IPSA

INSTITUTE

Bosnia and Herzegovina
Ministry of Transport and Communications

Project title:

"Motorway in Corridor Vc" Preparation of Planning and Study Documentation

Lot no. 2

Environmental Impact Study
Book 01
July 2006

IPSA

INSTITUTE

Bosnia and Herzegovina
Ministry of Transport and Communications

Main project indication

Client:	Bosnia and Herzegovina Ministry of Transport and Communications
Contract no.:	BA-5C-ICB-05-S-04-BOS
Project Title:	“Motorway in Corridor Vc“ Preparation of Planning and Study Documentation
Authorized Representatives of the Client:	Project manager: M.Sc. Namik Kupusović,B.Sc.C.E. Project manager deputy: Božo Blagojević, B.Sc.C.E.
Client's Contact Data:	Tel. (00387 33) 204 620 Fax (00387 33) 668 493 E-mail: mkpbih@bih.net.ba
Leading Consultant	IPSA Institute d.o.o., Put života bb, 71000 Sarajevo, Bosnia and Herzegovina
Authorized Leading Consultant:	Ph.D. Ešref Gačanin,B.Sc.M.E. general manager of IPSA Institute
Contract Manager and Resident Contract Manager- LOT2	Doc.M.Sc. Emir Mašnić,B.Sc.C.E. Ana Handžić, B.Sc.C.E.
Leading Consultant Contact Data:	Tel. (00387 33) 276 320 Fax (00387 33) 276 355 E-mail: ipsage@bih.net.ba
Consultant-Partners:	Institut za hidrotehniku Stjepana Tomića 1, 71000 Sarajevo, B&H Traser Maršala Tita 70, 71000 Sarajevo, B&H DIVEL Tešanjska 5a, 71000 Sarajevo, B&H Zavod za saobraćaj Stjepana Tomića 1, 71000 Sarajevo, B&H IGH d.d. Janka Rakuše 1, 10000 Zagreb, R. Croatia Urbanistički zavod BIH Zelenih beretki 14, 71000 Sarajevo, B&H

PLANNING – STUDY DOCUMENTATION
MOTORWAY IN CORRIDOR Vc

LOT 2: SECTION DOBOJ SOUTH (KARUŠE) – SARAJEVO SOUTH (TARČIN)

ENVIRONMENTAL IMPACT STUDY
PHASE II

SUBPHASE – ENVIRONMENTAL IMPACT STUDY

IPSA Institute, Sarajevo

Sarajevo, July 2006

IPSA

INSTITUTE

Bosnia and Herzegovina
Ministry of Transport and Communications

CLIENT: **MINISTRY OF COMMUNICATIONS AND TRANSPORT OF BOSNIA AND HERZEGOVINA**

AUTHORISED REPRESENTATIVE OF THE CONSULTANT: **IPSA INSTITUTE, SARAJEVO**

LOT 2: SECTION DOBOJ SOUTH (KARUŠE) – SARAJEVO SOUTH (TARČIN)

ENVIRONMENTAL IMPACT STUDY - PHASE II

SUBPHASE – ENVIRONMENTAL IMPACT STUDY

CONSULTANTS: **IPSA, Sarajevo**

GROUPE COORDINATOR: Ph.D. Aleksandar Knežević, B.Sc.Mech.Eng.
COORDINATORS: M.Sc. Amir Fejzić, B.Sc.Tr.Eng.

EXPERT TEAM:
Ph.D. Husnija Resulović, B.Sc. Agriculture
Ph.D. Tatjana Lj. Mijatović, B.Sc.Agriculture
Ph.D. Faruk Mekić, B.Sc. Forestry
Ph.D. Amra Hadžimuhamedović, B.Sc.Arch.
Ph.D. Sadbera Trožić-Borovac, B.Sc.Biology
Doc. Ph.D. Esad Mulavdić, B.Sc.C.Eng.
M.Sc. Amir Fejzić, B.Sc.Tr.Eng.
M.Sc. Esad Bukalo, B.Sc.Agriculture
M.Sc. Sanda Midžić, B.Sc.C.Eng.
M.Sc. Nusret Dreković, B.Sc.Geography
Dragana Selmanagić B.Sc.C.Eng.
Saša Džumhur, B.Sc.Tr.Eng.
Sabina Hadžiahmetović, B.Sc.C.Eng.
Vukašin Balta, B.Sc.Geology
Jasmina Čomić, B.Sc.Chemistry
Azrudin Husika, B.Sc.Mech.Eng.
Azra Švrakić, B.Sc.Biology
Željko Majstorović, B.Sc.Physics
Nedžad Voljevica, B.Sc.Agronomy
Dženan Zulum, Prof. of Geography
Slavica Jovanović, Senior Meteo Technician
Muharem Čatović, Meteo Technician
Amra Krehić, Meteo Technician

