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Gap Analysis & ESIA Disclosure Pack

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Volume 1: Environmental and Social Impact Assessment Report

Chapter 13 Soil

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Volume 1: Environmental and Social Impact Assessment Report

Chapter 13 Soil

October 2023

The Infrastructure Project Facility (IPF) is a technical assistance instrument of the Western Balkans Investment Framework (WBIF) which is a joint initiative of the European Union, International Financial Institutions, bilateral donors and the governments of the Western Balkans which supports socio-economic development and EU accession across the Western Balkans through the provision of finance and technical assistance for strategic infrastructure investments. This technical assistance operation is financed with EU funds.

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13 Soil

13.1 Introduction

This chapter reports findings of the assessment of the impacts of the Project to the soil during both the construction and operational phases.

The study area for soil characterisation and assessment includes the surface area covered by the project footprint and the buffer zone of 500 m on each side from the motorway axis that have the potential to be affected directly by the proposed works associated with overland migration of pollutants directly to soil.

The assessment of the Project has been undertaken primary through a desk-based study using available information relating to the existing and land categorisation from the Spatial plan of the Federation BiH, land use according to the Corina Land Cover database and results of laboratory testing of baseline soil quality on samples taken relevant to the location of works. The impacts are assessed analysing the risk of direct impact of construction and operation activities and discharge of pollution in the soil along the motorway.

Where appropriate, this chapter also identified proposed mitigation measures to minimise or control likely adverse effects arising from the project.

This chapter should be read in conjunction with the following chapters:

Chapter 1	Introduction
Chapter 2	About the Project
Chapter 3	Detailed Project description
Chapter 4	Policy, legislative and institutional context
Chapter 5	Assessment methodology
Chapter 8	Surface waters
Chapter 15	Waste and materials management
Chapter 16	Social impact assessment
Chapter 17	Cumulative impacts
Chapter 18	Residual impacts
Chapter 19	ESMP.

13.2 Baseline Conditions

13.2.1 Land categorisation

According to the Spatial Plan of the Republic of BiH (1981-2000), that is currently used in Federation of BiH until the new Spatial Plan is adopted, the land is classified according to three land categories:

- Agro-zone I – highly valuable agricultural land,
- Agro-zone II – medium valuable agricultural land,
- Agro-zone III – least valuable agricultural land.

Based on the Law on Agricultural Land[1], land is according to its quality classified in one of the mentioned categories in the classes from I-VIII where:

- classes I - IV are suitable for agricultural production, they represent arable land with no restrictions or little restrictions for use. This category of land is classified as agricultural land;
- classes V an VI represent the land that can be cultivated if agro-technical measures are implemented. This type of land is used for agricultural production and rarely for the other purposes;
- classes VII i VIII are not suitable for cultivation due to high restrictions to use and high costs for agro-technical measures to enable cultivation. This type of land is used for purposes other than agriculture.

Land categorisation is presented in

Figure 13-1 and Figure 13-2.

