to be done on locations with waterproof base, secured with a system for collection of waste waters and/or their treatment with grease trap; • Contracting with an authorized company for supply of industrial water, and if ground- or surface water's pumping is performed to secure a Permit for pumping of waters from MOEPP etc.	***NO. The following assumptions are about the Contractor of the construction way of working.***
Residual impacts: Despite the implementation of measures for mitigating the impact on groundwater regime, there is still a possibility of residual impacts occurrence.		
Measures for mitigation of residual impacts: If an occurrence of residual impacts is evident, further analysis on the source of		

emissions and the measures implemented will be performed, and appropriate measures will be taken in accordance with the analysis.		
Operation		
Impacts	**Impact mitigation measures**	
Impacts are not expected	Measures for mitigation are not foreseen	
Residual impacts: Residual impacts are not expected		
Measures for mitigation of residual impacts: /		

Environmental components-Ambient air		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction		
Impacts	**Impact mitigation measures**	
Deterioration of ambient air quality The construction works and transportation activities can cause deterioration of ambient air quality.	*Measures for mitigation of emissions in ambient air from transportation activities:* An optimal layout of the landfills for depositing of materials and stationary construction sites (bases) should be provided in the final design of the railway, in order the length of the access/haulage roads to be reduced on minimum. Once the access roads, landfills, stationary bases and scope of work for each of them are defined, a detailed analysis of the dispersion of pollutant substances (model) should be prepared and additional mitigation measures according to the results should be envisaged. Also, the contractor of construction works should prepare: • Plan for organization of the construction site; • Dust Management Plan; • Blast Management Plan; • Traffic Management Plan.	***NO. We believe these tasks belong to the Contractor of the construction.***
Construction		
Impacts	**Impact mitigation measures**	
Deterioration of ambient air quality The construction activities (which include blasting, asphalting, welding etc.) and the traffic	• Implementation of the measures from the Plan for organization of the construction site that should include, inter alia: - Information about the population/sensitive receptors for construction activities and working hours, before starting with construction phase, as well as placing of a	***NO. We believe these following assumptions belong to the Contractor of the construction.***

activities will generate dust emissions, exhaust gases, VOCs, aerosols etc. These emissions can cause direct impacts on the air quality and indirect impact on the human population, biodiversity, soil etc.	protection fence or temporarily protective walls on the construction sites. • Implementation of the measures from the Dust Management Plan, that includes good construction practice and techniques for dust reduction, such as: - Setting anemometers/mobile weather stations at locations where construction works are ongoing. If the wind is with high intensity and there is a chance to mobilize a bigger dust quantity that can't be reduced with other measures, to stop the construction activities; - Placement of protective fence around the construction sites on sensitive locations (in populated areas); - Spraying with water (manually or with sprinklers) should be used during the time of excavation, in order to control the visible dust; - Stabilizing or covering the heaps of inert material (earth and waste from construction activities) and daily taking out the excavated earth and other waste material from the construction sites and their transportation and disposal on locations specified by the local self-government in covered transportation vehicles; - The storage sites will be regularly sprayed with water; - Raw materials and waste will be transported in covered trucks; - It's not allowed to incinerate the vegetation removed during clearing of the project area; - Stationary dust emission sources (including concrete batching plants, crushers) will be located as far as possible from the sensitive receptors; - Introduction of procedure for control of asbestos during the demolition works, according the national legislation for hazardous waste, Directive no. 91/689/EEC for hazardous waste, Directive no. 87/217/EEC from the Council on prevention and mitigation of asbestos environmental pollution and EU Directive no. 2009/148/EC for protection of the workers from risks involving impacts of asbestos exposure on the work place. - The materials from the demolition process will be managed according to the national legislation and the EU legislation on management of hazardous waste and asbestos. The risk assessment will be carried out prior commencement of the activities, that will include exposure to asbestos-contaminated dust or materials that contain asbestos. • Implementation of the measures from the Blast Management Plan:	

	- Use of air abatement techniques for dust collection from the drilling equipment (bag filters, water sprays etc.) in order to control dust emissions; - The drilled dry and fine material in the blasting area will be kept wet in order to prevent blowing of dust; - The blasting should be limited to days without winds and days with strong winds should be avoided (especially when the weather is dry) and when the winds blow towards the sensitive areas; - The Blast Management Plan should take into consideration the limitation of the size of the blast, in order to stabilize the dust emissions; - Minimizing the activities for blasting and increased implementation of practices that involve drilling with a tunnelling machine; • Implementation of measures from the Traffic Management Plan, that includes: - Control of the driving speed in areas with unsurfaced roads (<20-40 km/h) to minimize the dust generation; - When driving out of the construction site, the trucks loaded with sand, aggregate, earth and excess material will be covered; - Optimal use of loaded vehicles, i.e. minimal number of freight vehicles will be engaged that will carry maximal volume of materials; - Installation of equipment/station for trucks/machinery chassis and wheels washing at all exit points of the construction site, in order to prevent dispersion of material on public local roads; - Vehicles and construction machinery should be maintained properly and should fulfil the standards for discharge of emissions; • The Plan will contain a grievance mechanism and processing, in terms of prompt intervention; • Implementation of measures from the management plans for: waste, raw materials, soil and erosion, vegetation, fire protection report, explosions and hazardous materials etc. • If there are grievances from the local sensitive receptors-residents, the Contractor will need to implement additional measures/review of existing measures on the location and implement new additional measures.	
Residual impacts: Despite the implementation of measures for mitigating the anticipated impacts, there is a possibility of residual impacts on the air quality, caused by dust emissions in the ambient air, generated by construction activities, especially in dry		

periods, as well as exhaust gases emissions.		
Measures for mitigation of residual impacts: If an occurrence of residual impacts is evident, further analysis on the source of emissions and the measures implemented will be performed, and appropriate measures will be taken based on this analysis.		
Operation		
Impacts	**Impact mitigation measures**	
Deterioration of ambient air quality Emissions from railway traffic and railway maintenance can deteriorate the ambient air quality.	• Implementation of best practice for maintenance of railway, trains and locomotives; • Implementation of European goods transportation standards; • Preparation of threat from natural disasters and other accidents assessment with a Plan for protection and rescue from natural disasters and other accidents.	***NO. We believe that assumptions about the railway operation are out of project scope.***
Residual impacts: Residual impacts are not expected		
Measures for mitigation of residual impacts: /		

Thematic area- NOISE		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction phase		
Impacts	**Impact mitigation measures**	
Increased noise level The construction works and the transportation activities in the contstruction phase will generate increased noise level, which may cause negative impacts on the population and wildlife along the alignment.	The contractor of the construction works needs to prepare a detailed Plan for noise management in the contruction phase, where appropriate measures for decrease of noise in the contruction phase will be foreseen and will allow to meet the criteria for the noise levels, defined in the Decision for establishing in which cases and under which conditions it is considered that the citizen's peace has been disturbed from harmfull noise (Official Gazzette of the Republic of Macedonia No. 1/09 from 01.01.2009). The Plan will identify in details the impacts, duration of impacts on which base specific measures for decrease will be proposed. The plan should be based on the following strategic goals: • Maximum shortening of the duration of construction; • Maximum use of the possibilities for simultaneous activities; • Minimal generation of noise from the equipment (use of most silent equipment or	***NO. We believe these tasks belong to the Contractor of the construction.***

	equipment with noise attenuators); • Minimal use of speicicial noisy equipment on sensitive locations or in the certain time of the day.	
Construction phase		
Impacts	**Impact mitigation measures**	
Increased noise level The construction works and the transportation activities in the contstruction phase will generate increased noise level, which may cause negative impacts on the population and wildlife along the alignment.	Despite the implementation of the measures, which will be covered in the Plan for noise management in details, the following measures for decrease of noise level are recommended: **Construction site:** • Locating the noisy equipment as far as possible from the noise sensitive areas; • Selection and location of access roads as far as possible from the noise sensitive areas; • Avoinding work during the night on noise sensitive locations; • Avoinding unloading materials that cause impulse noise. This includes loading materials in dump trucks; • Limitation of blasting operations, exclusively at night and in the shortest possible time internal; • Shutting down the engines of the equipment and machinery when they are not in use; • Concentration of noise activities on one location and transfer to another in shortest possible term; • Avoiding movement the trucks on the streets of residential areas, whenever possible; • Minimizing driving backwards with the machinery in order to decrease the noise from the noise signals; • Avoiding to create a line of vehicles that run iddle in sensitive areas; • Not to use the sirens of the vehicles for any kind of signalization except when neccesarry; • Implementation of introductory trainings, staff trainings in relation to noise sensitivity, the need to make less noise, not to yell or whistle; • Installation of temporary barriers where it is practical; • Locating the equipment so that the characteristics of the terrain can be used as a natural barrier; • Decrease of noise after the completion of works, i.e. when dismantling the equipment	***NO. We believe these tasks belong to the Contractor of the construction.***

<table>
<tr><td></td><td>and leaving the construction site.
Equipment
Installation of wide-rande reverse alarms for the equipment which is expected to be driven backwards frequently or during the night;
Check if every vehicle or equipment with an engine with internal combustion has quality muffler (exhaust) installed;
Ensure that the equipment and the machines are well maintained, armor and mufflers are not damaged, rotating parts are balanced, noise from friction is reduced with lubrication, and the noise from cutting is reduced with regular sharpening of the cutting equipment.
Reduction of noise at sensitive receptors
Most of residential objects that are identified as affected by the noise from future railway traffic, will also be exposed on noise from the contruction phase (see chapter on noise impacts). That’s why the measures for reducing the noise from the railway traffic should be implemented as early as possible during the construction, which will ensure noise reduction in both phases at the same time, i.e. installation of permanent sound barriers or sound insulation on the objects as early as possible in the construction phase;
Consultations with affected residents for establishing an acceptable strategy for noise management;
Establishing an easily acceptable and well promoted call service, as well as well developed procedure for complaints and handling with complaints and proposals.</td><td></td></tr>
<tr><td colspan="2">Residual impacts: There is a possibility for residual impact occurrence that will last only the construction phase, and are directly dependent from the level of working activities, use of equipment and machines, their maintenance, as well as use of access roads. With the implementation of the noise protection measures the residual impacts will be within the limits of the legally allowed noise levels. The importance of residual impacts will be dependant on the nearby receptors and their sensitivity.</td><td></td></tr>
<tr><td colspan="2">Measures for mitigation of residual impacts: If an occurrence of residual impacts is discovered, further analysis on the source of noise emissions and the proposed measures implemented will be performed, and according to this appropriate measures for decrease of residual impacts will be taken.</td><td></td></tr>
<tr><td colspan="2">Operational phase</td><td></td></tr>
<tr><td>Impacts</td><td>Impact mitigation measures</td><td></td></tr>
<tr><td>Increased noise level
Railway traffic along the rail, use of</td><td>The noise from the railway traffic can be controlled with primary and secondary measures. Primary are the ones taken on the source of the noise (surface, sleepers, connectors, rails,</td><td>NO. We believe that in general these assumptions about the railway</td></tr>
</table>

rail vehicles for maintenance of the rail, transportation of passengers to the station and halt, will generate increase noise level, which may cause negative impacts on the population and wildlife along the alignment.	wheels, brakes, speed). Secondary measures are with the purpose to reduce the impact of the noise on the receptors. Primary measures for reduction of noise level in the environment are: • Fully welded rails instead of joined together; • Specially designed sleepers; • Use of flexible rail connectors for the sleepers; • Decrease of speed when crossing through sensitive locations; • Avoiding accelaration or breaking when crossing through sensitive locations; • Use of disk brakes instead of block; • Regular shaping of wheels in order to always have ideal circular form; • Use of brake systems and warnings that generate lowel noise level. Secundary measures or measures on the receptors include obstacles of dispersment of the noise. They include: • Sound barriers directly to the rail or on smallest possible distance; • Sound barriers on smallest practical distance from the receptors; • Sound insulation on affected receptors. *Sound barriers* Among the most spread measures for noise protection is setting sound barriers between the source of the noise and the receptor. The rule is the hight of the barrier to be 30% higher from the hight where the barrier touches the line between the source and the receptor. According to this the distance of the barrier from the source of the noise affects on its height. The calculations of the sound barriers will be done once their optimal distance from the axis of the rail is established. The basis of the calculations of the sound barriers are given below.	***operation are out of project scope, but the three following ones have been considered.*** ***YES.*** ***SLEEPERS UIC 240.*** ***YES.***