IPSA

INSTITUTE

Bosnia and Herzegovina
Ministry of Transport and Communications

ENVIRONMENTAL STUDY IMPACT

Project leader: Doc. M.Sc. Emir Mašnić

Responsible designer Ph.D. Aleksandar Knežević

Director:

Ph.D. Ešref Gačanin

Sarajevo, July 2006

CONTENTS:

Review of tables in the text:

Review of Illustrations in the text:

1. NON-TECHNICAL SUMMARY

Description of the route and future motorway basic elements

Planned route of the Corridor Vc motorway leads within LOT2 through municipalities Usora, Tešanj, Maglaj, Žepče, Zenica and Kakanj in Zenica Doboj canton. In Sarajevo canton it leads through municipalities Ilidža (from Vlakovo) and Hadžići (to Tarčin). In Srednja Bosna canton chosen route leads through Kiseljak municipality. Section Kakanj-Vlakovo (45km) is not the subject of this study, as it is currently under construction.

Motorway route is conditioned with area planning for this area. Area plans in Bosnia and Herzegovina were made after the adoption of Area Plan for Bosnia and Herzegovina for 1981-2000. Routes of European motorways (E 73, E 661, E 761 and E 762) were set within the Area plan of Bosnia and Herzegovina. A remark was made that special attention must be paid to the environment protection in municipality zonal plans and town planning documents along the route of trans-European motorway North-South, corresponding to E 73 road that which leads through valleys of rivers Neretva and Bosna.

Area plan of Bosnia and Herzegovina for 1981 – 2000 published in Official Gazette, no. 33/88, differs in the sense of motorway route positioning determined with Draft Plan from 1982. Hence the planned and allocated motorway routes in Zonal plans for municipalities Tešanj and Ilidža, and in Decision on spatial allocation for motorway corridor for municipality Kiseljak differ from adopted Area Plan B&H text, but correspond to planned motorway route or variant solution for motorways in Draft Plan.

Total length of the route within lot 2– Sarajevo south (Tarčin) is approx. 145km and is divided into 4 sectors as follows:

- Karuše-Donja Gračanica,
- Donja Gračanica-Kakanj,
- Kakanj-Vlakovo, and
- Vlakovo-Tarčin.

Sectors are divided into 8 sections;

Section 1. Karuše – Medakovo (chainage km 0+000 do 4+000)
Section 2. Medakovo - Ozimica (chainage km 4+000 do 24+876,440)
Section 3. Ozimica – Poprikuše (chainage km 24+876,440 do 38+617,434)
Section 4. Section Poprikuše – Nemila (chainage km 38+617,434 do 46+388,80)
Section 5. Nemila – Donja Gračanica (chainage km 46+388,80 do 58+434,599)
Section 6. Donja Gračanica – Drivuša (chainage km 58+434,599 do 66+959,592)
Section 7. Drivuša – Kakanj (chainage km 66+959,59 do 82+595,000)
Section 8. Blažuj – Tarčin[1] (chainage km 0+000 do 19+100)

Position of the route in relation to the settlements is shown at Illustration1.1.

[1] Within some analysis divided into sub-sections 8a Blažuj-Vlakovo and 8b Vlakovo-Tarčin.