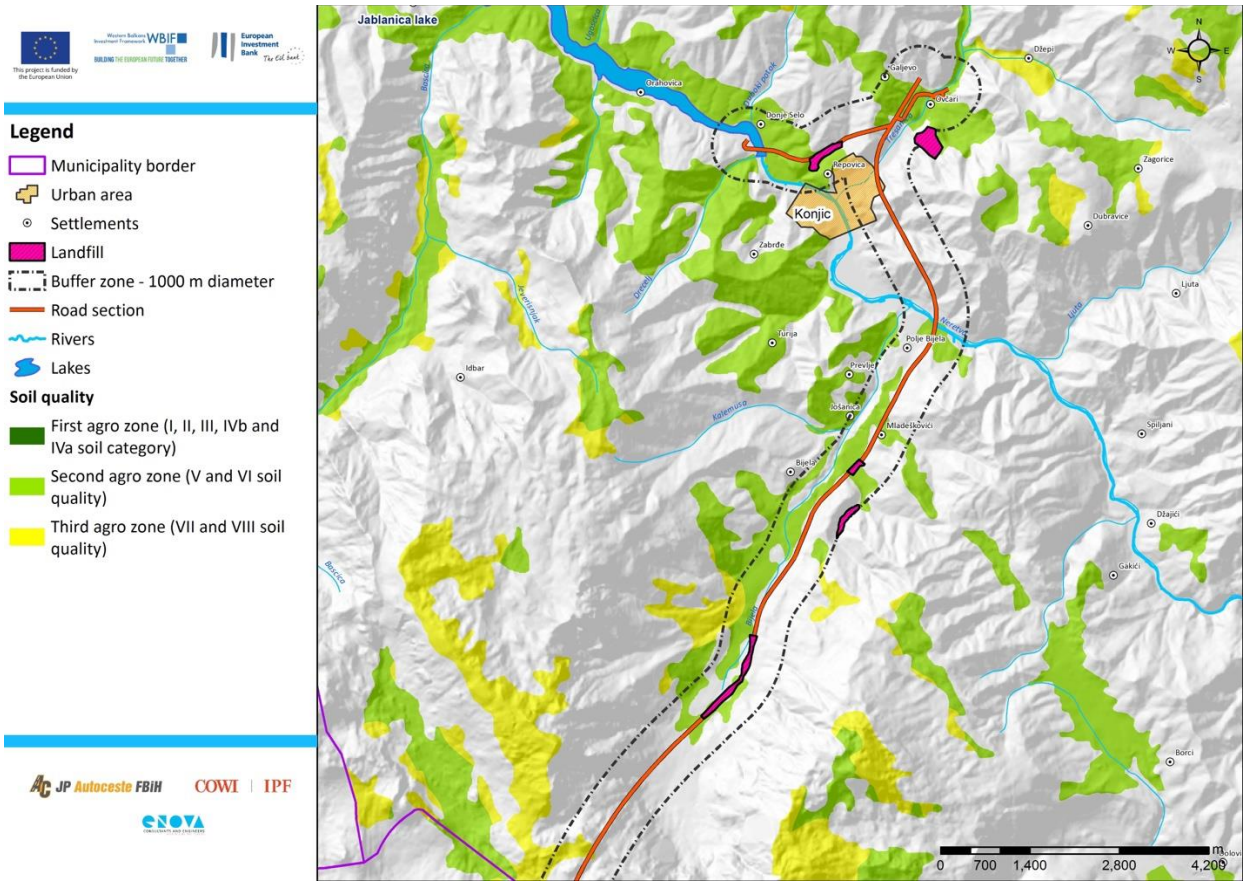

Figure 13-1: Land categorisation in the Project area – Konjic side

[1] Official Gazette of FBiH, no. 52/09

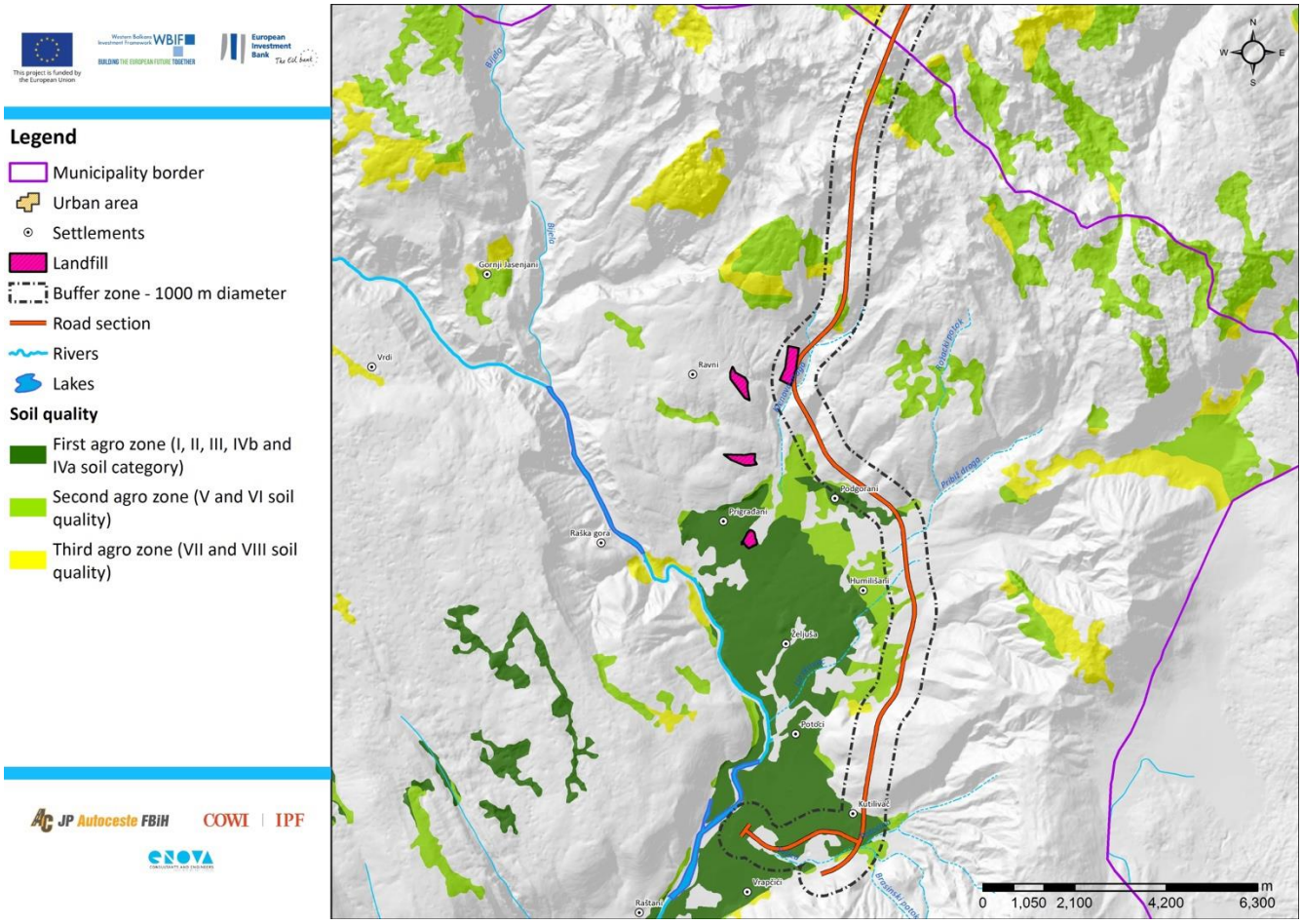

Figure 13-2: Land categorisation in the Project area – Mostar side

As shown in the figure above, the Project area is mostly uncategorized in terms of the soil quality values, except for the part of the route passing through Konjic urban area, area of the Konjic Bypass in the alluvium of Neretva River, and before Mostar North Interchange.

33% of the land covered by the project footprint belong to the first agro-zone with highly valuable agriculture land, 61% of the land belongs to the second agro-zone with medium valuable agriculture land and around 6% to the third agro-zone with least valuable agricultural land.

Table 13-1: Land categories under the project footprint

Land categories	Area (ha)	%
First agro-zone (I, II, III, IVb and IVa class)	364.14	33.2
Second agro-zone (V and VI class)	667.06	61
Third agro-zone (VII and VIII class)	63.50	5.8
TOTAL	**1,082.6**	**100**

13.2.2 Land use

Based on the information obtained from the 2018 Corine Land Cover for BiH the route of main alignment, Konjic Bypass and access roads passes mainly through urban, agricultural, and natural areas (forest). The southern section, after the Prenj Tunnel, is passing close to the area with agricultural land (mostly vineyards).

The land use according to the 2018 Corine Land Cover for BiH for Konjic and Mostar side of the motorway aligment is given in Figure 13-3 and Figure 13-4.