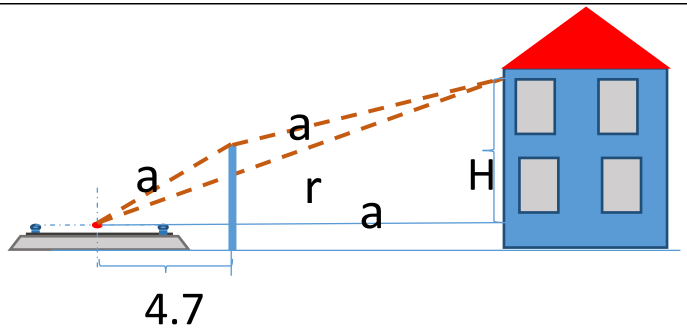


Photo 1 Geometric sizes of the sound barriers calculation

The noise mitigation as result of a sound barrier is calculated according to this equation:

$$D_{e,k} = -(10 \cdot \log(3 + 60 \cdot z_k \cdot K_{w,k}) + D_{BM,k})$$

In which

$D_{BM,k}$ – noise reduction due to terrain abatement and meteorological conditions

$z_k = a_{Q,k} + a_{A,k} - r$ difference in road through and over the obstacle

$a_{Q,k}$ - distance from the source to the top of the barrier

$a_{A,k}$ - distance from the top of the barrier to the receptor

r - shortest distance from the source to the receptor

If the barrier doesn't cover the optical line between the source and the receptor, then z_k gets negative value.

Time correction

$$K_{w,k} = e^{-\frac{1}{2000} \cdot \sqrt{\frac{a_{Q,k} \cdot a_{A,k} \cdot r}{2 \cdot z_k}}}$$

3a $z_k<0$ $K_{w,K}=1$

Due to the cost price of the sound barriers, they are applicable only on the places that cover larger number of habitats. Additional problem is the field configaration. Conflicts (increased noise levels in relation to allowed values) appear mainly in wide open space on which, usually, the rail is elevated so the height of the barrier needs to be increased additionally.

With rare exceptions, only populated objects under or near the bridges are exposed to noise larger than the maximal for the area from third degree of noise protection. On the sections without bridges berms are formed with the excavations of the rail allignement. That's why, almost all sound barriers, foreseen on this rail section, are on the bridges. In **Table 3** a list of locations is provided where the sound barriers should be put, i.e. their location, length and height.

YES.

Table 3 List of needed barriers, their length and height

Bridge or distance to bridge	from (km)	to (km)	Side	Length (m)	Height (m) above the rail*
B03	65+841	65+980	Right	30	1.5
B19	71+038	71+127.5	Right	89.5	2
B20	71+323.5	71+419	Right	95.5	2
B20	71+323.5	71+419	Left	95.5	2
B21	71+569	71+602	Right	33	2
B21	71+569	71+602	Right	33	1.5
B23	72+804	72+935	Right	137.5	1.5
/	72+935	73+300	Right	365	2
B30	75+340	75+480	Right	140	1.5
B37	79+793	80+003	Left	210	1.5
After B42	82+105	82+352	Left	247	2
*the height above the head of rail is calculated					

To preserve tha landscape, the barriers should be made from transparent materials (polycarbonate) 20 mm thick. Considering that most of the barriers are on bridges, full concrete fence with thickness of 10cm can be part of the barrier, and the difference to the required height should be supplemented by the polycarbonate elements.

<u>Individual objects</u>

On the locations where the individual objects are exposed on increased noise level, the noise protection with protection walls is not the most appropriate solution. In these cases it is much more economical to intervene with sound insulation on the object itself. In the following table a list of indifidual objects where intervention is needed are presented. This is not a definite

NO.

list, because the characteristics of all identifiable objects are not known with certainty.

Table 4 List of individual objects that require individual sound protection

Chainage	Side	Type of object
6 +790	Right	Two story house
69+800	Right	Two story house
70+030	Right	Two story house
70+200	Right	One story house
70+220	Right	One story house
81+100	Left	One story house

Residual impacts: There is a possibility for residual impact occurrence despite the use of measures for mitigation of the noise level, especially on conflict locations where an improvement of the sound insulation of the habitats is recommended, in which due to the configuration of the field and from economic reasons (non-profitability) sound barriers can't be installed.	
Measures for mitigation of residual impacts: If an occurrence of residual impacts is discovered, further analysis on the conditions, efficiency of applied measures will be performed, and according to this appropriate measures for decrease of residual impacts will be taken.	

Thematic area-Vibrations		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction phase		
Impacts	**Impact mitigation measures**	
Impacts on sensitive receptors from increased vibration level in the construction and operational phase	• In order to protect this project from unforeseen risks, as well as the residents of the populated areas from possible negative consequences, related with damage of houses, it is recommened: • Record the current state of all houses located along the rail alignment, in certain area with width of 100 m. • Due to the monitoring the conditions of the houses, during the construction and operational phase of the rail, in the affected areas of the alignement, a documented state of the objects should be made, where the actual state of the objects will be described, before starting with construction activities. This will assist in fair compensation for damages as result of the occurred vibrations during the	***NO. We believe these tasks belong to the Contractor of the construction.***

<table>
<tr><td></td><td>construction and operational phase of the rail.
Implementation of quantitave assessment of the expected vibrations from activities that include shock impacts, drillings, compaction using compactors, demolition, as well as diggings in the vicinity of sensitive objects (for example: masonry structures, historical monuments, as well as those not built aseismically).
The impacts from vibrations and seismic effect on objects on the rail alignment should be determined during the construction and operational phase.</td><td></td></tr>
<tr><td colspan="2">Construction phase</td><td></td></tr>
<tr><td>Impacts</td><td>Impact mitigation measures</td><td></td></tr>
<tr><td>Increased vibration level
Increased vibration level caused by the construction works, blasting and work of contructions machines can affect the sensitive receptors along the rail alignment</td><td>Construction operations (cuts, tunnels, bridges) should be done with application of work technique of the construction machinery, especially for drilling and blasting, which will not allow occurrence of harmful seismic effects with adverse impacts on the environment. Because of that, determing the harmful distances to the objects should be in accordance to the technical norms of the legal regulation.
Blasting should be done according to developed mining project for drilling and blasting, according to geological and geotechnical characteristics of the field and protection of objects. Otherwise, permament deformation of the objects in the vicinity above the portals or above the tunnels can be caused by the harmful seismic impacts from the explosions. This especially refers to construction of tunnels of the alignement in urban city area of Kriva Palanka, where the objects are on 5 to 20 m distance above the tunnels alignement.
Avoiding simultaneous performance of more operations that cause vibrations, i.e. working in phases is recommended, where cumulative vibrations impacts will be avoided which would be much larger from the one caused by individual performance of operations.
Avoiding activities during the night, beucase people are more sensitive on vibrations in their home during the night hours and in cases of demolition of existing objects, not to use methods involving hit (impact) if possible.</td><td>NO. We believe these tasks belong to the Contractor of the construction.</td></tr>
<tr><td colspan="2">Residual impacts: During the detailed examinations in the pre-construction phase the possibility of occurrence of residual impacts will be established.</td><td></td></tr>
<tr><td colspan="2">Measures for mitigation of residual impacts: Measures for mitigation will be foreseen, If an occurrence of residual impacts is discovered.</td><td></td></tr>
</table>

Operational phase		
Impacts	**Impact mitigation measures**	
Increased vibration level Increased vibration level from railway traffic can cause negative impacts on sensitive receptors.	• In the operational phase, the characteristics of the train movement, the construction objects and the ground should be known, according to which the protection measures will be defined.	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Residual impacts: During the detailed examinations in the pre-construction phase the possibility of occurrence of residual impacts will be established.		
Measures for mitigation of residual impacts: Measures for mitigation will be foreseen, If an occurrence of residual impacts is discovered.		

Thematic area-Climate change		IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
Construction		
Impacts	**Mitigation measures**	
Climate change Greenhouse gas emissions generated from the construction equipment, heavy vehicles, other vehicles, facilities for the production of construction materials (if they are in or near the project area), removal of forests, degradation of organic waste (from removed vegetation and clearing of the project area), can cause negative impacts on climate change	• Implementation of the measures from the **Vegetation Management and Removal Plan**, that will include methods and procedures for removal, storage, transport and further treatment of the removed vegetation in terms of reducing the greenhouse gas emissions • Incineration of the vegetation in the project area is not allowed • The Contractor should immediately (with the commencement of construction activities) take action for establishment of forest near the project area that will compensate the leaf surface capable of CO_2 • Implementation of the measures from the **Traffic Management Plan** that will include: - Optimization of the heavy vehicles traffic, i.e. to be performed in a way that will provide use of minimal number of trucks for the transport of maximal volume of material and shortest routes for transport of materials and waste to a dumping ground - Adequate maintenance of the vehicles and the construction equipment in order to achieve compliance with the relevant emission standards etc.	***NO. We believe these tasks belong to the Contractor of the construction.***

	• The Contractor of the construction activities should prepare and implement **Waste Management Plan** as well as **Fire, Explosion and Hazardous Materials Management Plan** etc.	
Residual impacts: By implementing the mitigation measures for greenhouse gas emissions, no residual impacts are expected. Residual impacts can appear due to the removal of vegetation, but they are insignificant.		
Residual impacts mitigation measures: If residual impacts are evident, an additional impact analysis will be carried out and additional measures will be undertaken.		
Operation		
Impacts	**Mitigation measures**	
Climate change Greenhouse gas emissions from the diesel locomotives and other auxiliary rail vehicles[92] for railway maintenance, vehicles for transport of passengers, inadequate management of the removed vegetation can cause negative impacts on climate change	• Implementation of good practice for railway maintenance and the equipment involved • Training of the employees that maintain the alignment as well as preparation of educational material regarding the prohibition of incineration of the vegetation along the alignment (a procedure that is prohibited) • PUC ”Macedonian Railways-Infrastructure” will prepare and implement Waste Management Program as well as Disaster and Other Accidents Protection and Rescue Plan (that includes measures for fire protection), as well as adequate personnel education	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Residual impacts: By implementing the mitigation measures for greenhouse gas emissions, no residual impacts are expected		
Residual impacts mitigation measures: /		

Thematic area-Climate change		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction and construction		
Impacts of climate change on the railway Climate change can cause	In order to avoid the possible impacts of climate change on the railway, it is recommended to implement the following measures during the pre-construction and construction phase: • Adequate dimensioning of the drainage infrastructure during the designing of the	

[92] HMD-heavy motor draisine for train pull, machine for construction of the permanent way, small maintenance machines, excavator for maintenance of slopes.