Illustration 1.1: Position of the route in relation to the settlements

Struktura naselja u području uz izabranu trasu autoceste na Koridoru Vc - LOT2

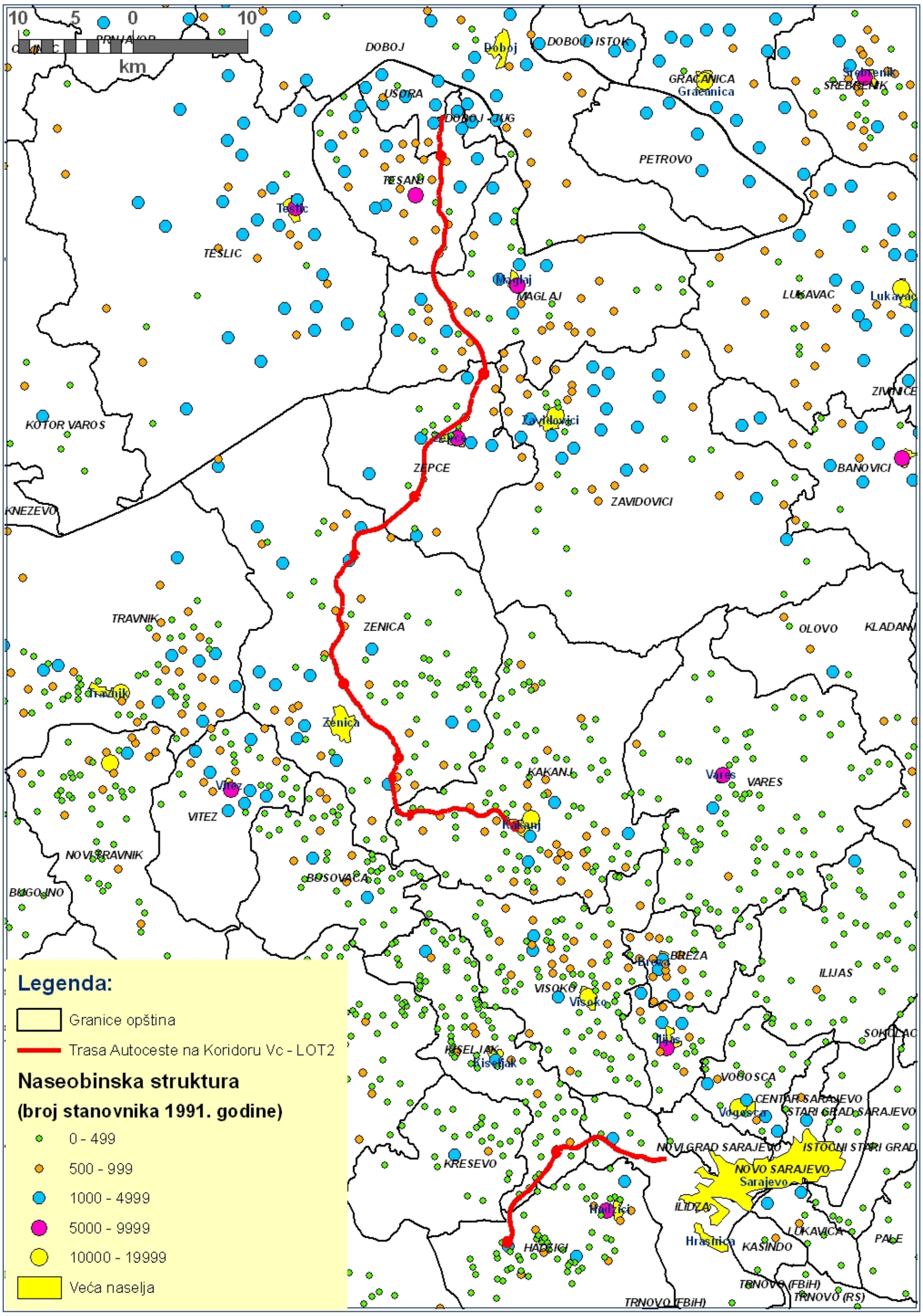


Table 1.1. shows main characteristics of the motorway sections within LOT 2.

Terrain of the motorway route in Lot2 Karuše – Sarajevo south (Tarčin) represents rugged land from the aspect of relief-morphological characteristics. Interchange Karuše is designed at the crossroad with road M4 Doboj – Teslić. City of Teslić and other surrounding settlements are connected to motorway through this interchange. Part of road between Rudanka and Karuše contains 32,8% of bridges and tunnels out of total section length with average elevation of 165m above sea level.

Further, runs along River Tešanjka and Trebačka to the notch Crni vrh where tunnel L=2.605m is planned. On this part of motorway maximum gradient equals i_{max}=1,5% for the length of 1.401m while inside tunnel gradient equals i_t=3% and is one-sided. Gradient of alignment is constant. Maximum curve radius is R_{min}=800m.

From Crni vrh notch or km14+181 route follows Stupanjska river or Stupanjski potok with constant inclination until km 23+641 of i_{max}= 3,5% in a length of 1.875m. Minimum radius of a horizontal curve is R_{min}=1.700m. From km23+641 to km27+200 alignment has a gradient i_{max}= 3,5% in a length of a 2.038m and with R_{min}=950m. After this, motorway enters vary narrow valley of River Bosna and runs along it to Kakanj.