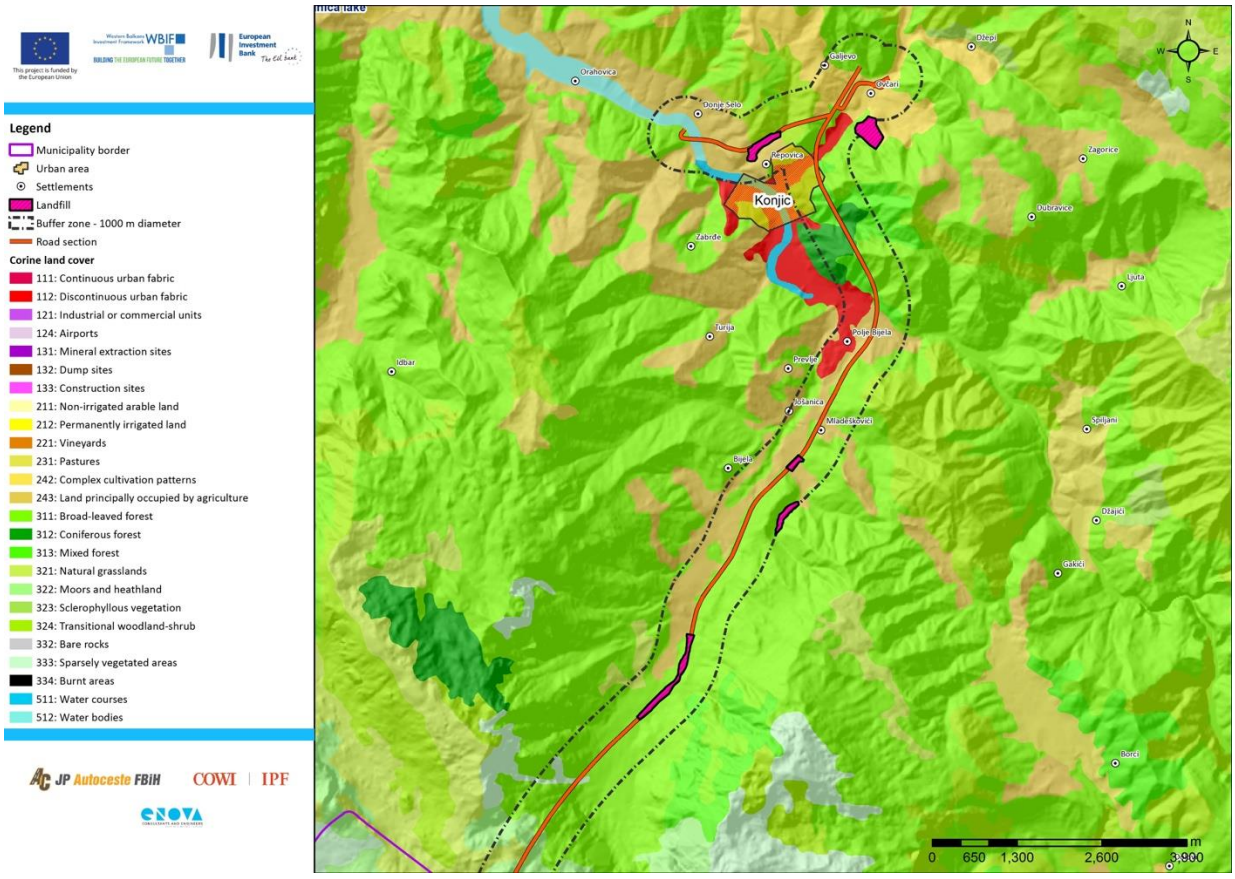

Figure 13-3: Land use on the Konjic side

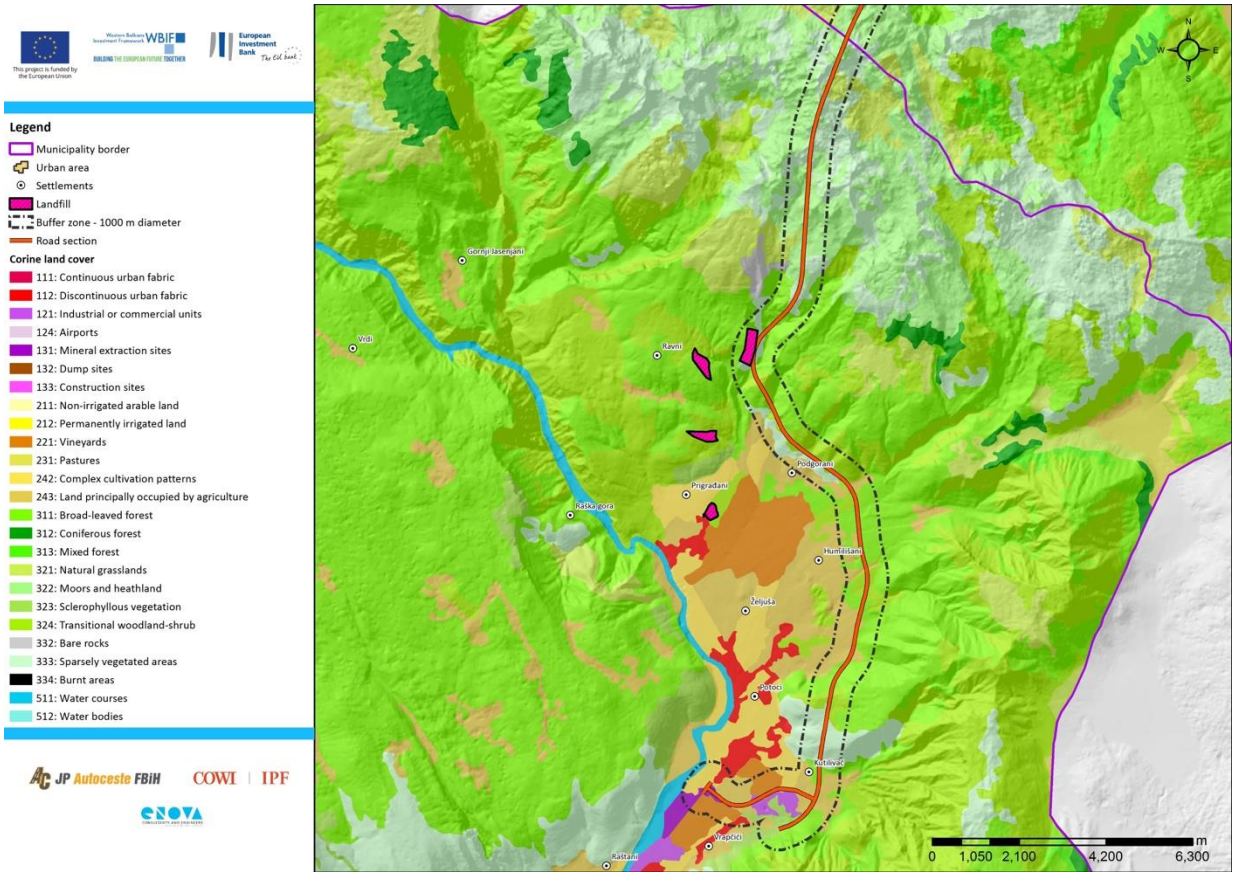

Figure 13-4: Land use on the Mostar side

The tables below give an overview of land categories that will be under impact from construction of motorway structures.

Table 13-2 refers to the land categories occupied by the footprint of main alignment and Konjic Bypass.
Table 13-3 refers to the land occupied by the footprint of access roads. The land occupied by the two footprints is under direct impact and will be permanently lost due to the motorway construction.

Table 13-4 refers to the land occupied by the footprint of spoil disposal sites and will be permanently covered by excess soil from construction.
Table 13-4: Land directly occupied by the spoil disposal sites

No.	Category	Area (ha)	%
1.	112 - Discontinuous urban fabric	0.28	0.37
1 - ARTIFICIAL SURFACES		0.28	0.37
1.	242 - Complex cultivation patterns	1.42	1.90
2.	243 - Land principally occupied by agriculture	0.01	0.02
2 - AGRICULTURAL LAND		1.43	1.92
1.	311 - Broad-leaved forest	44.38	59.52
2.	324 - Transitional woodland-shrub	20.8	26.93
3.	333 - Sparsely vegetated areas	8.40	11.26

No.	Category	Area (ha)	%
3 - FOREST		72.86	97.71
TOTAL		**74.57**	**99.63**

Table 13-5 provides information on the land in the 500 m buffer zone from the motorway and the bypass axis (excluding the footprint) that might be under impact in the construction and operational phase by pollutant release from the motorway area that can impair the soil quality of the buffer.

Table 13-2: Land directly occupied by the main alignment including Konjic Bypass

No.	Category	Area (ha)	%
1.	112 - Discontinuous urban fabric	1.62	1.23
2.	131 - Mineral extraction sites	2.54	1.93
1 - ARTIFICIAL SURFACES		4.16	3.16
1.	221 - Vineyards	1.25	0.95
2.	242 - Complex cultivation patterns	7.51	5.71
3.	243 - Land principally occupied by agriculture	17.65	13.42
2 - AGRICULTURAL LAND		26.41	20.08
1.	311 - Broad-leaved forest	45.36	34.50
2.	312 - Coniferous forest	1.59	1.21
3.	313 - Mixed forest	4.90	3.72
4.	321 - Natural grasslands	2.44	1.85
5.	322 - Moors and heathland	14.63	11.13
6.	323 - Sclerophyllous vegetation	0.51	0.39
7.	324 - Transitional woodland-shrub	15.23	11.58
8.	333 - Sparsely vegetated areas	15.71	11.95
3 - FOREST		100.37	76.33
1.	512 - Water bodies	0.52	0.40
4 - WATER		0.52	0.40
TOTAL		**131.47**	**10**

Table 13-3: Land directly occupied by the 30 m wide access roads

No.	Category	Area (ha)	%
1.	112 - Discontinuous urban fabric	1.33	8.96
1 - ARTIFICIAL SURFACES		1.33	8.96
1.	221 - Vineyards	0.73	4.91
2.	242 - Complex cultivation patterns	1.88	12.69
3.	243 - Land principally occupied by agriculture	7.05	47.55
2 - AGRICULTURAL LAND		9.66	65.14

No.	Category	Area (ha)	%
1.	311 - Broad-leaved forest	3.58	24.12
2.	324 - Transitional woodland-shrub	0.17	1.16
3.	333 - Sparsely vegetated areas	0.09	0.62
3 - FOREST		3.84	25.90
TOTAL		**14.83**	**100**

Table 13-4: Land directly occupied by the spoil disposal sites

No.	Category	Area (ha)	%
1.	112 - Discontinuous urban fabric	0.28	0.37
1 - ARTIFICIAL SURFACES		0.28	0.37
1.	242 - Complex cultivation patterns	1.42	1.90
2.	243 - Land principally occupied by agriculture	0.01	0.02
2 - AGRICULTURAL LAND		1.43	1.92
1.	311 - Broad-leaved forest	44.38	59.52
2.	324 - Transitional woodland-shrub	20.8	26.93
3.	333 - Sparsely vegetated areas	8.40	11.26
3 - FOREST		72.86	97.71
TOTAL		**74.57**	**99.63**

Table 13-5: Land occupied by the buffer zone around motorway and Konjic Bypass (500m from the axis, excluding the footprint)

No	Category	Area (ha)	%
1	112 - Discontinuous urban fabric	97.21	2.32
2	121 - Industrial or commercial units	45.35	1.08
3	131 - Mineral extraction sites	21.58	0.51
1 - ARTIFICAL SURFACES		164.14	3.92
1	221 - Vineyards	78.54	1.87
2	242 - Complex cultivation patterns	164.14	3.72
3	243 - Land principally occupied by agriculture	697.05	16.63
2 - AGRICULTURAL LAND		931.33	22.22
1	311 - Broad-leaved forest	1583.57	37.78
2	312 - Coniferous forest	49.36	1.18
3	313 - Mixed forest	98.02	2.34
4	321 - Natural grasslands	74.47	1.78
5	322 - Moors and heathland	430.89	10.28
6	323 - Sclerophyllous vegetation	42.93	1.02
7	324 - Transitional woodland-shrub	316.44	7.55
8	332 - Bare rocks	3.46	0.08

No	Category	Area (ha)	%
9	333 - Sparsely vegetated areas	460.15	10.98
3 - FOREST		3059.31	72.99
1	511 - Water courses	17.76	0.42
2	512 - Water bodies	18.89	0.45
4 - WATER		36.65	0.87
TOTAL		**4,191.43**	**100**

Almost 76% of the project footprint (motorway and the Konjic Bypass) will be laid down on the forest land and almost 20% on the agricultural land. This percentage exclude the land occupied by tunnel construction since these structures will pass underground. Out of the 100 ha of the forest land, actual forests take up to 40% while the rest are mainly shrubs, bushes, and low growing vegetation. This land will be permanently lost due to the motorway construction. Additional 10 ha of agricultural land and 4 ha of forest will be occupied by access roads. The spoil disposal sites will occupy 1.43 ha of agricultural land and 73 ha of forest land of which 44 ha is the broad-leaved forest. Such distribution of land use is expected since the motorway is passing through rural areas and mountains.