deformations on the rail and bridges, tunnel encumbering, impairment of the signal and electronic system that can lead to interruption and threaten the safety of the railway traffic	railway • In order to reduce the risk of bridge scour, the placement of large stone blocks at the base of the bridge piers and enforcement of foundations with concrete is recommended. The critical points where protection works are envisaged are given in Project description. • Stabilization with retaining walls at all possible areas prone to erosion • Stabilization of the inclines in cuts, as well as slopes, by means of installing a drainage system or by implementing the technique "soil nailing" – placement of reinforcing elements in the soil, e.g. reinforcement steel bars • Reduction of the alignment angle • Raising of the track and the signaling equipment at locations prone to flooding. • During designing, consider the installation of expansion joints at bridges that will contribute to bridge adaptation to temperature changes, which will alleviate the effects of thermal expansion of the bridge	***YES.*** √ ***YES.*** √ ***YES.*** √ ***YES.*** √ ***YES.*** ***YES.*** ***YES.*** √
Operation		
Impacts	**Mitigation measures**	
Impacts of climate change on the railway Climate change (elevated and/or lowered temperature, heavy rain and snow, ice etc.) can lead to deformations of the railway (rail buckling, rail breaking and track circuit failure, bridge expansion, damage of the signalisation and the electric power system, higher risk of fire etc.) that can jeopardize the safety of the railway traffic	The mitigation measures, i.e. climate change adaptation measures for the built structures of the railway should alleviate the damage from the expected climate change, that can otherwise affect the structural integrity of the railway, the signalling infrastructure, electric power system and safety of railway traffic. The adaptation measures are shown below, which will help to alleviate the future impacts of the climate change and would strengthen the resilience/adaptation of the railway to the future climate change	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Impacts due to increased temperature and occurrence of droughts	**Adaptation measures** Rail buckling can be prevented with the implementation of the following measures: • Monitoring the temperature in order to detect a possible increase	***NO.We believe that in general these assumptions about the railway operation are out of project scope.***

The increase of temperature can directly impact the: structure of the rail (rail buckling, bridge expansion), frequent occurrence of fire, warming of the electric equipment, extension of the vegetation period, instability of built structures, scouring etc. These manifestations may cause delay in train traffic and increase of the maintenance expenditures	• Avoid railway repairing or maintenance activities that can immediately deteriorate the stability of the track during exceptionally high temperatures in the summer period[93], since this will increase the probability of rail buckling • Coloring the rails with a white color at points that are most prone to buckling, which will make the steel to absorb less heat • Speed restrictions of trains at vulnerable sections, since slower trains exert less force on the rail which reduces the probability of buckling <u>Reduction/prevention of fires</u> In order to prevent fires, the following measures are recommended: • Preparation of Vegetation Management Plan • Clearing of the flammable waste around the railway • The trains generating sparks to be supplied with sufficient amounts of firefighting water and firefighting equipment • Compliance with the appropriate standards in tunnels (described in the part for fire risks)	***Although the bridges, tunnels and facilities are designed the increase of temperature.***
Impacts due to heavy rains and floods Short-term heavy rains can increase the risk of floods, and they also may cause erosion and landslide that can jeopardize the earthworks (embankments etc.) as well as the stability of railway bridges, viaducts and cuts	**Adaptation measures** The described possible impacts from heavy rain and floods triggered by climate change can be managed with the following measures: • Establishing a communication system with the country's Hydro-meteorological department (or other relevant institutions) in order to get timely notifications for possible floods • Regular presence of equipped teams for taking timely action (water pumping etc.) • Setting of flood defense systems (barriers lined with a membrane that will prevent the water from fleeing towards the railway infrastructure) • Regular maintenance of the culverts, clearing of branches and leaves from the ditches and culverts along the railway • Installation of pumping stations at sites that are prone to flooding	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Impacts due to strong winds Strong winds can jeopardize the safety of the railway traffic due to	**Adaptation measures** The impacts from strong winds can be reduced if the following measures are implemented: • Installation of instruments for measuring the magnitude of winds or online	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***

[93] The temperature range at which the rail does not buckle (at high temperatures) nor breaks (at low temperatures) in continuously welded rail (as the Section 3 will be) is 21^{o}C to 27^{o}C (NR/L2/TRK/3011). Thus, above 27^{o}C the risk of rail buckle increases.

the increase of probability for wagon overturning, and can affect the stability of the electric equipment and signalization along the railway	communication with the Hydro-Meteorological Department • Restriction of the railway traffic during strong winds	
Impacts due to extreme low temperatures, snowstorm and ice Low temperatures can cause rail breaking and track circuit failure, while large snowdrifts can lead to snow infiltration in the motor of the train and cause traffic delays. During a heavy snowstorm, large snowdrifts are possible that can block the railway	**Adaptation measures** In order to reduce and/or prevent the impacts from low temperatures, snowstorm and ice, the following measures are proposed: • Use of rail vehicles for winter maintenance and clearing of the railway equipped with a system for application of hot air on snow and ice, snow/ice shovels • At the sites that are most prone to freezing risk or snow blockades, to set barriers that will prevent the snow from falling at the track. These sites are located at the shaded side of the Kriva Reka's Valley, at the village of Uzem • Prevention of snow and ice accumulation by applying antifreeze liquid and placing heating belts at the contact rail • Clearing of the vegetation that is too close to the track (due to snow burdening of the branches which can lead to twisting towards the track, causing damage on the track or traffic delay) Prevention of track circuit failure (track circuits are part of the signaling equipment) by: • Monitoring of the condition of track circuits in order to take action before a track circuit failure can happen • Restriction of the railway traffic until the track circuit is repaired • Maintenance of the track circuits – replacement of the older and worn out circuits	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Risks for staff and passengers Increased temperatures can cause passenger discomfort if appropriate ventilation system is not available in the train and the railway station. If the halt is not protected from direct sunlight, it can increase the passenger health risks.	***Mitigation measures*** In order to alleviate the health&safety risk of the passengers and the personnel that works in trains, the following measures are recommended: • Installation of an adequate ventilation system within the trains • The railway station and the halt should enable protection of passengers from climate change impacts (mostly high temperatures, direct sun radiation, rain etc.)	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***

High temperatures as well as heavy rains and strong winds are a risk factor not only for passengers, but for the personnel working in the trains, too, as well as for the workers that maintain the railway.		
Socio-economic impacts due to climate change The impacts that can be triggered by climate change can lead to socio-economic losses due to increase of maintenance costs, train delay or termination of railway traffic for a certain period of time, increase of the frequency of road transport etc.	***Mitigation measures*** Impacts on socio-economic aspects can be eliminated/mitigated if the measures for climate change mitigation (mentioned previously) are implemented. Thus, no special measures for mitigating the impacts on socio-economic aspects are recommended	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Residual impacts: By implementing the measures for adaptation of the railway to climate change, avoidance of possible impacts is expected. Still, even after the implementation of the measures it can't be confirmed for sure whether residual impacts are possible		
Residual impacts mitigation measures: If residual impacts are evident, further analysis will be carried out and additional measures will be recommended		

Environmental components–Visual aspects of the landscape		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction		
Impacts	**Mitigation measures**	
The construction and operation of the railway may negatively impact the visual features of the landscape	Development of a Landscaping Design which will be implemented during the construction and operation of the railway[94]	***YES. Noted the alignment has been as an input for this project.***

[94] The Design will include data on localities, modes of plantation and types of plants for landscaping. The plantation of native trees and shrubs is recommended due to protection of the local biodiversity. The Design should envisage the creation of a plant nursery for native trees that will be used for landscaping of the project area.

Construction		
Impacts	**Mitigation measures**	
Visual aspects of the landscape The project requires significant excavations and cuts which will permanently change the microterrain of slopes, thus causing change in the visual aspects of the landscape along a great deal of the alignment. The project area spreads across the Osogovo rural landscape which has relatively small landscape values; this is backed up by the design solutions that include a great number of tunnels, thus mitigating the negative impact. Therefore, the effects of the construction and operation of the railway in most part are assessed as "medium", while those along the section that passes nearby Kriva Palanka are assessed as "non-significant"	In order to mitigate the impacts during construction, the following general measures are recommended: • Implementation of "good construction practice" along the whole alignment-excess excavations, temporary dumping sites for the excavated material and the construction of new haulage roads (except the ones envisaged with the project documentation) are not allowed • During construction, the dust reduction measures should be implemented thoroughly, as recommended in impacts on ambient air mitigation measures. • The disposal of excavated material from cuts on slopes or in seasonal watercourses is not allowed. The excavated material should be transported to sites previously designed for that purpose (filling of depressions, construction of protective slopes or final dumping grounds) • The removal of vegetation, especially woody plants, must be reduced to minimum and limited to the part of the alignment where the permanent way will be set and the adjacent areas • Use of the cleared areas of the alignment as haulage road for heavy vehicles and freight vehicles, as the construction activities progress. Where not applicable, the use of the existing rural road network is recommended. If there is an exceptional need of new haulage roads, these must be reduced to minimum in relation to number and width • Revitalization/rehabilitation of the disturbed areas to be performed immediately after the end of construction activities at the consequent locations, i.e. not at the end of construction of the railway at large. The revitalization/rehabilitation of the area will be performed in accordance with the project documentation/program prepared for that purpose which will include at least mechanical works and land stabilization, as recommended in **soil impacts mitigation measures**, as well as removal of unintentionally cut-off material (large stones, rocks etc.) at	***NO. We believe these tasks belong to the Contractor of the construction.***

	the slopes, and grassing and afforestation with native species of trees etc.	
Operation		
Impacts	**Mitigation measures**	
The railway will impact the visual features of the landscape	**Measures that should be implemented immediately after the end of construction and during operation** • Besides the aforementioned stabilization and revitalization of the affected areas, implementation of detailed activities for landscaping of the area around the alignment are required. The landscaping should include horticultural measures with some specificities for this project: 4. Reducing the visibility of the railway (which means preservation of the visual character of the landscape to maximum, i.e. as far as the natural conditions allow) by planting woody plants along the alignment. But, plantation can't be simply made in a linear manner along the whole alignment since it would mean introduction of another linear structure in the area, which also interferes with the visual character of the landscape (even if the plants are trees). Thus, plantation of trees in a forest-patch pattern is required at some locations (depending on the terrain and in accordance with the previously prepared Landscaping Design). However, a complete mitigation of the disturbed visual character of the landscape at bridges can't be achieved (see residual impacts) **Measures that should be implemented during railway operation** During railway operation, vegetation maintenance measures should be implemented, that will alleviate the visual impacts from railway construction (see above)	***NO. Clarify if this assumptions should be included in the envioromental documents.*** ***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Residual impacts (construction and operation): Even if the mitigation measures are implemented, residual impacts on visual charactersitics of the landscape are expected, especially at bridges, but the landscape change is expected to be accepted by the local population as its main receptor		
Residual impacts mitigation measures: Implementation of good construction practice, maintenance of the newly constructed structures or the revitalized sections and a good practice for railway maintenance at large		

Environmental components–Functional characteristics of the landscape-Bio-corridors		IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
Pre-construction		
Impacts	**Mitigation measures**	
Functional characteristics of the landscape A certain danger of reducing the permeability of the landscape in terms of seasonal migrations of smaller animals (amphibians and reptiles) exists, especially near permanent and seasonal watercourses (ponds and streams in particular) that serve as breeding habitats for frogs	The project documentation for railway construction contains data on culverts; hence, probably there would be no need for additional interventions. Still, for the final assessment of the need for additional culverts that will also serve as animal passages, a biomonitoring should be carried out in spring, prior commencing the construction activities	***NO. We believe that there is not need to additional interventions.***
Construction and operation		
Impacts	**Mitigation measures**	
Functional characteristics of the landscape Due to the large number of tunnels and bridges along the alignment, it is expected that the functional characteristics of the landscapoe won't be significantly affected in terms of migration of large animals	Due to insignificant impacts, no measures are recommended in terms of additional wildlife crossings that would facilitate the movement of animals	***YES. We agree with these assumptions.***
Residual impacts: No significant residual impacts are expected		
Residual impacts mitigation measures: /		