From km27+200 to Donja Gračanica km58+037, motorway is positioned on very unfavorable terrain, which requires construction of numerous structures and tunnels (8 tunnels longer than 500m and two bridges, l=432m and 465m). Due to better adjustment to terrain, the alignment is not continuous. Maximum gradient is 3,96%/1.360m, with minimum radius R_{min}= 650m of a vertical curve.

Continuing from Donja Gračanica, route passes around city Zenica, elevating to maximum of 464m above sea level, reaching point 150m higher than the city. Maximum gradient of alignment is i_{max}=4%/3.602m, with R_{min}=1.000m and R_{vmin}=22.500m. Because of population density and unfavorable topographic conditions extensive roadbed insurances on this part of route will be required.

Part of route from Drivuša to Kakanj will be made by enlargement and transformation of road M17 into a motorway in total length except for tunnel Vijenac L=2.964m in Lašva valley. Alignment is very favorable i_{max}=2% and R_{vmin}=50.000m. This part of the route with exceptional curve radius of 450-550m (four times) is kept as original built M17. Enlargement of M17 road is two sided: emergency stopping lane is attached to a left side, while complete right half of motorway is attached to a right side of the existing road.

As shown in a Figure 1.1, part of route from Rudanka to Kakanj is characterized by numerous bridges and tunnels in particular the parts between interchanges Ozimica – Poprikuše (59,74%), and Nemila-Gračanica (58,86%), and part of route between two Lašvanske half-interchanges (87,19%).

At sector Vlakovo - Tarčin, route must be connected to a Sarajevo bypass at interchange to Blažuj in Vlakovo. This was taken into consideration when making preliminary solution, although the designed route start was moved closer towards Tarčin for 2,2km. Preliminary design should consider missing part of route as well as interchange Vlakovo. In this sector as well, route is placed on a terrain with very unfavorable topographic conditions resulting in high percentage of bridges and tunnels in total length of route: between interchanges Vlakovo-Lepenica 39,87%, and between Lepenica-Tarčin 58,35%.

Table 1. Technical parameters of proposed route sections in sector Karuše-Sarajevo south (Tarčin)

Section No.	Sector (with sections between interchanges)	Length (from km - to km)	Route length (km)	Average alignment gradient (%)	Curve Sa/L (°/km)	Σ Bridges (km)	Σ Tunnels (km)	R_{min}	Average alignment elevation	Percentage of bridges and tunnels in total route length (%)
1	Karuše-Medakovo	63+112-63+963 0+000-3+527	4,378	0,45	20,28	0,743	0,245	750	172	22,57
2	Medakovo-Ozimica	3+527-24+388	20,861	1,82	25,88	1,916	2,605	800	270	21,67
3	Ozimica-Poprikuše	24+388-37+400	13,012	1,59	27,81	2,268	5,505	950	276	59,74
4	Poprikuše-Nemila	37+400-45+428	8,028	0,42	28,76	0,900	4,580	900	283	68,26
5	Nemila-Donja Gračanica	45+428-58+037	12,609	1,53	43,89	2,532	4,890	750	357	58,86
Sector Karuše-Donja Gračanica		**63+112-63+963 0+000-58+037**	**58,888**			**8,359**	**17,825**			**44,46**
6	Donja Gračanica-Drivuša	58+037-66+385	8,348	2,66	30,09	1,75	2,050	1.100	420	45,52
7	Drivuša-Lašva 2	66+385-68+356	1,971	0,45	43,94	0,000	0,000	730	336	0,00
8	Lašva 2-Lašva 1	68+365-72+237	3,881	1,43	21,22	0,420	2,964	900	368	87,19
9	Lašva 1-Kakanj[2]	72+237-81+608	9,371	0,25	44,82	0,390	0,000	450	371	4,16
Sector Donja Gračanica-Kakanj		**58+037-81+608**	**23,571**			**2,560**	**5,014**			**32,13**
10	Vlakovo-Lepenica[3]	0+000-7+360	7,360	2,00	27,24	0,739	2,195	750	571	39,86
11	Lepenica-Tarčin	7+360-16+897	9,537	1,44	16,28	1,765	3,800	1.000	599	58,35
Sector Vlakovo-Tarčin		**0+000-16+897**	**16,897**			**2,504**	**5,995**			**50,30**

Source: Pre-Feasibility Study – LOT 5

[2] The end of sector is 985,5m away from interchange Kakanj
[3] Start of sector is 2,2km away from interchange Vlakovo

Basic technical data:

- Designing standards: TEM standards.
- Motorway is designed with 2x2 traffic lanes in a cross section, each 3,75m wide; 2x1 emergency stopping lane 2,50m wide; and shoulders 2,00m wide.
- Curve and height parameters depend on terrain configuration with extreme values according to TEM standards.