The current use of land will be determined in the framework of the expropriation procedure. Some preliminary information based on the census carried out for the purpose of this project is given in Chapter 16 Social Impacts Assessment.

13.2.3 Soil quality

13.2.3.1 Soil Quality along the Main Motorway Route

The baseline soil quality monitoring was carried out as a part of this assignment on six locations along the Konjic (Ovcari) - Prenj Tunnel - Mostar North subsection. The monitoring was carried out on 16.3.2021 and 1.7.2021 at a depth of 0 to 30 m at the sampling points listed in the Table 13-6. Soil quality monitoring was performed in accordance with the *Rulebook on Determining the Permitted Quantities of Harmful and Dangerous Substances in the Soil and the Methods of Their Testing*[2].

Table 13-6: Description of sampling points

Ordinal number	Description of the SP	Location
SP 1 – Ovcari	Beginning of the route in the vicinity of Ovcari Interchange	N: 43° 40' 13,23" E: 17° 58' 46,43"
SP 2 – Polje Bijela	Next to river Neretva, under the Viaduct No. 4 in Polje Bijela	N: 43° 38' 12,36" E: 17° 58' 46,17"

[2] Official Gazette of FBiH, no. 72/09

Ordinal number	Description of the SP	Location
SP 3 – Bijela	Next to the road R435	N: 43° 37' 26,71" E: 17° 58' 9,66"
SP 4 – Mladeskovici	Village Mladeskovici under the Viaduct	N: 43° 36' 58,37" E:17° 57' 53,23"
SP 5 – Podgorani	Close to the village Podgorani under the Viaduct	N: 43° 27' 48,86" E: 17° 53' 39,14"
SP 6 – R435a	Next to the road R435a towards Rujiste	N: 43° 26' 37,20" E: 17° 54' 41,11"