Environmental components – Biodiversity: Habitats		IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
Pre-construction		
Impacts	**Mitigation measures**	

Biodiversity The construction and operation of the railway will cause negative impacts on habitats and the biodiversity at large (plants and animals)	In order to provide prevention, elimination, mitigation and/or compensation of the effects from the negative impacts on habitats, plant species and the biodiversity at large, the implementation of the following measures is recommended prior the commencement of construction activities:	
	• During pre-construction phase, the future Contractor, together with the MOEPP, Ministry of Economy, Ministry of Transport and Communication, and the Municipality of Kriva Palanka to identify locations (mostly on public land) where previous surveys (hydrogeological and geodetic) will be carried out that will be a base for project documentation and documentation regarding the environmental impact assessment, in accordance with the Law on environment and the appropriate bylaws	***NO. We believe these tasks belong to the Contractor of the construction.***
	• The borrow pits for stone and other resources must be defined in advance in order to enable the biodiversity impact assessment. The use of resources for the purpose of railway construction is not allowed at the following habitats: - Alluvial sediments (riparian gravel banks and poplar and willow stands) – for sand and gravel excavation, - Rivers and streams – for sand and gravel excavation, - All types of forests (degraded forest stands could be an exception, but the impacts should be identified in advance)	***YES.***
	• The excavated inert material to be used (as much as possible) as construction material and additionally to propose borrow pits that the future Contractor will inspect for the quality of material, production capacity, distance to the project area and the existence of project documentation, including documentation in accordance with the requirements of the Law on environment	***NO. We believe these tasks belong to the Contractor of the construction.***
	• To consider all the strategic and developmental documents regarding nature conservation and utilization of natural resources	***NO. It might be included in the environmental documents.***
	• To avoid installation of worker camps and parking lots for heavy vehicles near the habitats described in the chapter: Impacts on habitats during construction	***NO. We believe it is a condition for the Contractor of the construction.***
	• To design an adequate monitoring system for the implementation of the	

	biodiversity protection measures as well as monitoring of the quality of surface waters • Implementation of the measures for risk management summarized in **Chapter on risk management**; • To prepare an in-depth Biodiversity Management Plan (plant and animal species). The plan will include the recommendations from the monitoring program proposed within this Study, but in more detail and for designated locations, then indicators, timeframe and frequency, responsibilities, budget etc., in accordance with the final Detailed Design for the railway	***NO. We believe it is out of the scope of the project.*** ***NO. We believe it is out of the scope of the project.*** ***NO.***
Construction		
Impacts	**Mitigation measures**	
Biodiversity The construction of the railway will cause negative impact on habitats (plants and animals)	**General measures** In order to provide habitat protection and protection of the whole biodiversity (plant and animal species) along the alignment of the railway, i.e. at sites where construction works will be carried out and during the whole period of construction, the implementation of the following general measures is recommended: • Avoid the occupation and degradation of adjacent land (in the vicinity of sites where construction activities are performed). Any kind of land use which is not envisaged in the Detailed Design must be carried out with consent of the landowner/manager of the land or other type of permit, if necessary • Continuous presence of a firefighting vehicle, for timely intervention in case of a fire • Provision of adequate storage sites for hazardous materials (e.g. fuels for heavy vehicles), appropriate storage and handling of these materials • The storage of hazardous materials at the construction site should be reduced to minimum • Avoid installation of worker camps, storage sites and dumping sites (soil heaps) on alluvial terrain due to the possible risk of high groundwater levels and their pollution. Additionally, these locations are	***NO.***

	habitats that were assessed as sensitive to disturbance and the level of significance of the impacts is high (if riparian vegetation is present) or moderate (in case of gravel and sandy sites) (see chapter on impacts) • After the completion of construction activities, if there is no need for further use of the organized sites, the objects should be dismantled and the terrain should be rehabilitated. The rehabilitation of the terrain will be implemented with the use of adequate project documentation, and native materials and plants	
Important habitats Clearing of the project area and the permanent removal of the vegetation in order to prepare the project area for the construction activities and providing access to locations will cause negative impacts on habitats in the area and beyond	Besides the general measures (listed above) that generally apply for all the habitats along the alignment, the following additional measures are recommended for some particular sites and localities: • The haulage roads must not be traced in the following habitats: - Beech forests; additional disturbance of these habitats is not allowed in particular at km 81+500 to km 82+600, except for the clearing of vegetation for the purpose of the project and rail placement - Wet and mesophilic meadows, in particular at km 74+800 to km 75+000; km 75+700, and km 81+100 where this type of habitat is strongly affected from the railway construction - Willow and poplar woodlands, stands and tree belts wherever encountered during the construction - Gravel banks of watercourses (rivers and streams) wherever encountered during the construction - Across rivers and streams wherever encountered during the construction • If stream crossing is necessary due to construction specifics, then the watercourse should be crossed with a bridge and should remain intact/non-disturbed (including the riparian vegetation, if any) • Randomly disposed waste (concrete, iron, rocks and stones etc.) should be removed immediately from the aforementioned habitats on a daily base • All the locations that will serve as temporary dumping sites for the excavated topsoil or other non-usable material must be previously	***NO.***

	designated by the designer and the construction company, so the possible negative impacts on habitats (and the environment in large) can be assessed in time at these particular locations[95]. The following habitats should not be used as temporary dumping grounds: - Willow and poplar woodlands, stands and tree belts, - Wet and moderately wet (mesophilic) meadows, - Beech forests, - Rivers, streams and their riparian zones • During the construction of bridges, the habitats listed below must remain intact as much as possible. The bridges should cross these habitats without causing significant damage. Regular monitoring should be carried out by an independent expert (biologist/ecologist) at the following habitats: - Willow and poplar woodlands, stands and tree belts; - Willow and poplar woodlands at: km 74+020 to km 74+300, and near km 75; km 81+200 to km 81+600; - Riparian willow and poplar belts: at km 74+200; from km74+800 to km 75+000; at km 75+760; at km 76+500; - Gravel and sandy banks at km 74+750 to km 75+000, and at km 76+500; - Rivers and streams at km 74+250; km 74+870; km 75+770; km 76+500; km 79+850; km 81+060 to km 81+170; km 81+760 to km 82+170, and km 84+100. • Occasional or regular professional supervision (biologist/ecologist) is recommended for the following habitats: - Willow and poplar woodlands, stands and tree belts; - Wet and mesophilic meadows; - Beech forests; - Hilly pastures; - Rivers and streams.	

[95] Based on previous surveys, a Dumping Ground and Borrow Pit Design should be prepared, which will be accompanied by appropriate documentation in accordance with the Law on environment

	Mitigation measures for forest habitats The mitigation of impacts on forest habitats is described in Chapter on habitats. **Mitigation measures for rivers and streams** Implementation of the measures described in Chapters on rivers and streams as habitats. **Mitigation measures for the rest of the habitats** No special measures are recommended for the other habitats, except the ones recommended above as general measures	
Residual impacts: In normal operational conditions, most of the impacts are expected to be significantly mitigated with the implementation of the recommended measures. The strict adherence to the good construction practice and the special measures for avoidance of construction activities in particular habitats will contribute in significant reduction of the negative impacts or their elimination		
Residual impacts mitigation measures: /		
Operation		
Impacts	**Mitigation measures**	
Habitats The clearing and maintenance of the vegetation around the railway, as well as the potential pollution from accidents, may lead to negative impacts on habitats	• Avoid use of herbicides for vegetation management adjacent to the railway (alternatively to avoid excess use of herbicides) • Implementation of measures for accident protection • No other specific mitigation measures are recommended	***NO. We believe that in general these assumptions about the railway operation are out of the project scope.***
Residual impacts: With the implementation of the mitigation measures, no residual impacts are expected		
Residual impacts mitigation measures:/		

Environmental components – plant species (flora)		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Pre-construction and construction		
Impacts	**Mitigation measures**	
Plant species (flora) The construction of the railway will cause negative impacts on plant species within the	Based on the data from the botanical literature and the data obtained during the site visit (for the purpose of this Study) it can be concluded that no specific measures are required for protection of particular plant species, since no endemic, rare or other type of sensitive species are recorded along the	***NO.***

<table>
<tr><td>project area due to execution of construction works, clearing of vegetation, excavation etc.</td><td>alignment.
Still, in order to avoid the excess and redundant destruction of individual plants and their populations, the implementation of following measures is recommneded:
• Destruction of old trees and other trees with specific appearance (specific form or with ornamental features) should be prohibited or avoided as much as possible.
• In order to detect the possible presence of plant species of conservation importance, a detailed insight of the alignment should be done prior commencing the construction works by appointed independent expert (biologist/forest engineer)</td><td></td></tr>
<tr><td colspan="2">Residual impacts: In normal operational conditions, most of the impacts are expected to be mitigated with the implementation of the recommended measures. The strict adherence to the good construction practice and the special measures for avoidance of construction activities in particular habitats will contribute in significant reduction of the negative impacts or their elimination</td><td></td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: If necessary, additional measures will be proposed</td><td></td></tr>
<tr><td colspan="2">Operation</td><td></td></tr>
<tr><td>Impacts</td><td>Mitigation measures</td><td></td></tr>
<tr><td>Plant species (flora)
The railway traffic and maintenance as well as accidental pollution may lead to the destruction of particular plant individuals</td><td>Plant species growing along railways are usually cosmopolitan and therefore have a very low conservation status. Hence, no special measures are recommended for the protection of plant species along the railway during its operation</td><td>No meassure is needed.</td></tr>
<tr><td colspan="2">Residual impacts: No residual impacts are expected if mitigation measures are being implemented</td><td></td></tr>
<tr><td colspan="2">Residual impacts mitigation measures: /</td><td></td></tr>
</table>