Nine interchanges at locations Medakovo, Ozimica, Poprikuše, Nemila, D.Gračanica, Perin Han, Janjići, Dolipolje, Lepenica are designed.

Five rest areas at locations Tugovići, Strupina, Dujmovići, Bilješevo and Lepenica are designed.

Two maintenance centers are also designed at locations „Crni vrh“ and Zenica south.

Methodology of making Environmental Impact Study

In accordance with laws in force in FB&H from 2003 and general practice, environmental analyses for more complex structures are made at two levels:

- Initial estimate of environmental impacts made by ministry in charge and on the basis of a documentation prepared for previous estimate, and
- Issuing of permit on impacts on environment by ministry in charge on the basis of Terms of Reference made by Ministry and Study on environmental impacts on the basis of the Terms of Reference.

Initial estimate of environmental impacts was completed in June/July 2005, on the basis of Documentation submitted to the Investor by designer on April 15, 2005. Although the purpose of Initial estimate was only:

- Monitoring of state of environment in the proposed corridor area,
- Identification of potential alterations of environment and potential loss of environmental qualities,
- Identification of those impacts, which must be avoided at all costs because of legal requirements or the preservation of prominent natural and cultural heritage,

Analyses of alternate motorway routes, as a basis for public debate and Ministry expertise were done in a scope of this activity. Consequently, two routes which satisfied requirements have been selected:

- Areas where route cannot be laid are avoided (prohibited areas, occupied areas, areas with particularly valuable content)
- Areas with valuable content were avoided as much as possible (for example – arable land), and
- Measures for impact decreasing on the chosen route were identified.

By this:

- Analyses were made within the scope of Initial estimate documentation are:
  - Impact the route might have to the surrounding
- Analyses that are now being finalized, within the Study on environmental impacts are:
  - Regarding motorway construction (construction-site organization, mechanization organization, impacts from mechanization, manipulation with construction material, borrowing and disposal area...),
  - Regarding traffic (prevention of noise, air and water pollution) and
  - Regarding management and motorway maintenance (impact monitoring, cleaning of water purification filters).

Documentation for Initial estimate of environmental impacts and Study of environmental impacts were done simultaneously by three groups of experts:

- Ecologists (experts for water and air, soil, bio-diversity, cultural heritage, landscaping),
- Area and economic growth planners, and
- Designers (including geologists, seismologists and hydrologists)

Each of theses expert groups analyzed properties of the wider corridor area in relation to their subject of expertise, and pinpointed sensitivities for the area considering construction and exploitation of the motorway (whether their expertise strictly forbids construction of motorway at micro location in question, whether the construction can be conducted as final alternative when there is no other solution, and whether it is acceptable with certain restrictions or whether it can be conducted without restrictions). Each expert group made their map of restrictions concerning space consumption, and each request was analyzed by experts from all three groups.
This knowledge was the basis for Initial estimate of environmental impacts on the surrounding. At later stage, when the opinions from the Ministry and citizens were collected at public debates it represented basis for Study of Environmental Impact. The difference of making Study of environmental impacts from activities related to collecting documentation for Initial estimate where motorway route was chosen and where conflicts in space were avoided or minimized was such that at this stage all necessary measures were undertaken in order to really achieve avoidance and minimization of impacts.

Soil and agricultural land

Participation of some soil types in Motorway Corridor Vc for LOT-2 in zone of 500 m is given in hectares and percentages:

- Lithosols	21,7 ha	0,4 %
- Calcomelanosol	67,6 ha	1,4 %
- Rendzinas	40,6 ha	8,3 %
- Rankers	79,1 ha	1,6 %
- Vertisols	111,3 ha	2,3 %
- Calcocambisols	25,7 ha	0,5 %
- Eutric Cambisols	1.384,7 ha	28,5 %
- Dystric Cambisols	1.213,1 ha	24,9 %
- Luvisols	465,4 ha	9,6 %
- Pseudogley	163,5 ha	3,4 %
- Fluvisols	928,6 ha	19,1 %
Total	4.867,1 ha	100,0 %

At complete route, Eutric Cambisol is present the most with 1.384,70 ha or 28,50 %, and the smallest quantity belongs to Litosol with 21,7 ha or 0,4 %.