Figure 13-5: SP1 –Ovcari

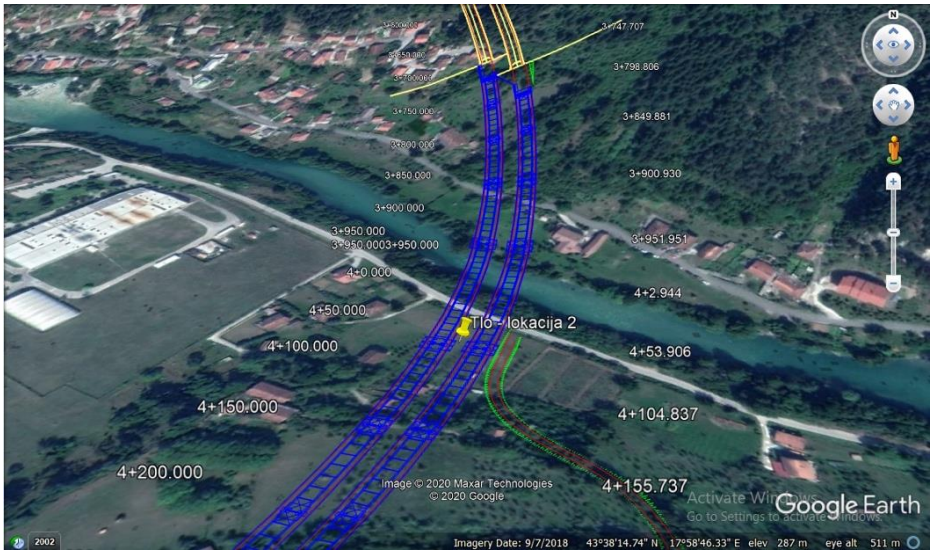

Figure 13-6: SP2 - Polje Bijela

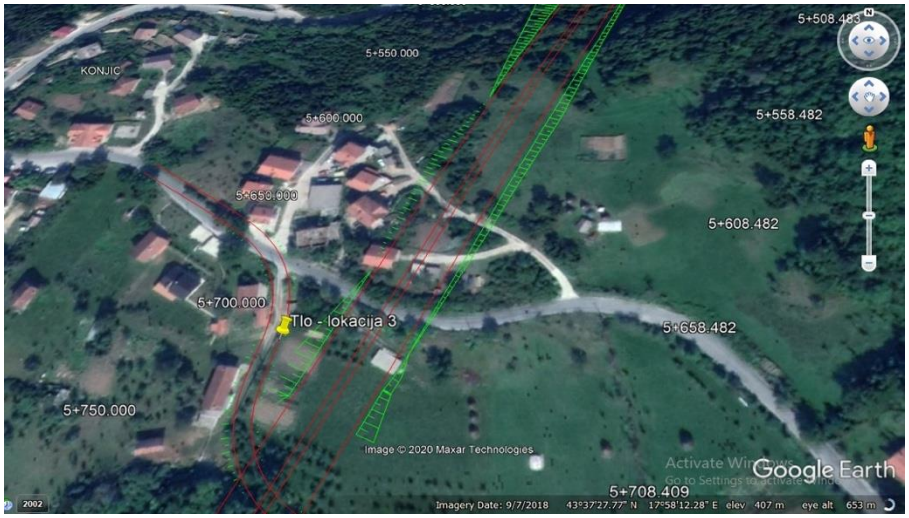

Figure 13-7: SP3 - Bijela

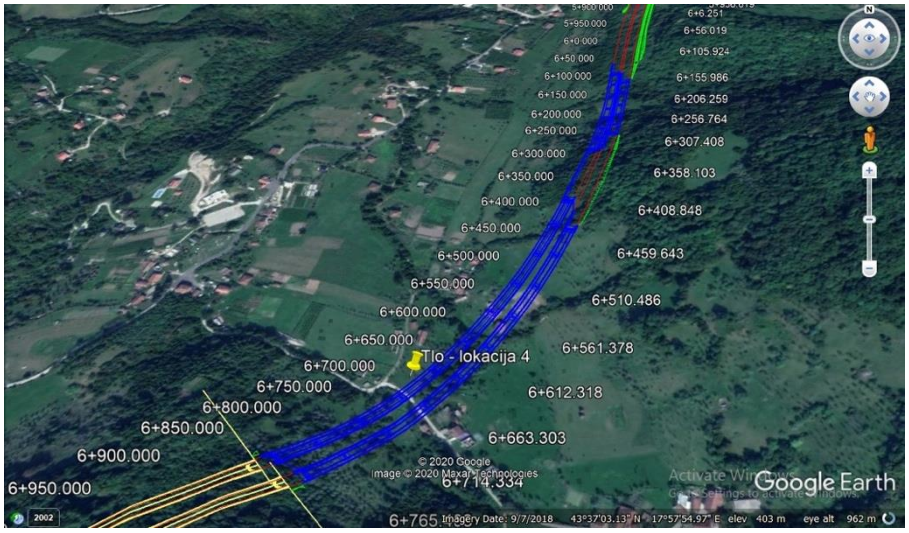

Figure 13-8: SP4 - Madeskovici

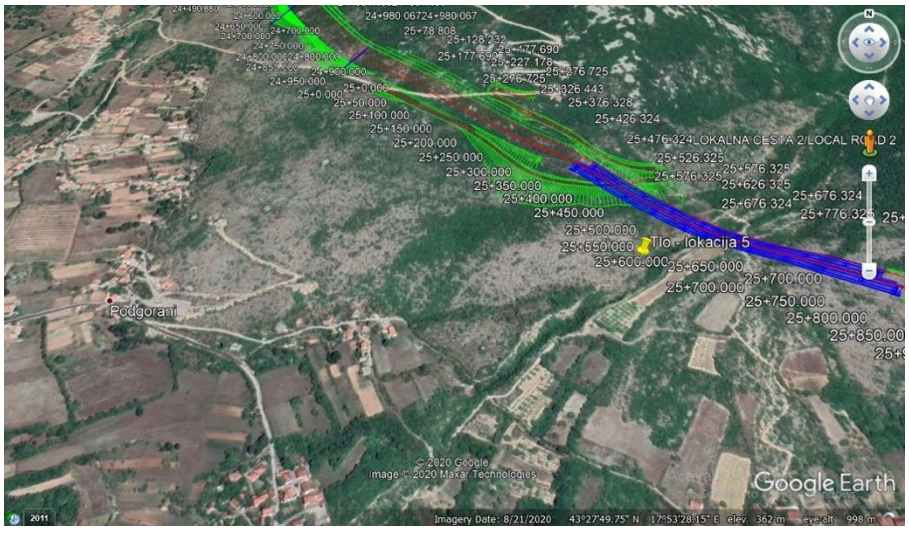

Figure 13-9: SP5 – Podgorani

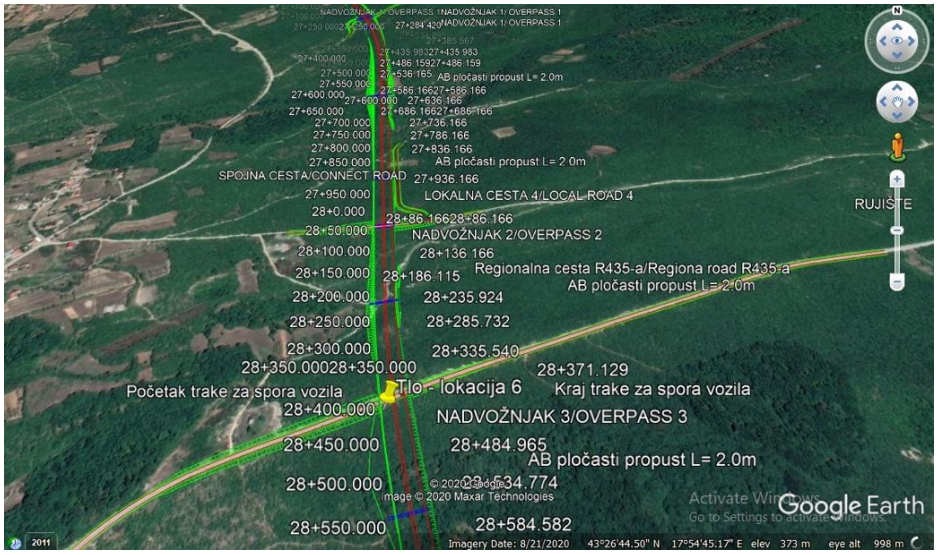

Figure 13-10: SP6 - R435a

SP 1, 3, 4, 5, 6 can be classified as agricultural land. Comparing the content of total forms of heavy metals in the soil sample with the values of the pollutants in agricultural land in accordance with the *Regulation on Determining the Permitted Quantities of Harmful and Dangerous substances in the Soil and the Methods of Their Testing*[3], it was found that the samples at the following sampling points during the winter period do not meet the limit values for agricultural land:

- Zinc in soil sample from SP 3 is **higher than the limit value**,
- Zinc in soil sample from SP 4 is **higher than the limit value**.

At other sampling points, the measured parameters are **below the limit values** stipulated by *Regulation on Determining the Permitted Quantities of Harmful and Dangerous substances in the Soil and the Methods of Their Testing*[4].

During the summer period sampling, it was determined that all measured parameters **meet the limit values** for agricultural land stipulated by the *Regulation*.

SP 2 can be classified as industrial zone. Criteria for soil pollution for industrial areas in Bosnia and Herzegovina do not exist, therefore the limit values of some EU countries are taken as a reference. Compared to land legislation criteria in Germany (BBodSchV, 1999) and Estonia (KKMm RTL, 1999) all measured parameters **meet the limit values** for industrial areas in winter and summer period.

The results of soil quality measurements from six aforementioned locations in March and July are presented in following tables.

[3] Official Gazette of FBiH, no. 72/09
[4] Official Gazette of FBiH, no. 72/09

Table 13-7: Results of the March soil quality measurements along the motorway alignment

Parameter	Standard/Method	Unit	SP1 Results	SP2 Results	SP3 Results	SP4 Results	SP5 Results	SP6 Results
pH in H_2O	BAS ISO 10390:2009		8.22	7.94	8.03	7.72	8.27	8.35
pH in KCl	BAS ISO 10390:2009		7.85	7.61	7.49	7.12	7.86	7.95
Ash	Gravimetric	%	96.85	90.58	93.69	92.05	98.84	97.14
Organic matter	Gravimetric	%	3.15	9.42	6.31	7.95	1.16	2.86
Nitrogen	BAS ISO 11261:2000	%	0.06	0.36	0.27	0.33	0.11	0.08
Phytoavailable P_2O_5	AL-method, FZALP U.5.4.5: from 15.1.2003.	mg/100g	17.04	2.58	2.72	136.16	2.32	1.90
Lead	BAS ISO 11047:2000	mg/kg	61.60	69.47	70.73	95.93	48.80	44.90
Cadmium	BAS ISO 11047:2000	mg/kg	0.678	1.107	0.647	0.256	0.968	0.723
Mercury	BAS ISO 11047:2000	mg/kg	0.02	0.07	0.05	0.11	0.02	0.01
Zinc	BAS ISO 11047:2000	mg/kg	39.00	235.00	200.20	217.00	28.90	53.43
Manganese	BAS ISO 11047:2000	mg/kg	203.50	553.00	784.70	939,50	206.30	126.80
Iron	BAS ISO 11047:2000	%	0.63	9.76	2.39	2.46	0.65	0.53
Cobalt	BAS ISO 11047:2000	mg/kg	14.97	26.70	18.03	19.23	17.57	15.37
Copper	BAS ISO 11047:2000	mg/kg	11.53	128.90	33.00	58.57	13.67	7.80
Chromium	BAS ISO 11047:2000	mg/kg	32.50	814.70	43.70	37.13	48.17	34.50
Nickel	BAS ISO 11047:2000	mg/kg	21.57	118.30	34.80	36.13	28.53	21.00
Total Petrolatum Hydrocarbons (TPH) - light fraction	BAS EN ISO 16703:3013	mg/kg	8.83	1.30	8.32	4.47	3.04	4.81
Total Petrolatum Hydrocarbons (TPH) - heavy fraction	BAS EN ISO 16703:3013	mg/kg	7.64	79.77	2.96	1.44	14.03	1.97
Total Petrolatum Hydrocarbons (TPH)	BAS EN ISO 16703:3013	mg/kg	16.47	81.07	11.28	5.91	17.07	6.78

Table 13-8: Results of the July soil quality measurements along the motorway alignment

Parameter	Standard/Method	Unit	SP1 results	SP2 results	SP3 results	SP4 results	SP5 results	SP6 results
pH in H_2O	BAS ISO 10390:2009		8.02	7.69	7.79	8.01	8.16	8.18
pH in KCl	BAS ISO 10390:2009		7.68	6.87	7.25	7.38	7.64	7.65
Ash	Gravimetric	%	85.90	90.96	84.65	87.61	94.60	92.16
Organic matter	Gravimetric	%	10.30	4.50	9.19	7.88	2.18	2.91
Nitrogen	BAS ISO 11261:2000	%	0.64	0.33	0.73	0.56	0.16	0.25
Phytoavailable P_2O_5	AL-method, FZALP U.5.4.5: from 15.1.2003.	mg/100g	9.57	3.51	8.87	6.98	1.41	0.63
Lead	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	82.07	85.06	50.80	75.87	60.07	51.30
Cadmium	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	0.67	0.61	0.76	0.62	0.73	0.63
Mercury	Direct amalgamation to SMS	mg/kg	0.07	0.04	0.07	0.07	0.03	0.04
Zinc	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	116.20	127.30	147.70	140.50	151.50	70.33
Manganese	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	321.20	1131.8	887.20	806.70	690.80	494.00
Iron	BAS ISO 11047:2000 BAS ISO 11047:2000	%	0.88	1.99	1.88	1.83	1.60	1.59
Cobalt	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	12.40	17.07	14.53	14.13	15.63	14.37
Copper	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	37.77	31.23	33.00	30.13	26.47	15.33
Chromium	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	37.33	41.87	40.73	39.70	56.77	54.13
Nickel	BAS ISO 11047:2000 BAS ISO 11047:2000	mg/kg	43.07	31.50	29.27	29.10	39.23	29.93
Total Petrolatum Hydrocarbons (TPH) - light fraction	BAS EN ISO 16703:3013	mg/kg	0.96	0.62	0.76	0.07	0.23	0.28
Total Petrolatum Hydrocarbons (TPH) - heavy fraction	BAS EN ISO 16703:3013	mg/kg	0.78	1.23	0.70	0.17	not detected	1.37
Total Petrolatum Hydrocarbons (TPH)	BAS EN ISO 16703:3013	mg/kg	1.74	1.85	1.46	0.24	0.23	1.65

13.2.3.2 Soil Quality along the South Connection to the Main Road M17 (Konjic Bypass)

Baseline soil quality monitoring was carried out as a part of this assignment on two locations along the Konjic Bypass. The monitoring was performed on the May 30, 2022, at the sampling points listed in Table 13-9. Soil quality monitoring was performed in accordance with the *Rulebook on Determining the Permitted Quantities of Harmful and Dangerous Substances in the Soil and the Methods of Their Testing*[5]. Based on the location of the test and the proximity of residential buildings for the SP 1 and SP 2, the land can be considered as agricultural.