<table>
<tr><td colspan="2">Components of the environment – Animal species (fauna)</td><td rowspan="3">IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY</td></tr>
<tr><td colspan="2">Pre-construction</td></tr>
<tr><td>Impacts</td><td>Mitigation measures</td></tr>
<tr><td>The construction of the railway will negatively impact the animal species</td><td>• Due to the presence of otter (Lutra lutra), adequate designing of the bridges is recommended. There are two bridges that are significant</td><td>In the final version of the main design there will be reduced the column</td></tr>
</table>

	from this aspect, and focus should be put on the long bridge no. 32 at km 76+402 to 76+611.5. The foundations of bridge piers should be designed out of the riverbed and at least 5-10 m from riverbanks • Implementation of a biomonitoring of the amphibians and reptiles during spring season in order to determine the need for placing additional culverts for protection of smaller animals (amphibian and reptile fauna)	***section in order to increase the free space in the river bed.***
Construction		
Impacts	**Mitigation measures**	
Animal species (fauna) The construction of the railway will cause negative impacts on animal species, disturbance of species due to destruction of bird and other vertebrates' nests, and mortality as a result of excavations and killing of amphibians and reptiles by workers due to unfounded fear, repulsion to certain species or illegal hunting of birds, mammals etc.	In order to avoid the negative impacts on fauna, the implementation of the following measures is recommended: • To avoid unnecessary destruction of important habitats (see mitigation measures for impacts on habitats) • Do not kill and pose serious injuries to the native fauna during clearing of vegetation. This especially goes for mammals, birds, reptiles, amphibians and fish • To inform and educate the workers that killing of animals is prohibited within the project area during construction (amphibians, reptiles, birds, mammals). Information materials to be prepared for this purpose • To inform hunting societies for the timeframe of construction works. Hunt should be prohibited within the project area (2 x 500 m) • To minimize large trees destruction • The injured or abandoned native wildlife juveniles to be transported to the nearest veterinary ambulance in Kriva Palanka or Kumanovo	***NO.***
Operation		
Impacts	**Mitigation measures**	
Animal species (fauna) The operation of the railway may cause negative impacts on animal species due to railway traffic and maintenance. These activities may lead to	In order to reduce the mortality rate due to direct impacts (collision with trains and electrocution), the following measures are recommended: • Removal of carcasses from the vicinity of the railway • Removal of food or any other type of waste from the vicinity of the	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***

destruction and degradation of the habitats (waste disposal, pollution, disturbance of animals), mortality due to electrocution, noise nuisance and disturbance etc.	railway. The removal of the potential food sources will reduce the presence of wildlife near the railway, which will reduce the mortality rate resulting from direct impact • To not plant fruits and nuts within the buffer zone of 2 x 100 m from the railway • Clearing of the snow under the viaducts. In this way the animals that would otherwise move on the railway can escape to the clearings on time, which will reduce the mortality due to collision with trains and will increase the traffic safety. This measure will have direct positive impacts for passengers, too, mostly because of raising the safety level and lowering the risk of injury/death • Restriction of fishing at Kriva Reka and its tributaries in order to preserve fish populations. Fishing should be prohibited at each water body near the railway (100 m). People will also benefit the measure because of lowering the health risk and risk of injury/death since the risk of traffic accidents will be lowered • Revegetation with willows should be carried out within a range of 25 m along the river, from both sides of the bridge (total of 50 m) • Piers carrying the electrical conductors (required for electrical traction of trains) is expected to be used by birds as halts, and even as potential breeding sites. In this case, the mortality of birds is exceptionally high, primarily in the migratory period. Therefore the preparation of new designs implemented in some european countries[96] is recommended. There are solutions for reducing the impacts of electrocution that provide significant reduction of mortality in birds and they are based on preventing the bird of getting closer to the circuit (mutual distancing of the cables, as well as from the main pier, to a distance larger than the wing span of the bird): • Supporitng elements (insulators) should be mounted downwards (to hang), and not upwards at the horizontal part of piers	

[96] So far piers have not gained the appropriate attention, but recently in Germany new designs of piers are being considered.

	• The minimal distance between adjacent cables should be larger than 140 cm • The distance between the top of the pier and the first cable under it, as well as the distance between the insulator and the non-insulated part of the cable should exceed 60 cm. If the cables are placed laterally on the pier, then they should be distanced from it on a insulated supporting element which is at least 140 m long • At each pier, at least 60 cm of the cable should be insulated with a plastic envelope, mounted on both sides of the supporting element	
Residual impacts during construction and operation: If all recommended impact mitigation/avoidance measures are implemented during construction and operation of the railway, it can be said that residual impacts relevant for fauna will appear for sure. The residual impacts are expected to be negligible during the construction. More significant residual impacts are expected during the operation of the railway: the existance of a small fragmentation effect is expected, as well as a certain mortality rate from collisions, and insignificant indirect impacts from water, air, soil, and vegetation pollution.		
Residual impacts mitigation measures: To record and quantify the residual impacts, a monitoring of the conditions of the populations of animals, the fragmentation effect, and mortality at the railway should be implemented. The results will serve to recommend additional residual impacts mitigation measures, such as reforestation, establishment of daily bio-corridors, strengthened hunt and fishing control etc.		

Environmental components – Diatoms and macroinvertebrates		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Construction		
Impacts	**Mitigation measures**	
The execution of construction activities in rivers and their vicinity, as well as the occurrence of accidental pollution or input of substances in rivers can cause negative impacts on river ecosystems (diatoms and macroinvertebrates)	According to the Water Framework Directive, all the aquatic habitats should have a good ecological status, based on the composition of benthic flora and fauna, as well as the macrophytic and riparian vegetation. Therefore, adequate measures need to be taken that are generally part of the “good construction practice” by which the pollution, eutrofication and modification of the aquatic habitats would be avoided. By protecting the aquatic habitats, the aquatic organisms are protected, too. More precisely, in order to mitigate the impacts on river ecosystems, the	***In general we believe that these tasks belong to the Contractor of the construction. They might be included in some environmental document.***

	implementation of the following measures is recommended: - Avoid the disturbance of natural habitats as well as the input of pollution substances - The material resulting from the construction of haulage roads, bridges and tunnels (rocks, pebbles, cobbles, soil, plants) should not be thrown into rivers - The haulage roads should not be traced along the riverbed and sufficient areas with riparian vegetation should be left in order to prevent the direct input of dust, sand and other materials during the use of the haulage roads - To prevent any kind of storage of construction materials near the rivers - The waste materials from construction activities should be properly disposed and removed from the rivers or their vicinity - Barrels or tanks where hazardous materials are being stored (oil, fuel, dyes) must be placed on appropriate and marked sites which are distanced from rivers. These materials should be handled very carefully in order to avoid leaks of hazardous materials into rivers - Handling of wet cement must be done in a careful and controlled manner in order to avoid its input within the river ecosystems. During the construction of bridge piers, the leak of cement into rivers should be prevented - Installation of mobile toilets or providing appropriate facilities located near the construction activities - Protection of the riparian vegetation, since it will represent an important buffer zone and protection of rivers - Prevention of interventions in the riverbed According to the results of the survey on diatom flora and macroinvertebrate fauna, an insignificant number of sensitive species to the activities from the construction or operation of the railway were determined. Still, regular monitoring of the populations of dragonfly species of *Cordulegaster heros* and *Caliaeschna microstigma* is recommended, especially in the river of Gabarska	***YES.*** √ ***YES.*** √

	Reka, in order to determine on time the possible negative impacts from the construction of the railway.	
Operation		
Impacts	**Mitigation measures**	
Maintenance of bridges as well as the potential pollution from accidents may negatively impact the aquatic organisms	The aquatic species of diatoms and macroinvertebrates inhabiting the aquatic ecosystems in the project area have a minor conservation importance. Generally, ubiquitous species of diatoms and macroinvertebrates are found. On the other hand, lesser impacts are expected from the operation of the railway when compared to construction. Thus, no specific protection measures are recommended for the operational phase	***NO. We believe that in general these assumptions about the railway operation are out of the project scope.***
Residual impacts during construction and operation: With the implementation of the mitigation measures, no residual impacts are expected.		
Residual impacts mitigation measures: /		

Environmental components: Proposed protected areas and internationally recognized areas		**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Construction and operation		
Impacts	**Mitigation measures**	
Proposed protected areas and Emerald sites The construction and operation of the railway may negatively impact the proposed protected areas. The impacts on the proposed protected areas relate to the construction phase (degradation of forests and other habitats, river diversion etc.), while a relevant threat during the operation is fragmentation of habitats (which will arise during the construction, but will have effects in the	No specific impacts were identified for the proposed area “Protected landscape Osogovski Planini”, the Emerald site “Pchinja-German” and the Emerald site “Osogovski Planini”. Hence, the recommended measures relating to habitats and fauna are completely applicable and sufficient for impact mitigation in the proposed and internationally designated protected areas. Very similar is the situation with the proposed protected area-nature park “Kiselichka Reka Gorge”, where certain impacts were identified, but they refer to the riparian habitats and the otter, and are not specific for the whole area. As described in the fauna mitigation measures, more attention should be given to the construction of the bridge no. 32 (km 76+402 to 76+611.5), i.e. the foundations of the bridge should be distanced 5-10 m off the riverbanks of Kiselichka Reka and the plantation of a willow belt by the river is necessary	***In the final version of the Main design there will be reduced the column section in order to increase the free space in the river bed.***

operational phase, too), which will be manifested as disturbance of the function of bio-corridors		
Residual impacts: The identified impacts on protected areas and the implementation of the mitigation measures will result in residual effect on all of the biodiversity components. The destruction and degradation of nature is impossible to be completely avoided. But the implementation of the mitigation measures will contribute to minimization of the impacts to acceptable residual effects		***NO. We believe these tasks belong to the Contractor of the construction.*** **It migth be included in an enviromental document.**
Residual impacts mitigation measures: Although there aren't any protected areas now, a certain amount of help can be offered in the future to the managers of the protected areas by the institutions/companies that manage the railway traffic, which would be a significant compensational measure		***NO. We believe that in general these assumptions about the railway operation are out of project scope.***

Thematic area-Forestry		IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
Pre-construction		
Impacts	**Mitigation measures**	
Impacts on forestry The construction of the railway will negatively impact the forestry sector due to deforestation/loss of forestland, loss of wood mass, loss of natural restoration, loss of private property forestland, change of land use from forestland into construction site etc.	• Prior commencing the construction works, the Contractor should prepare Forest Management and Removal Plan which will precisely define the procedure for execution of all the activities in order to mitigate the negative impacts in the project area • Timely implementation of the expropriation procedures and fair reimbursement for the loss of ownership (for private landowners of forests and forest land) • Timely commencement of the procedures for permanent change of land use (private and public property) into construction site, in accordance with the Law on expropriation, Law on forests, the Rulebook for determinig the reimbursement costs for permanent change of forests and forest land, as well as with other relevant laws and bylaws	***NO. We believe that in general these assumptions about the railway operation are out of project scope.*** ***NO. We believe the expropriation procedures are out of the project scope.*** ***NO. We believe the expropriation procedures are out of the project scope.***
Construction		
Impacts	**Mitigation measures**	
Impacts on forestry The construction of the railway will	• Implementation of the measures from the Forest Management and Removal Plan • Avoid execution of construction works, tracing of haulage roads, establishment of	***NO.*** ***There is clearly a need a construction***

negatively impact the forestry sector due to deforestation/loss of forestland, loss of wood mass, loss of natural restoration, erosion, loss of private property forestland etc.	borrow pits, storage of materials and waste near the riparian poplar and willow woodlands (km 74+020 and km 81+600), the riparian willow and poplar belts (km 74+200 and km 81+300) and the submontane beech forests (km 81+500 to km 82+600); • Minimization of the areas where construction works are carried out and minimization of logging by adequate solutions in the Execution Designs • Avoid tracing new haulage roads and maximal use of the existing ones for supply of raw materials, machines or removal of waste etc. • Avoid storage of materials, excavations or embanking at sites where there is forest replenishment • Partial landscaping of the area, as well as reforestation of sites where construction works have been completed in order to achieve partial compensation of the negative impacts and reduction of the erosion risk, establishment of natural balance, the function and dynamics of the ecosystems and habitats • Implementation of the mitigation measures for biodiversity, air, soil etc. • Implementation of the measures from the Fire, Explosion and Hazardous Material Management Plan	***works in these areas, but there will be avoid set there borrow pits, storage of materials, waste… These might be included in some environmental document.*** ***YES.*** ***YES.*** ***YES.*** ***NO. It might be included in some environmental documents.***
Residual impact: With the implementation of the forestry impact mitigation measures there is a possibility for residual impacts due to deforestation		
Residual impacts mitigation measures: If residual impacts are evident, an additional analysis of impacts will be carried out and additional measures will be recommended		
Operation		
Impacts	**Mitigation measures**	
Impacts on forestry The maintenance of the railway and vegetation removal, as well as accidental fires etc. may negatively impact the forestry sector	• Deforested areas should be restored by taking measures for natural or man-made forest restoration with native species, which are also more adapt to climate change. If there is no possibility for reforestation, other land area should be designated for that purpose (compensation, which will be implemented by the Investor) • The natural disaster and accident should be assessed within a Natural Disaster and other Accidents Protection and Rescue Plan	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Residual impacts: In normal operational conditions, no residual impacts are expected		
Residual impacts mitigation measures: /		