Land types represented within the corridor of the Vc motorway alignment for LOT-2 in the zone of 500 m, are shown in hectares and in percentages:

- Agricultural land	1.968,7 ha	39,1 %
- Forest land	1.134,1 ha	22,5 %
- Developed land	488,5 ha	9,7 %
- Water courses	185,0 ha	3,7 %
- Other (tunnels)	1.252,5 ha	25,0 %
Total	5.027,7 ha	100,0 %

For the whole motorway alignment the prevailing type of land is agricultural land with 1.968,7 ha or 39,1 %, while water courses are represented only with 185,0 ha or 3,7 %.

Agricultural soils represented with regards to the utilization categories within the corridor of the Vc motorway alignment for LOT-2 in the zone of 500 m, are shown in hectares and in percentages:

- Arable soil	1.625,0 ha	82,6 %
- Orchards	61,7 ha	3,1 %
- Meadows	232,7 ha	11,8 %
- Pastures	35,8 ha	1,8 %
- Barren land	13,5 ha	0,7 %
Total	1.968,7 ha	100,0 %

For the whole motorway alignment the prevailing type of agricultural soil is arable soil with 1.625,0 ha or 82,6 %, while barren land is represented with 13,5 ha or 0,7 %.

Soils with different agricultural quality classes represented within the corridor of the Vc motorway alignment for LOT-2 in the zone of 500 m, are shown in hectares and in percentages:

- I	2,1 ha	0,1 %
- II	590,8 ha	30,0 %
- III	482,7 ha	24,5 %
- IVa	79,8 ha	4,1 %
- IVb	474,7 ha	24,1 %
- V	165,1 ha	8,4 %
- VI	126,2 ha	6,4 %
- VII	26,5 ha	1,3 %
- VIII	20,7 ha	1,1 %
Total	1.968,7 ha	100,0 %

For the whole motorway alignment the prevailing type of agricultural land represented the most is the soil with agricultural quality class II with 590,8 ha or 30,0 %, while the soil with agricultural quality class I is represented with 2,1 ha or 0,1 %.

Arable soil with different quality classes represented within the corridor of the Vc motorway alignment for LOT-2 in the zone of 50 m, are shown in hectares and in percentages:

- I	0,1 ha	0,0 %
- II	89,0 ha	39,8 %
- III	48,3 ha	21,6 %
- IVa	6,1 ha	2,8 %
- IVb	41,2 ha	18,4 %
- V	23,0 ha	10,3 %
- VI	11,7 ha	5,2 %
- VII	3,3 ha	1,5 %
- VIII	0,7 ha	0,4 %
Total	223,6 ha	100,0 %

For the whole motorway alignment the prevailing type of arable soil is Class II quality arable soil with 89,0 ha or 39,8 %, while the arable soil of Class I quality is represented with 0,1 ha or 0,04%.

Agro-zones of agricultural land represented within the corridor of the Vc motorway alignment for LOT-2 in the zone of 500 m, are shown in hectares and in percentages:

- First agro-zone	1.630,0 ha	82,8 %
- Second agro-zone	291,5 ha	14,8 %
- Third agro-zone	47,1 ha	2,4 %
Total	1.968,7 ha	100,0 %

For the whole motorway alignment the prevailing agro-zone is the First agro-zone with 1.632,5 ha or 82,8 %, while the Third agro-zone is represented with 47,1 ha or 2,4 %.

Impacts on soils and agricultural land

Impacts caused by construction of the motorway have been studied with regards to two aspects:

- The construction phase (direct impacts)
- The operational phase (indirect impacts)

During the construction phase there will be physical destruction of soils, i.e. permanent loss of soils, degradation of soils (erosion, losses of water courses, compaction and structure damaging), temporary occupation of areas (waste areas, construction sites, warehouses, quarries and similar), contamination of soil (oil, lubricants and fuel spillage), prevention of access to the agricultural land lots.

Permanent loss of soils: The construction of the motorway will result in physical destruction of soil due to construction of the motorway body itself as well as accompanying motorway services within the motorway corridor. These losses refer to construction of motorway lanes and central and side reserves, interchanges and toll collection facilities, shoulders and embankments, drainage structures and water treatment facilities, drainage culverts and channels, rest areas, parking lots, petrol stations, hotels, restaurants and tourist areas, prevention and safety facilities, maintenance and other necessary facilities.