Table 13-9: Description of sampling points

Ordinal number	Description of the SP	Location
SP 1 – Ovcari	Beginning of the Konjic Bypass in Ovcari	N: 43°40'11.86" E: 17°58'35.90"
SP 2 – near the Konjic landfill	In the settlement near the municipal solid waste landfill site	N: 43°39'38.46" E: 17°57'15.81"

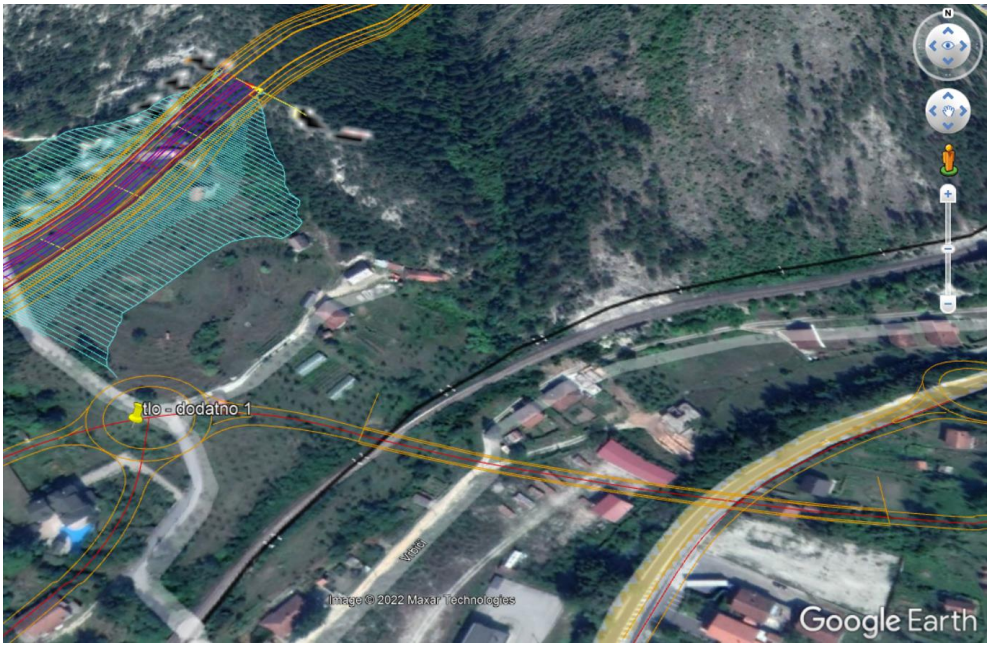

Figure 13-11*: Beginning of the Konjic Bypass in Ovcari*

[5] Official Gazette of FBiH, no. 72/09

Figure 13-12: Settlement near the municipal solid waste landfill site

According to the structure, the soil is powdery-loamy and in accordance with the limit values shown in the *Rulebook*, the tested soil samples **meet the limit values** according to the soil type.

The results of soil quality measurements are presented in the following table.

Table 13-10: Results of soil quality measurements along the Konjic Bypass

Parameters	Method	Unit of Measure	SP1 Results	SP2 Results
pH (H_2O)	BAS ISO 10390:2009	-	8.34	8.16
pH (1.0 M KCl)	BAS ISO 10390:2009	-	7.87	7.84
Organic content – humus	BAS ISO 14235:2003	g/kg	12.3	11.2
Dry matter content	BAS ISO 11465:2000	%	98.6	99.1
Total nitrogen	Modified Kjeldah method BAS ISO 11261:200	mg/kg	0.07	0.07
Total phosphorus	BAS ISO 11263:2002	mg/kg	8.7	11.0
Copper, Cu	BAS ISO 11047:2000	mg/kg	9.8	8.1
Zinc, Zn	BAS ISO 11047:2000	mg/kg	147	79.9
Lead, Pb	BAS ISO 11047:2000	mg/kg	35.3	16.9
Cadmium, Cd	BAS ISO 11047:2000	mg/kg	<2	<2

Parameters	Method	Unit of Measure	SP1 Results	SP2 Results
Nickel, Ni	BAS ISO 11047:2000	mg/kg	<12	<12
Manganese, Mn	BAS ISO 11047:2000	mg/kg	361	187
Iron, Fe	EPA 7000 B:2007	mg/kg	16007	9388
Cobalt, Co	BAS ISO 11047:2000	mg/kg	<12	<12
Chromium, Cr	BAS ISO 11047:2000	mg/kg	<12	<12
Mercury, Hg*	EPA 7474:2007	mg/kg	0.0013	0.0022
Total petrolatum hydrocarbons*	BAS CEN ISO7TS 16558.2:2018	mg/kg	<100	<100

**The method is not covered by accreditation*

13.2.3.3 Soil Quality along the Access Roads to Prenj Tunnel

Baseline soil quality monitoring was performed on May 30, 2022, on three locations along the access roads to Prenj Tunnel (Table 13-11). The monitoring was performed in accordance with the *Rulebook on Determining the Permitted Quantities of Harmful and Dangerous Substances in the Soil and the Methods of Their Testing*[6].

Table 13-11: Description of sampling points along the access roads

Ordinal number	Description of the SP	Location
SP 1 – Bijela	Access road in the settlement Bijela	N: 43°36'16.86" E: 17°56'43.92"
SP 2 – HP Investing site	Access road near the HP Investing industrial site	N: 43°26'40.13" E: 17°51'49.45"
SP 3 – Prigradjani	Access road in the settlement Prigradjani	N: 43°27'39.68" E: 17°52'25.22"

[6] Official Gazette of FBiH, no. 72/09

Figure 13-13: Access Road in the settlement Bijela

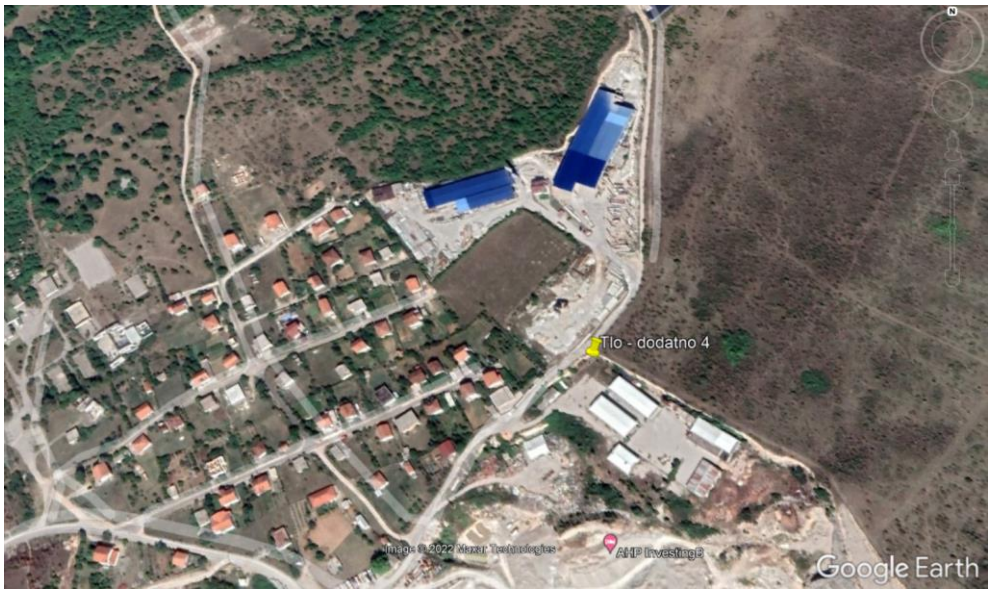

Figure 13-14: Access Road near the HP Investing industrial site

Figure 13-15: Access Road in the settlement Prigradjani

Based on the test locations and surrounding environment, SP 1, SP2, and SP 3 can be considered as agricultural land. According to the structure of the soil samples, the soil is sandy and is evaluated against the limit values given in the Rulebook. All parameters for all three analysed soil samples **meet the limit values** stipulated by the *Rulebook on determination of permitted amounts of harmful and dangerous substances in soil and their testing methods* except for zinc as follows:

- Zinc in soil sample from SP 1 is **higher than the limit value**,
- Zinc in soil sample from SP 2 is **higher than the limit value**.