<table>
<tr><th colspan="2">Environmental components-Waste</th><th rowspan="3">IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY</th></tr>
<tr><th colspan="2">Pre-construction and construction</th></tr>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>The inadequate waste management may negatively impact the environmental media and components and pose threat to the health of the community</td><td>The Contrector of the construction works should prepare Waste Management Program for the construction phase. The program should at least contain the following:
• Identification of the different types of waste and envisaged quantities of waste that will be generated at the construction sites, in accordance with the List of wastes („Official Gazette of the Republic of Macedonia“ no. 100/05)
• Selection and classification of the different types of waste in accordance with the List of wastes and handing them over to authorized companies
• Determination of the way of treatment of the different types of waste
• Establishment of a procedure for waste management
• Providing containers and sites for waste storage
• Defining the time of waste collection and transportation of the generated waste from the construction site
• Re-use of excavated earth and the construction waste as much as possible
• Re-use of other types of waste
• Determination of the estimated value of the reusable or recyclable waste
• Recording the type and quantity of generated waste and preparation of annual reports for waste quantities that are handed over to authorized companies
• Establishment of a monitoring of the measures taken for waste management
• Training of the employees for proper waste treatment
It is also recommended:
• Full implementation of the measures and recommendations from the Waste Management Program: contracting authorized companies for collection, transport and treatmeant of waste, as well as accepting the waste
• Engaging an expert-waste manager that will provide a complete implementation of the Plan in accordance with the legal requirements
• Municipality of Kriva Palanka to appoint/designate sites for dumping of the inert waste/construction waste and excess excavated earth which cannot be used in the</td><td>NO. We believe these tasks belong to the Contractor of the construction.</td></tr>
</table>

	construction of the railway	
Operation		
Impacts	**Mitigation measures**	
The inadequate waste management may negatively impact the air quality, water, soil etc. due to the generation of different types of waste, regular maintenance of the railway, equipment (railway vehicles, railway wagons etc.) and other railway components (station, halt, railway maintenance objects), as well as during passenger transport	• Establishment of waste management procedures • For proper waste management, containers with different colors will be placed for disposal of different waste streams, especially at the station, halt and in objects where there will be workforce • The Operator of the railway should contract authorized companies for collection and transport of the different waste streams • If the Operator of the railway, from the beggining of its work, generates more than 200 kg of hazardous waste and/or more than 150 t of non-hazardous waste during a period of one calendar year, is obliged to prepare Waste Management Program and to implement it in accordance with the Art 21 of the Law on waste management	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***
Residual impacts: No residual impacts are expected		

SOCIAL IMPACT	**MITIGATION MEASURES**	**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
PRE-CONSTRUCTION		
Social environment management system		
Improper management of the implementation of the social environment management system	Within the company ("Macedonian Railways-Infrastructure", MR-I), appoint an employee who will be responsible for managing and monitoring the implementation of mitigation measures, as well as monitoring the programs, and to regularly report the highest levels of the company and external stakeholders. The person must be familiar with the company's procedures, MFI standards / requirements, plans and programs to be achieved during the implementation of the Project. In order to achieve integrated management, it is not recommended to delegate managerial responsibilities from different segments of the System for social (and environmental) management to different employees. It is better to appoint, train and continually improve professionals who will be able to manage the responsibilities that come with funding from outside sources.	***NO. We believe that in general these assumptions about the social impact are out of the project scope.***
Residual impacts	**Residual impacts are not expected if all measures are implemented.**	

Delay in the implementation of the project due to the company's non-compliance with the requirements of the IFIs	Procurement must be carefully planned and carried out in the sense that all possible options for engaging subcontractors must be examined before starting the tender procedure. The developer's staff must start early consultations with all potentially interested companies that can engage in construction work. The developer must either allocate staff or hire an experienced external associate who will prepare all necessary documents and procedures before the tender is announced	
Residual impacts	Delays can always arise during the implementation of the project, although all procedures and recommendations have been implemented. In any case, this project is complex and requires the engagement of various professionals and companies that are not always in good condition for accepting the assignments, or ready for teamwork.	
Delay in the realization of the project due to badly performed expropriation and dissatisfaction of the stakeholders	The most appropriate measure for mitigating the negative impacts of the process of expropriation of property (land, house and other property) is the implementation of good international practice in treating property acquisition / expropriation, which includes the preparation of the **Political Resettlement Framework** and the **Resettlement Action Plan** . In particular, it is necessary, along with the preparations for the construction phase of the project, to develop and implement a **Political Resettlement Framework**, from which an **Action Plan on Resettlement** will arise. The most important thing in this process is the proper information, communication and consultation of the persons that will be expropriated, as early as possible, until their final resettlement and the disappearance of the negative consequences of that resettlement. The use of these practices is in line with national legislation, but also more so in order to create a situation in the society (especially stakeholders) where the negative consequences of the implementation of the project will completely disappear or be marginalized.	
Residual impacts	It is almost impossible to mitigate the negative impacts as a whole, because not all sides will always be satisfied. It is possible, due to the inertia and confidence of individuals in the developer, to underestimate the need for implementation of this measure, and then to create the situation before the occurrence of this negative impact. Or, some of the stakeholders have high aspirations and in every possible way insist on creating this imapct, in order to obtain greater financial and material benefits from the investor.	
Increased anxiety among the population due to the lack of	It is recommended that MR-I conduct a series of consultative activities with stakeholders, especially those who own land near or along the route of the railway alignment. A grievance mechanism will be prepared and implemented and it will be publicly available in every affected settlement, at the headquarters of the Public Enterprise and the premises in the field, as well as in the premises of the municipality of Kriva Palanka.	

communication with local settlements and property owners near the project area	The developer must constantly and regularly maintain communication with the affected inhabitants of Kriva Palanka and other settlements: Uzem, T'lminci and Zhidilovo, and especially with those who own land near the project, on the very route of the railway line or the facilities that will serve the project. But that communication must be systematized and translated into a Stakeholder Engagement Plan that will be developed according to the good international practice that promotes IFIs. Additionally, it is necessary for the contractor to organize an office, which will serve as the Information Office of the project. It will be a public location where all information and documents related to the project will be available to the public. The location of such an office is best to be as close as possible to the construction site.	
Residual impacts	Residual impacts will remain, but with much lower intensity, because it is very difficult to impact the thoughts of people and their interests and desires.	
Problems related to the organization of the workforce	The Contractor must prepare and implement an **Employment Plan** for the needs of the project, in cooperation with the local ESA office, where special attention will be given to engaging the local workforce. The plan will cover all aspects, from the analysis of the existing situation on the labor market at the local, regional and national level, to the organization and systematization of the required jobs for the project. It is preferable to include in the tender documentation a request to the contractors to submit a specification with a number of engaged workers by construction phase and their qualifications, and which are planned to be engaged if they participate in the construction of the project.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Despite the implementation of all measures, residual impacts are possible.	
Non-compliance with IFI standards regarding workers and working conditions	The developer must develop and implement a Occupational Health & Safety Management System. This management system will be compulsory for the Developer, including contractors and subcontractors. It will include aspects such as: identifying and using PPE, regular training and monitoring as well as ongoing security checks, as well as other measures. Part of the management system must be the **Occupational Health and Safety Plan** with an implemented grievance mechanism, in accordance with national laws, as well as with the requirements of the IFIs. The grievance mechanism for workers obliges the contractor to receive and appropriately resolve employee complaints in a fair and reasonable manner. The Occupational Health and Safety Plan will minimize, if not eliminate, all health and safety risks and the sources of those risks to workers. All contractors and subcontractors must comply with the requirements of the plan. The contractor will procure all resources, labor and materials from reliable sources of good reputation, where, along with the price, factors such as quality, reputation, performed projects and services are considered.	***NO. We believe that in general these assumptions are out of the project scope.***

Residual impacts	Residual impacts are not expected if all measures are implemented.	
Housing, communications and utilities		
Expropriation of houses / homes	The most appropriate measure for mitigating the negative impacts of the process of expropriation of homes and other property is the implementation of good international practice in the purchase of property (expropriation), which includes the preparation of the Political Resettlement Framework and the Resettlement Action Plan. In particular, along with the preparations for the construction phase of the project, a **Resettlement Policy Framework** needs to be developed, from which an **Action Plan on Resettlement** will arise. The most important thing in this process is the proper information, communication and consultation of the persons that will be expropriated, especially their homes, and as early as possible, at an early stage of the project. People who will lose their homes must be consulted from the very beginning and to find a solution according to the needs and possibilities. It is necessary to remain in contact with these persons until their final resettlement and the disappearance of the negative consequences of that resettlement. The use of these practices is in line with national legislation, but also more so in order to create a situation in the society (especially stakeholders) where the negative consequences of project implementation will completely disappear or be marginalized.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	It is almost impossible to mitigate the negative impacts as a whole, because not all sides will always be satisfied.	
Economy and livelihood		
Increasing the expectations of the affected population in terms of employment	Prior to the commencement of the construction work, the Contractor must publish a good Employment Plan, which will be developed together with the regional unit of the Employment Agency of the Republic of Macedonia, where it will be determined that the project will create jobs, but only for qualified and for those who will pass the training and retraining process. It is not good to increase expectations in such a small social environment (the municipality and, in particular, the affected populated areas) due to the latent negative social consequences that such expectations carry with them. The contractor will hire unskilled labor, but also highly qualified profiles, because it is still a project with complex construction activities. In any case, some of the residents of the affected areas must be employed, and the contractor must provide training for all of them. The percentage of the local workforce in the project should be determined by the Investor, in cooperation with the local self-government and the regional unit of ESA.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Despite the implementation of all measures, residual impacts are expected. The expectations of the local population can not be controlled from the outside.	