Soil degradation: Utilization of access roads and marking of the alignment for construction of the motorway will result in degradation of soil such as erosion caused by removal of vegetation and by cuttings, and in significant effects with respect to groundwater flows due to collecting of drain waters, damaging of soil structure and compaction of soil due to passing of heavy machinery over the arable land.

Temporary occupation of certain areas: Some of the areas are going to be occupied temporarily for construction of various structures, utilization of soil and construction materials. This is going to reflect in construction of site facilities such as temporary residential area, parking lots, warehouses and storage areas and similar, as well as establishing of waste areas for depositing of removed soil material and quarries for obtaining of construction material for embankments.

Soil pollution: During construction of the motorway while using the construction machines and various means for transportation of construction materials, as well as machines for installation of such materials there is a possibility of soil pollution due to spilling of oil, lubricants and fuel. The consequence of such spilling is contamination of soil by organic pollutants (light and heavy fractions of hydrocarbons) and heavy metals (lead (Pb), zinc (Zn) and cadmium (Cd)).

Prevention of free access to the lots of arable land: In certain phases of construction some of the access roads to the arable land are going to be cut off which will prevent their normal usage.

As a consequence some of the farmers may be faced with increased transportation costs of their products or with impossibility to apply adequate agro-technical measures in their fields. This primarily happens during construction of the alignment, i.e. by cutting of slopes and building of embankments, regulation of river beds or smaller water courses, construction of tunnels, bridges and viaducts as well as during construction of temporary structures and facilities.

During the phase of the motorway operation there will be processes of contamination and degradation of soils, crops and vegetation.

Soil contamination: During the phase of motorway operation due to participation of increased number of vehicles and their increased speeds, the soil will become more contaminated due to exhaust gases, wearing of tires and road maintenance activities. The consequence is pollution of soil by organic pollutants (light and heavy hydrocarbons), heavy metals (lead, zinc and cadmium) as well as by sodium chloride (used in winter period to prevent ice on the pavement). The process of soil pollution during the motorway operational phase is going to be more intensive and will last for a longer time period, which can lead to contamination of vegetation and crops. It will especially affect agricultural products such as fruits and vegetables (salad, spinach, onions and similar).

Degradation of soil and crops: Incident situations, such as traffic accidents leading to turning over or skidding of the vehicles into the surrounding agricultural or forest land, especially when heavy vehicles or trucks with trailers are involved, can lead to compaction or damaging of soil structure, damaging or total destruction of crops, damaging of infrastructure (safety barriers, fencing, poles, railings, etc.) as well as demolishing of equipment, irrigation and drainage systems (pipes, channels and similar).

Mitigation measures for soil and agricultural land impacts

System of measures for mitigation of negative impacts on soil and agricultural land covers prevention measures, mitigation measures and rehabilitation measures.

Prevention measures: The main objective of the prevention measures is to act on time in order to prevent negative effects on soil and agricultural land, and therefore on agricultural production. These measures consist of prohibition to use fuels that contain lead, obligatory usage of catalysers in the vehicles, reduced speed at critical points and in areas of intensive agricultural production (First Agro-zone), prohibition of agricultural products cultivation in the vicinity of the motorway corridor especially those products that in their edible part can accumulate harmful and hazardous substances (such as salad, spinach, onions, etc.), usage of agricultural products cultivation under controlled conditions in the areas close to the motorway alignment (production of flowers and decorative plants in the greenhouses), production of industrial plants and field crops (potatoes, cereals and food grains) in open areas, as well as fruits and vegetables at a greater distance from the motorway. All these measures should be introduced on the basis of suitable legal regulations and fully in compliance with the principles of sustainable development and international standards.

Mitigation measures: Mitigation measures refer to undertaking of activities in the motorway construction phase with the aim to prevent adverse effects on soil and plants, i.e. on agricultural production, which are manifested through removal and storing of fertile soil, securing of passages and access to the farms, remedy of the degraded soil, decontamination of contaminated soil and extensive planting of bushes and trees along the embankments.

Removal and storage of fertile soil: Having in mind the fact that there are no absolute measures for protection of the soil and that occupation of valuable agricultural quality class soils (First

Agro zone) could not be avoided, it is necessary to undertake removal and storage of fertile soil. Arable soil with different quality classes represented within the corridor of the Vc motorway alignment for LOT-2 in the strip of 50 m, are as follows:

- II	890.000 m^2 x 0,45 m = 400.500 m^3
- III	483.000 m^2 x 0,35 m = 169.050 m^3
- IVa	61.000 m^2 x 0,30 m = 18.300 m^3
- IVb	412.000 m^2 x 0,25 m = 103.000 m^3
Total	= 690.850 m^3

Therefore for the whole motorway alignment it is necessary to remove 690.850 m^3 of fertile soil.