The results of soil quality measurements from three locations are presented in the following table.

Table 13-12: Results of soil quality measurements along the access roads

Parameters	Method	Unit of Measure	SP1 Results	SP2 Results	SP3 Results
pH (H_2O)	BAS ISO 10390:2009	-	8.23	7.99	8.13
pH (1.0 M KCl)	BAS ISO 10390:2009	-	7.88	7.50	7.79
Organic content – humus	BAS ISO 14235:2003	g/kg	12.2	56.5	21.5
Dry matter content	BAS ISO 11465:2000	%	99.3	96.0	98.8
Total nitrogen	Modified Kjeldah method BAS ISO 11261:200	mg/kg	0.08	0.09	0.07
Total phosphorus	BAS ISO 11263:2002	mg/kg	9.7	9.5	7.6

Parameters	Method	Unit of Measure	SP1 Results	SP2 Results	SP3 Results
Copper, Cu	BAS ISO 11047:2000	mg/kg	<5	17.8	9.5
Zinc, Zn	BAS ISO 11047:2000	mg/kg	107	138	94.3
Lead, Pb	BAS ISO 11047:2000	mg/kg	<15	36.0	<15
Cadmium, Cd	BAS ISO 11047:2000	mg/kg	<2	<2	<2
Nickel, Ni	BAS ISO 11047:2000	mg/kg	<12	26.8	16.8
Manganese, Mn	BAS ISO 11047:2000	mg/kg	257	1180	206
Iron, Fe	EPA 7000 B:2007	mg/kg	8074	26289	10776
Cobalt, Co	BAS ISO 11047:2000	mg/kg	<12	<12	<12
Chromium, Cr	BAS ISO 11047:2000	mg/kg	<12	23.8	<12
Mercury, Hg*	EPA 7474:2007	mg/kg	<0.001	<0.001	<0.001
Total petrolatum hydrocarbons*	BAS CEN ISO7TS 16558.2:2018	mg/kg	<100	<100	<100

**The method is not covered by accreditation*

13.3 Assessment of Potential Impacts

During the construction phase, the main causes of potential negative impact on land and soil quality are:

- nature of construction works (excavation, drilling, tunnelling, etc.),
- presence of construction machines at the site,
- generation of different types of wastes and
- uncontrolled discharge of sanitary waters from workers' camps.

The main possible impacts on land and soil quality in the construction phase are identified to be:

- Occurrence of rockfall along the route regarding terrain type and slope stability. Slope stability may be sensitive by the creation of road cuts or embankments, especially during the works on the viaducts while rockfalls might be an issue during excavation works on the tunnels.
- It is possible, that without adequate protection measures soil erosion could occur on road cuts, road embankments and viaduct embankments.
- Topsoil stripping may bring risks of erosion of exposed ground and increased water runoff and siltation of occasional streams. The use of heavy machinery and equipment, particularly on steep slopes to clear construction corridors may also result in serious compaction or erosion problems. For instance, presence of quarries and borrow sites (the sources for road building materials) if not properly rehabilitated, may cause erosion.
- Damage and/or loss of topsoil may occur in case the topsoil is not removed; mixed with subsoil and/or other material during and after removal. The topsoil not subject to removal may be compacted by heavy vehicles, scattered during transportation to temporary stockpiling site as well as lost by strong wind and water erosion when in stockpiles. The quality of topsoil may deteriorate if the stockpiles are not managed properly.
- Construction equipment (vehicles and equipment for construction) moving around the site may create soil compaction, which may harm the soil's productivity, impair drainage, and increase the risk of flooding. This disruption consists of localized changes in the profile of the soil in the immediate surroundings of the excavations.
- Soil dewatering due to increase in surface runoff (10-20% water loss) and evaporation (60-70% water loss) as a result of removal of vegetation and changes in land slopes.
- Increased risk of localised pollution due to the maintenance of construction vehicles at the site, e.g., lubricants and oil changes, washing of vehicles, etc.
- Localised reduction in soil quality resulting from potential release of wastewater into soil.
- Localised reduction in soil quality resulting from depositing, storing, and handling of municipal and other special waste categories. Workers at the construction site may generate solid and liquid waste as elaborated in Waste Management Plan. Untreated wastes are major sources of pollution

that may disrupt soil quality (e.g., pollutants settling in soil may impair the success of soil organisms, thus increasing the likelihood of erosion.
- Changes in land use from agricultural and forest to construction land.
- Deforestation, in terms of cutting, clearing, and removal of forest or stand of trees where land is converted to a non-forest use.

All potential impacts are localized to the Project footprint area, temporary and limited to the construction phase only.

In norther part of the route, approximately 5 km in the area of Konjicka bijela, the forest land is represented by high forest. The deforestation will take place in the project footprint, therefore reforestation measures using biodiversity metrics must be planned to ensure no net loss. It is assessed that in the operational phase the natural succession will also take place and cause natural reforestation to climatogene vegetation that will ensure ecosystem restoration to a level that will not impair the natural processes.

In southern part of the motorway sub-section, the forest land is represented by hornbeam, oak and shrubs which have character of low shrubby forest and stump forest. Therefore, the natural succession in this area will be faster due to the character of the vegetation but reforestation will also be planned. Reforestation shall be also planned on the access road.

The impact on agricultural land used by local communities in active agriculture production is considered permanent and irreversible due to the land take. Land take will also be assessed in Chapter 16 Social Impact Assessment where appropriate compensation for land users will be planned in line with federal regulations and the 2019 EBRD E&S policy.

The alignment from tunnel Prenj exit on the southern part of the sub-section is extended through the tectonically deep canyon Klenova Draga with traces of intensely glacial erosion. Its cliffs are up to 550,0 m in height.

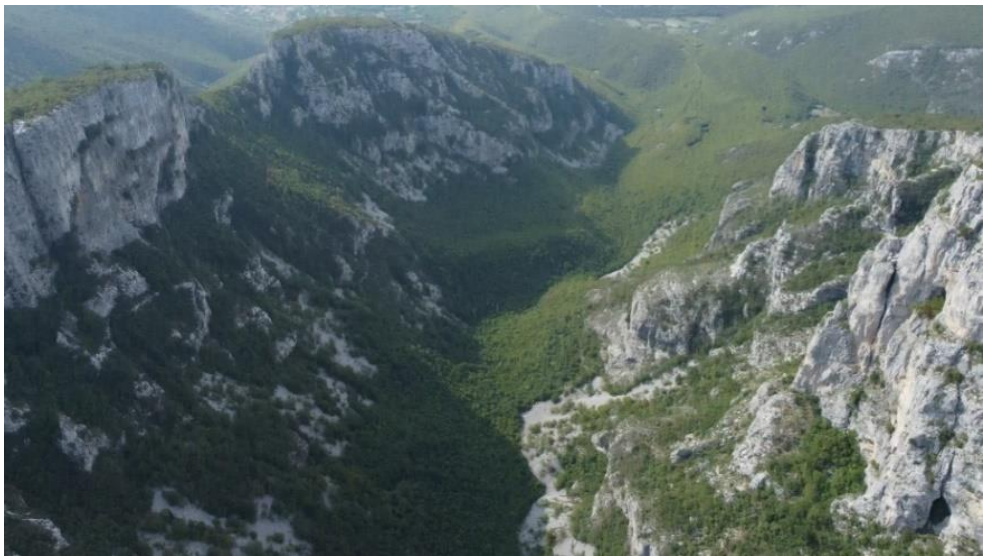

Figure 13-16: View at the Klenova Draga canyon from the tunnel Prenj exit portal direction

The bottom of the canyon is relatively narrow, i.e., 120,0 – 250,0 m wide and it is covered with scree deposits. Scree deposits have a maximum thickness over 30,0 m, with an approximate inclination 45°. Steep rocky slopes are mainly dipping over 70°.