Loss of qualified personnel from local companies (increase of operating costs)	Prior to the commencement of the construction work, the contractor must publish in public a good Employment Plan, developed together with the local office of the Employment Agency of the Republic of Macedonia. This plan must analyze the potential local labor market and find a solution with the least damage to all stakeholders. Labor market in Kriva Palanka is limited, as well as available qualified resources, especially after a period of strong migration.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Despite the implementation of all measures, residual impacts are expected. The expectations of the local population can not be controlled from the outside.	
CONSTRUCTION		
Social environment management system		
Reduced stakeholder involvement in the construction phase	The developer must maintain an open communication channel with stakeholders and project stakeholders in the construction phase, since not all stakeholders are able or willing to fill out a complaint or grievance. The company must regularly hold semi-annual meetings with representatives of local community and other interested stakeholders. A strong emphasis must be placed on the presence of women at those meetings.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	
Community health and safety		
Increased threat to the community and livestock due to the presence of a construction site	The contractor should develop and implement procedures for the protection of the health and safety of local communities, populations and their livestock. Procedures should include familiarization with the safety rules for workers and the construction site, and in order to prevent unauthorized access to the construction site, work camps, transport vehicles, construction machinery and warehouses. The Contractor will prepare and implement a **Construction Management Plan** in order to respond to the accidents and urgent cases in a manner appropriate to the construction risks. This plan will rely on the prior identification of the risks of major incidents, and will include the necessary measures to prevent major incidents, as well as mitigate their consequences for the local community. The contractor must create safe pedestrian and traffic corridors through the construction site, at the request of the local community and residents. The same corridors will be marked with visible signs, but also communicated with the representatives of local communities, as well as schools. The contractor must design and implement a **Safety Campaign for the population in the construction of infrastructure projects** that will include educational and informative activities for the population of the affected part of the city. Most of this campaign must be carried out before the start of construction activities, while the other part in the construction phase. The campaign must consist of a series of lectures intended for	***NO. We believe that in general these assumptions are out of the project scope.***

	primary and secondary school students in Kriva Palanka, the risks to population safety when there are construction activities for the construction of infrastructure projects, as well as the risks to the population in the operational phase of the project. The campaign must be supported by media, with information, publication of manuals, leaflets and recommendations in printed form available for the local affected population, but also in electronic form on the website of the municipality, as well as other institutions of local character, as well as on the site of the Investor. Additionally, those parts where there are paths for the movement of domestic animals will have to have a special protection regime in order not to cause loss of goods. Locations where animals can be expected can be found around the villages Zhidilovo, T'lminci and Uzem.	
Residual impacts	Although all measures are implemented, there will still be "interested" parties that will try to find a way to satisfy their own curiosity and find themselves at a construction site at some point.	
Emergencies due to of transportation of materials for and along the railway	The Contractor, in cooperation with the developer, and in particular the competent services, should prepare an Emergency Preparedness Plan, covering all possible incidents related to the railway during construction and operation, as well as the possible measures for rapid reaction and mitigation of the harmful consequences. Material damages must be compensated in full, at market prices of the materials and services for their placement in their original condition.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Despite the implementation of all measures, residual impacts are expected, but it is early to talk about something that has not happened yet	
Problems related to workers' behavior towards the local environment	In terms of labor rights, all workers (including contractors and subcontractors) will have contracts with clearly expressed rights and conditions for their employment, and their legal rights. Contracts will be explicitly explained to all workers when necessary to ensure that workers understand their rights. Contracts must be concluded before the commencement of the working activities. All workers (including contractors and subcontractors) will be able to join trade unions of their choice and have the right to collective negotiations. All employees, even those of subcontractors, must sign a Code of Conduct, which should be accessible and visible, and each worker must understand the weight of the document and the consequences it brings if it violates it.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Despite the implementation of all measures, residual impacts are possible.	
Fear for personal health and safety due to the	Preparation and full implementation of a **Temporary Traffic Management Plan** in the settlements, actively communicated with the stakeholders from the affected settlements and the local public. All critical points that must be covered by the plan must have the appropriate traffic signalization during the	***NO. We believe these tasks belong to the Contractor of the construction.***

increased volume of traffic across settlements	construction phase and the speed limit that will correspond to the newly occurred situation. The notification of the existence of the plan must be communicated in a timely manner with the local communities, and publicly displayed in the municipality and the premises of the information office of the project.	
Residual impacts	Despite the implementation of all measures, residual impacts are possible	
Noise disturbance due to construction activities	The Contractor, in coordination with the Investor and the local self-government, should hold several meetings with the local population, where all the negative consequences of the project will be explained, in particular, the noise, the frequency of vehicles and workers, as well as the safety of the population during the upcoming period of construction activities in the immediate vicinity of their homes. It is desirable that these meetings be held prior to the beginning of the construction activities. Citizens have the right to know what will happen in the immediate vicinity of their homes and properties. The contractor should avoid construction activities in times of major religious holidays, non-working days, as well as activities that create increased noise and are not suitable for the night hours, that is, after 19 h.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Despite the implementation of all measures, residual impacts are possible	
Adults in remote areas	During the construction phase it is necessary to provide non-financial assistance to the Inter-municipal Center for Social Work Kriva Palanka (IMCSWKP) for visiting old and vulnerable individuals / groups in the affected area. This non-financial assistance will encompass the provision of driver, vehicle and fuel in order IMCSWKP to visit the socially vulnerable individuals living in remote settlements, located north of the planned line, once a week. Preparation of an Action Plan for Social Support during the construction phase, which will regulate the relations and social support that the contractor should deliver to the IMCSWKP described above.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Residual impacts are not expected if all measures are implemented	
Housing, communications and utilities		
Disruption of everyday life caused by limited access to inhabited settlements, land	Public availability of time frames for construction activities, especially for each settlement. Engaging an appropriate % of the workforce for this project from the entire project area, with a special advantage given to the applicants from the rural populated areas of the project area.	***NO. We believe that in general these assumptions are out of the project scope.***

and property		
Residual impacts	Residual impacts are not expected if all measures are implemented	
Degradation of local roads due to construction transport related to the project	Upon completion of the construction activities, the Contractor must repair the damaged local roads used for the transport of goods and people.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented	
Material assets		
Interruption of access to communal and road infrastructure	The Contractor is expected to undertake all the necessary activities to provide information on the location of the infrastructure along the alignment. But it is likely that, with the exception of the gas and power grids whose location is known, there may be unregistered water supply from private sources and wells that are not registered in the respective utility companies. In case of interruption of access to communal infrastructure, the contractor is obliged to service the interruption as soon as possible or to provide an alternative approach. The Contractor will compensate for all damages incurred.	***NO. We believe these tasks belong to the Contractor of the construction.*** **Yes**, It is included in the Infrastructural Design,prepared in the frame of the Project scope and will be included in the Tender dossier for the future Contractor
Residual impacts	Residual impacts are not expected if all measures are implemented	
Vibration impacts on houses	In order to protect the project against unforeseen risks, as well as the inhabitants of the settlements from possible negative consequences related to damage to houses, it is desirable for the contractor to record the current state of all houses that are located along the alignment in the width of 100m. The condition of all houses should be checked and recorded. If some of the houses later (during the operation of the railway) report damage due to blasting, there will already be a record of the condition of the house before the commencement of the construction of the railway. All damages caused must be compensated in full, at market price.	***NO. We believe that in general these assumptions are out of the project scope.***

Residual impacts	Despite the implementation of all the measures, residual impacts are possible. Sometimes vibrations damage the building gradually, and this is not always visible.	
Degradation of local roads due to construction transport related to the project	Upon completion of the construction activities, the Contractor must repair the damaged local roads used for the transport of goods and people.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented	
Economy and livelihoods		
Disturbance of livestock due to construction noise, blasting and / or displacement of grazing livestock away from the alignment of the railway	Mitigation measures should include consultation / meeting with the owners of livestock grazing on the local hills and by the river, where they will be timely informed about the time frame of the construction activities per location, but also the grievance mechanism, and the location where the latest information about the project will be published and which will concern them.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Despite the application of all mitigation measures, residual impacts can still be expected	
Increase of employment	NONE	
Residual impacs	NONE	
Loss of agricultural land and property for railway purposes	Mitigation measures should include consultation / meeting with the owners of the livestock and the agricultural land to be confiscated. If it is assessed that households will lose some of their livelihood, for the purpose of subtracting agricultural property, they must be compensated through the Resettlement Action Plan.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Residual impacts are not expected if all measures are implemented	

Economic loss to local businesses	At the very beginning of the construction work, the contractor must meet with the owners of the fishpond where the construction solutions will be presented, and the minimization of the negative impacts of the project on the fishpond and the restaurant will be discussed. This case, like other similar cases with economic losses due to the project, not seen in this phase of the project, must be covered in the Resettlement Policy Framework and the Resettlement Action Plan. In the event of causing a halt to the work of the fishpond or the restaurant or other economic losses, the owners of the fish farm should be compensated at market prices.	***NO. We believe these tasks belons to the Contractor of the construction.***
Residual impacts	Despite the application of all mitigation measures, residual impacts can still be expected	
Increased level of professional engagement for local companies	NONE	
Residual impacts	NONE	
Economic benefits of the project	NONE	
Residual impacts	NONE	
Education		
Disturbance from an interrupted process of education and learning	A communication and information channel must be established between the contractor and the local authorities and the affected communities, at the very beginning of the construction phase. It should be maintained until the very completion of the construction activities. The local population from the town and the populated areas where the explosions will take place must be noticed about the timeframe of the planned blasting on a weekly basis.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Despite the implementation of all measures, residual impacts are expected.	
Labor and working conditions		

Stress caused by a noisy work environment	Compliance with local labor legislation and EU directives on Occupational safety and health, as well as the use of personal protective equipment 89/654 / EEC, 89/656 / EEC, 89/686 / EEC and 2009/104 / EC. It is necessary to use personal protective equipment. The Contractor must create a Occupational Health and Safety Plan with an implemented grievance mechanism for employees.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented	
Influx of workers	Creation of a Worker Accomodation Plan that will be in line with the standards of good international practice translated through the experience and standards of IFIs. If there is a need to organize a camp for workers, it must not be near to any of the rural settlements. Every contracted worker from the Contractor must sign a Code of Conduct for Workers, which will include not only declarations and measures related to the labor and material process, but also respect for the local population, community and their property. The Code of Conduct for Workers must be publicly available together with the Grievance Complaints Procedure.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented	
Incidents caused by easily flammable, corrosive and explosive materials	Provide special training for workers for handling flammable materials and protection and fire prevention. Store flammable materials away from their initiating sources and oxidizing materials. Storage must be in rooms with natural air or passive ventilation. The area where the materials are stored should be separated and specifically marked for potentially flammable materials (no smoking, using mobile phones or other sparkling devices).	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	
Stress caused by exhaust gases in the workplace	The Contractor must create a Occupational Health and Safety Plan with an implemented grievance mechanism for employees.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	

Threatened health of workers due to work at a height	Mitigation measures must include appropriate training on the use, servicing and integrity of PPE (Personal Protective Equipment). Appropriate use of scales and scaffolds must be left to trained employees. Use of anti-fall devices, including a safety belt and rope movement limiter, to prevent access to potential points at risk of collapse, or anti-fall protection devices that are fully fastened to the body used in conjunction with shock absorption wires or devices for self-pulling and blocking of an inert fall, attached to a fixed stopping point or horizontal "safety lines". Prevention from falling and implementing protective measures is required when the worker is exposed to danger of falling over two meters in a working machine, in water or other liquids, in dangerous substances or through an opening in the working surface. Must comply with local labor legislation and EU directives on Occupational safety and health, as well as the use of personal protective equipment 89/654 / EEC, 89/656 / EEC, 89/686 / EEC and 2009/104 / EC	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	
Threatened health of workers from rotating and mobile equipment	Use of specially designed machines that eliminate the danger of a trap, as well as ensuring that the limbs are away from danger of injury under normal operating conditions. When a machine or equipment has an exposed movable part or spitz that may endanger the safety of each worker, the machinery or equipment shall be fitted with, and protected from a bumper or other device which prevents access to the movable part or the exposed sharp part. Bumpers should be manufactured and installed in accordance with the appropriate safety standards for machines.	***NO. We believe these tasks belong to the Contractor of the construction.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	
Threatened health of workers due to the driving of industrial vehicles and traffic to the construction site	Training and licensing of industrial vehicle operators for the safe operation of specialized vehicles such as forklifts, including safe reloading and loading, load limits. Mobile equipment with limited rear visibility must be equipped with a sound alarm. It is important to establish a crossing, speed limit on-site, vehicle inspection requirements, operating rules and procedures (for example, banning for forklift trucks in a downward position), and controlling patterns or directions of traffic. Compliance with local labor legislation and EU directives on occupational health and safety.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	
Cultural heritage, religion, values and habits		