Both rocky sides are tectonically degraded with a high risk of rock fall in case of stronger seismic shocks. As evidence there are localized landslides, especially where the entrance to Gradina tunnel (T4) is planned. Through the whole length of the canyon there is debris flow, active in the very wet periods.

The construction of the Klenova Draga tunnel solves to the greatest extent the issue of the rock fall risk in the zone of the Klenova Draga gorge. However, the embankment that is designed across the Klenova Draga (between exit of Prenj tunnel and entrance of the tunnel Klenova Draga) in a length of about 300 m, is located within sectors 1 and 4, where a medium to high risk has been determined in terms of the stability of the rock mass according to the map of the rock fall risk (available in the geotechnical survey mission G1). Additionally, the access roads to the Prenj Tunnel will be constructed in the Klenova Draga valley.

According to the available data, there are no significant instabilities at the location of the entrance of Klenova Draga tunnel portal.

In order to ascertain and mitigate against any risks, a specific engineering study on rock fall analysis has been proposed and will be carried out in the following stages of design development. The first conclusions from the initial evaluation are summarized below:

- The newly conducted digital elevation model (DEM) gives a more accurate picture of the gorge relief,
- The valley has been formed mainly due to karstification and secondary by stream erosion. This means that the nearly vertical cliffs noted in parts of the valley are eroded caverns. This process results in a far more stable relief than a typical gorge.
- The bottom area of the valley is covered by extended limestone talus materials that work as an extended protective "cushion" against any rock fall from the higher parts of the valley preventing rock bounce.
- At this stage, a few potential instability areas can be identified. These instability areas will be re-evaluated during the fieldwork stage of the rock fall analysis. Up to now, the potential instability points are evaluated as points of no critical risk since there are karstified areas with no favourable joint system at the base of the rock mass to trigger a major rock fall.
- Since the past is the key to the future, no major rock falls are noted on the surface, leading to the assumption that other than the erosional accumulation of small rock fragments no widespread major rockfall has taken place in recent times (by recent we mean 100 to 500 years or more).
- The tree vegetation is extensive in the area that has a significant protective influence.

On the basis of this analysis, the proposal for stabilising the slopes using heavy duty RockFall Protection Fence (RFPF) was given and shall be confirmed with the detailed slope stability/rock fall design calculations that are to follow in the subsequent design stages.

No significant impact on the geomorphology is expected during the operation phase. However, several potential impacts on soil quality in the buffer zone have been identified as a result of:

- precipitation intercepted by the motorway surfaces,
- sanitary waters at the location of toll station,
- movement of vehicles on the motorway,
- accidents on the motorway and
- winter maintenance activities.

The main impacts on land and soil quality in the buffer zone in the operation phase are:

- Reduction in soil quality along the route as a result of emission of air pollutants from traffic, such as $PM_{2.5}$ and PM_{10}, sulphur dioxide, nitrogen oxides, carbon monoxide, and volatile organic compounds (VOC);
- Reduction in soli quality as a result of accidental fuel and oil spills from motor vehicles participating in an accident that may be washed off from road surfaces and enter the soil;
- Reduction in soil quality as a result of use of de-icing agents in road winter maintaining activities, especially on the Konjic side.

These impacts will be manifested in a longer time in comparison to the construction phase where such impacts are expected to be of a temporary character. However, the design and construction of appropriate surface run-off collection and treatment system, as well as development of Spill Response Plan should be enough to mitigate these impacts.

Table 13-13 below provides a summary of impacts and assessment of their significance.

Table 13-13: Summary of potential impacts on land and soil quality and assessment of their significance before mitigation

Phase	Type of potential impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Soil						
Pre-construction	Due to the timespan between preparation of this Study and start of construction works, up-to-date information on soil quality in the	Adverse	Moderate	Medium	**Moderate**	**Significant**

Phase	Type of potential impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
	project area will be needed to determine the baseline conditions					
Pre-construction	Occurrence of rockfall due to instability of terrain and the nature of construction works	Adverse	Minor	High	**Moderate**	**Significant**
Construction	Soil erosion as a result of excavations and use of heavy machinery and equipment	Adverse	Moderate	Medium	**Moderate**	**Significant**
Construction	Deforestation may cause soil erosion Soil dewatering Accidental spills Direct discharge of wastewater from maintenance of construction vehicles at the site and sanitary waters from construction camp Inappropriate waste/spoil disposal	Adverse	Moderate	Medium	**Moderate**	**Significant**
Operation	Direct discharge of surface run-off Accidental fuel and oil spills	Adverse	Moderate	Medium	**Moderate**	**Significant**

Phase	Type of potential impact	Adverse/ Beneficial	Magnitude	Sensitivity	Impact evaluation	Significance (before mitigation)
Operation	Reduction in soil quality resulting from use of de-icing agents	Adverse	Minor	High	**Moderate**	**Not significant**

13.4 Mitigation and Enhancement Measures

13.4.1 Pre-construction Phase

Baseline monitoring

Due to the timespan between preparation of this Study and start of construction works, up-to-date information on soil quality in the project areas will be needed to determine baseline conditions:

- Repeat the analysis of soil quality in the project area, possibly in two seasons (summer and winter). Increase the number of samples if deemed necessary to cover more specific points of interest.

Rockfall analysis

- Carry rockfall analysis and determine position and length of RockFall Protection Fence in the Klenova Draga valley

13.4.2 Construction Phase

Soil erosion

The detailed design of the Project shall incorporate following measures to reduce the likely release of loose material or material with the potential to become loose in-situ:

- Slope stabilisation - including mulching (straw mulching), brushwood mulching, erosion control blankets, soil binders and gravelling
- Retaining walls - to retain loose materials on slopes where it would naturally be held
- Sediment traps and basins - which will intercept and retain sediment-laden runoff
- Drainage channels – which will divert run-off water
- Treatment system – to remove material contained within the run-off water
- Revegetation in line with the Land and Habitat Restoration Plan (LHRP). This plan will be read and implemented in combination with the Topsoil Management Plan and Waste Management Plan. This plan will include measures to increase the stability of loose materials and surfaces which become exposed during construction phase. It will also include measures restoration of the borrow pits and their surroundings, if any, and recultivation of the construction waste landfill.

Loss of fertile topsoil

- Prepare a **Topsoil Management Plan** (TMP). The TMP shall describe topsoil stripping procedures and rules, topsoil stripping depth and volumes, topsoil stripping supervision, transportation and stockpiling requirements, stockpile location, topsoil stockpile design, stockpile management, erosion hazard and erosion control, runoff drainage/diversion, soil protection measures at the storage area, maintenance of the stockpile and topsoil application procedure.
- In the TSMP, provide for the proper removal of the fertile and potentially fertile soil layer, in accordance with the provisions of the *Law on Agricultural Land*, Article 55 (O.G. FBiH, No. 52/09).

Soil contamination by accidental spills, direct discharge of wastewater, and inappropriate waste disposal

- Implement the same measures as under Geology and Groundwater
- Implement the same measures as under Surface Water
- Implement the same measures as under Waste and Materials Management.

All above listed measures including RLRP and TMP to be included in a **Construction Environmental and Social Management Plan** (CESMP)[7] and implemented accordingly.

13.4.3 Operational Phase

Soil contamination by direct discharge of surface run-off without treatment, accidental spills, and use of de-icing agents

In the **Operational Environmental and Social Management Plan** (OESMP) include and implement the following measures:

- maintenance and clean up the drainage system to prevent impact on erosive sliding of the soil or flooding,
- monitoring of slopes, in particular after strong rains for identification of possible traces of erosion,
- implementation of mitigation measures defined for works during road repair/maintenance works,
- analysis of soil for identification of the impact caused by ice breaking salt with subsequent organic amendment and/or amendments to adjust pH or nutrient deficiencies.
- Implement the same measures as under Surface Water.

[7] Construction Environmental and Social Management Plan (CESMP) to be developed as a part of the Construction Site Organization Plan (CSOP), to meet the national requirements in accordance with the national *Decree on Construction Site Organisation, Mandatory Documentation on Construction Site and Construction Work Participants*, as well as the EBRD and EIB E&S requirements. The minimum content is stipulated in the ESAP.