Potential destruction and loss of undiscovered archaeological sites	In accordance with the Macedonian Law on Protection of the Cultural Heritage, in case of unexpected discovery of archaeological sites, the Contractor is obliged to immediately inform the Investor (MR-I) and the Ministry of Culture and to follow their instructions. Construction work will be temporarily suspended while the competent authorities decide whether any research is needed or all protection measures should be applied. The contractor should follow the instructions given by the authorities responsible for the protection of cultural heritage. The contractor must keep the discovered objects in place and in the state in which they are detected. Workers should undergo basic training on the procedure for a random archaeological site.	***NO. We believe these are Contractor of the construction duties.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	
Anxiety due to blasting during religious ceremonies	In order to protect the inhabitants from the affected settlements from the possible negative consequences of interrupting religious practices, especially the burial of the dead and thus creating a dispute between the local community and the contractor, it must prepare a weekly timetable for activities that will generate strong noise and place it in public locations in settlements. The same can be regularly reported to such an event and local media, as well as the municipality, which would easily distribute this information. Sunday must also be a day without explosions, because the majority of inhabitants in other affected settlements are Orthodox Christians.	***NO. We believe these are Contractor of the construction duties.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	
Operation		
Demographics		
Reduction of migration	NONE	
Residual impacts	NONE	
Community health and safety		
Possible incidents at the railway crossings	The developer must implement a regular practice of raising local awareness about the negative aspects of disregarding the signalization of the railway crossings. Local residents must be remembered, especially the youth, about the possible consequences of disregarding the security infrastructure and signaling along the railway.	***NO. We believe these tasks belong to the Contractor of the construction.***

Residual impacts	Despite the implementation of mitigation measures, there will be residual impacts. Attempts to illegally cross with a vehicle through a railway crossing will not disappear. Some people rely on their own feelings when it comes to personal safety and often do not obey the rules prescribed by the railway operator.	
Possible incidents with crossings across the railway at illegal crossings	The developer must implement a regular practice of raising local awareness about the negative aspects of crossing the railway line at illegal pedestrian crossings. Local residents must remember, especially the youth, about the possible consequences of disregarding the rules for safe passage through the railroad, that is, the crossing of the railway at illegal pedestrian crossings.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Despite the implementation of mitigation measures, there will be residual impacts. Attempts to illegally cross the railway track will not disappear. Some people rely on their own feelings when it comes to personal safety and often do not obey the rules prescribed by the railway operator.	
Anxiety due to noise from rail traffic	Specifically for this project, mitigation measures are proposed in the "Noise" section.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Residual impacts are also possible after the implementation of mitigation measures. Sometimes, to some extent, the proximity of the railway may initiate the relocation of more sensitive persons / households in the more quiet parts of the town or in another settlement, i.e. a kind of process of internal migration. Such induced migrations in reality depend not only on the proximity of the railway line, but also on economic and other factors.	
Economy and livelihoods		
Deterioration of the economic situation of the residents in the municipality and possible migrations	The contractor must, in cooperation with the local office of the Employment Agency of the Republic of Macedonia and other competent state institutions, before the very end of the project, prepare a Plan for renewal of the livelihoods (PRL) for the persons employed in the project who have lost their jobs after Completion of the construction phase of the project. The plan must include measures and programs that will help the person engaged in the construction phase of the project, easier to overcome the period after completion of the project and the state of loss of income in the household on this basis. Such measures may be, for example, assistance in self-employment, retraining, access to finance for opening a business, etc.	***NO. We believe these tasks belong to the Contractor of the construction.***

Residual impacts	Residual impacts are possible.	
Labor and working conditions		
Diseases caused by electromagnetic radiation at the workplace	Regular health control of staff exposed to this type of radiation.	***NO. We believe that in general these assumptions are out of the project scope.***
Residual impacts	Residual impacts are not expected if all measures are implemented.	

RISK FROM ACCIDENTS

Risk of accidents during the construction phase

Risk of incidental leakage of hazardous materials

MITIGATION MEASURE	IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
Preparation and full implementation of the Hazardous Materials Management Plan and leakage control;	***NO. We believe these tasks belong to the Contractor of the construction.***
A warehouse or storage tank for flammable liquids and gases, refueling station, fuel supply station can be built or placed at a site for which the Ministry of the Interior affairs will give prior consent.	***NO. We believe these tasks belong to the Contractor of the construction.***
Construction of a secondary system (tanks) for collection of leachate around storage tanks;	***NO. We believe these tasks belong to the Contractor of the construction.***
Training workers about possible hazards and harmful effects of chemicals / hazardous substances;	***NO. We believe these tasks belong to the Contractor of the construction.***

Preparation of a plan for evacuation and rescue in case of fire, explosion;	***NO. We believe these tasks belong to the Contractor of the construction.***
Possession of appropriate equipment in case of fire, explosion, leakage.	***NO. We believe these tasks belong to the Contractor of the construction.***

Risk of fire / explosion

MITIGATION MEASURES	**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
Preparation of an Fire, Explosions and Hazardous Materials Management Plan in the construction phase;	***NO. We believe these tasks belong to the Contractor of the construction.***
Preparation and application of a notification procedure in case of a state of emergency – fire during the execution of construction works;	***NO. We believe these tasks belong to the Contractor of the construction.***
• Preparation and application of emergency evacuation procedures, including type of evacuation during incidental situations during the construction phase;	***NO. We believe these tasks belong to the Contractor of the construction.***
Training of workers involved in construction activities for fire protection, explosions and hazardous materials;	***NO. We believe these tasks belong to the Contractor of the construction.***
• Setting up adequate equipment for fire extinguishing at the construction site and training of the workers (and supervision) for handling it;	***NO. We believe these tasks belong to the Contractor of the construction.***
To find the location of all underground installations (electricity, water, gas and sewage networks and others) in the preconstructive phase and their drawing on a map (which will be available in a prominent place on the	***NO. We believe these tasks belong to the Contractor of the construction.***

construction site);	
• Designation of the pipeline with signs of occupational health&safety;	***NO. We believe these tasks belong to the Contractor of the construction.***
• Familiarization of all workers, for the exact location of the pipeline;	
• Mechanical excavations by mechanization and storage of building materials and tools must not be carried out near a gas pipeline, that is, within the range of 15 meters from the pipeline;	***NO. We believe these tasks belong to the Contractor of the construction.***

General operational safety of the railway

MEASURES	**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
• proper operation of the station and the intersections of the railway line; • the "infill" function is necessary to be implemented through the balise[97] groups; • These balise groups will be installed 400 m in front of the incoming signals (between warning signals and input signals) and between the input and output signals of the stations; • defining the technical operation of the proposed equipment; • the operation of one track and multi-track sections, which would allow two-way traffic; • the proper functioning of the section, does not depend on the type of: ballast, sleepers and rails; • operation with several levels of adhesion, between the wheel set and the rail and	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***

[97] Balise is a designation (marker) set between the rails, which is part of the European Train Control System

• implementation of all operating modes during the train stop (depending on the type of train).	

Pedestrian safety

MEASURES	**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
• Set clear and prominent warning signs; • Fencing or other barriers to the place where the train station ends to prevent access to trains of unauthorized persons; • Education, especially for young people in terms of the dangers of self-willed crossing; • Use of pedestrian bridges near the crossing point; • Use video surveillance to monitor the train stations and other areas where a train often passes and alarm system to detect wild switches.	***YES.*** ***YES.*** ***NO. We believe that in general these assumptions are out of project scope.*** ***YES. Some roads and pedestrian bridges are proposed in the project.*** ***NO.***

Transport of hazardous materials

MEASURES	**IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY**
• Implementation of a system for proper checking, acceptance and transport of hazardous materials. Since these materials can be transferred from third parties, the checking and acceptance process should be in accordance with the international and national standards for the packaging, marking and labeling of containers, as well as the necessary certificates. • The use of wagon tanks that meet national and international standards appropriate for the loading of hazardous materials; • Preparation of the Hazardous Materials and Leakage Control Management Plan and emergency preparedness plans based on the analysis in case of accidents;	***NO. We believe that in general these assumptions about the railway operation are out of project scope.***

• Preventive and control measures include: - Proper planning of the time of transport of hazardous materials in order to minimize the risk to the community (for example, limiting the transport of hazardous materials to some routes); - Construction of protective barriers and other technical measures (drainage) at sensitive locations (near water resources, settlements, etc.); - Implementation of emergency notification systems and evacuation procedures; • Implementation of the Hazardous Materials and Leakage Control Management Plan, including the provisions for the safety of persons, the prevention of unauthorized access and measures to reduce risks during the storage and transport of hazardous materials; • Using a standardized system for charging a fuel locomotive, including automatic shutdown systems.	

Fires and explosions

MEASURES	IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
• Preparation of Assessment of the threat of natural disasters and other accidents with the Plan for protection and rescue from natural disasters and other accidents. • Monitoring the vegetation along the railway line; • Timely cleaning, as well as other activities to maintain vegetation to avoid the risk of fires during seasons when the risk is high (summer and early autumn); • Planting and managing fire-resistant tree species within, and in the immediate vicinity of the railway. In accordance with the EU Regulation No. 1303/2014, for the technical specifications for interoperability relating to "safety in the railway tunnels" of the railway system in the European Union (TSI), an assessment has been made of	***NO. We believe that in general the following assumptions about the railway operation are out of project scope.*** ***YES. In each tunnel included in the Main Design, has been considered the EU***

the places where firefighting equipment is required. In the following locations, ie tunnels, fire equipment should be installed as follows: • entrance of the tunnel T01; • the exit of the tunnel T04; • entrance of the tunnel T07; • on the exit of the tunnel T08; • the entrance to the tunnel T09; • the exit of tunnel T12; • the entrance and exit of tunnel T13; • the entrance to the tunnel T14; • on the exit of the tunnel T16; • the entrance and exit of the tunnel T19; • the entrance and exit of the tunnel T20; • the exit of the tunnel T21; • on the entrance and exit of the tunnel Deve Bair.	***Regulations about firefighting.***

Measures to protect against earthquakes

MEASURES	IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
• Preparing a plan for evacuation and rescue in the event of an emergency; • Training of employees and preparation of guidelines in case of an earthquake.	***NO. We believe that in general these assumptions are out of project scope.***

Measures for flood protection

MEASURES	IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
• Take measures that are given in the section Hydrology and surface waters; • Regulation and regular cleaning of the beds, especially: Kriva Reka, Toranica River, Kiselichka River and Vetunichka River;	***NO. We believe these tasks belong to the Contractor of the construction.***

• Preparing a plan for evacuation and rescue during the construction phase; • Training all employees for evacuation and rescue.	

Landslide protection measures

MEASURES	IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
• Before starting the construction phase, it is necessary to prepare a Plan for protection against erosion and drifts, which will include: determining the critical points where landslides may occur during the construction and operation phase, the most effective methods for protection from Erosion, the most appropriate measures for drainage, the most effective methods for retention of deposits, etc. • During the construction phase, prepare a plan for evacuation and rescue in the event of an emergency situation and to be familiar with all employees.	***NO. We believe these tasks belong to the Contractor of the construction.***

Emergency Management Guidelines and Action Plan contents

EMERGENCY PLANNING	IMPLEMENTED IN THE MAIN DESIGN (YES/NO), ADDITIONAL COMMENT IF NECESSARY
▪ Assessing what constitutes an "emergency" for the specific operation / work, refers to the dangers listed in the risk assessment in **Table 107, Table 108, Table 109** and an on-site incident plan for dealing with incidents; ▪ Communication, responsibility for emergency evacuation, establishment of a control center; ▪ Set up emergency procedures, including upgrading and revision of the plan, and ▪ Testing the emergency plan scenario.	***NO. We believe these tasks belong to the Contractor of the construction.***

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