Securing of passages and access to the farms: In the phase of motorway construction when the contractors start with execution of the works or in the case when, due to regulation of water courses, access to the farms is prevented, it is recommended to undertake necessary measures to secure and provide access to such farms in order to avoid disruption of their utilization. Such measures cover construction of access roads, construction of bridges and passages. These measures will be undertaken as necessary either individually or in combination with other measures.

Remedy of degraded soil: During construction of the motorway there will be a need to rehabilitate soils due to appearance of erosion processes or cutting of water bearing strata in the areas where the site structures had to be built (such as site residential compounds, parking lots, warehouses and storage areas and similar), in the storage areas for depositing of removed rich soil and opened borrow pits for the filling material. For this purpose it is necessary to prepare the soil remedy and re-cultivation programme fully in compliance with valid legal regulations and the Law on agricultural soil (Official Gazette of FBH 2/98).

Soil decontamination: In a situation when it comes to spilling or leaking of fuel, lubricants or similar hazardous liquids it is necessary to undertake adequate soil decontamination measures. Such measures should include sprinkling of the spillage with sawdust followed by burning of collected sawdust. Final measure is removal and depositing of contaminated soil.

Extensive planting of bushes and trees along the embankments: In order to prevent contamination of highly valuable agricultural soil (Class I and Class II quality) it is necessary to build a vegetation protective belt up to 2,5 to 3,0 meters high. With regards to the quality classes of agricultural soil for the whole motorway alignment it is necessary to build 21.720 meters of vegetation belt on the right side and 20.500 m on the left side of the motorway. In total it is 42.220 meters of the protective vegetation belt.

Rehabilitation measures: During operation of the motorway it is necessary to undertake adequate rehabilitation measures due to degradation of soil, adverse effects on agricultural and food production and damaging of infrastructure (contamination and accidents) such as:

- Establishing of monitoring system,
- Undertaking of soil decontamination measures,

Establishing of monitoring system: In order to follow adverse effects of the motorway on agricultural soil it is necessary to establish a system which will monitor concentrations of heavy metals, organic pollutants and salts, and on the basis of the readings propose, adequate rehabilitation measures.

Soil decontamination measures: During the motorway operational phase, the process of soil contamination is going to be more pronounced. This process will be noticed more in the vicinity of the motorway at a distance from 0 to 200 meters right and left of the road. Soil contamination can be mitigated by eliminating the adverse effects of the pollutant in the soil. Measures for rehabilitation of contaminated soils can be divided into technical, chemical and phito-melioration measures.

System for monitoring of the soil condition

Environment Protection Law of the Federation of Bosnia and Herzegovina stipulates the procedure for assessment of the environmental impacts as well as for undertaking of certain activities in the environment which are described in Articles 3. and 4. of the Regulations for construction of the plants for which an environmental impacts assessment is obligatory ("Official Gazette of the Federation of Bosnia and Herzegovina", No. 19/04). Due to the fact that the Corridor Vc Project covers construction of the motorway, this Project is on the list of the projects for which undertaking of an Environmental Impacts Assessment Study is obligatory. The main objective of this study is to establish the extent of soil degradation and contamination, selection of possible mitigation or protection measures, evaluation of alternative methods and designs for ultimate protection measures and assistance in development of the environment management plan.

Programme of soil monitoring activities

Zero case: The subject of this monitoring is the soil located along approx. 500 metres wide strip of the adopted motorway alignment of the LOT 2 section, in the total length of approx. 102 km of which the agricultural soil is along approx. 49 km, forests along 13 km and the rest of the alignment belong to the tunnels and bridges. 32 localities have been preliminary identified during analysis of the adopted Corridor Vc Motorway alignment where the soil samples have been taken for the purpose of establishing of Zero case quality.

Monitoring of soil during the construction phase: During the construction phase some problems with degradation and contamination of the soil by organic pollutants and heavy metals could be expected. In order to monitor such degradation it is necessary to follow the situation and changes such as:

- Erosion of the soil due to removal of vegetation and cutting of slopes;
- Appearance of surface waters due to drainage and catchments waters,
- Construction of site facilities (settlements, parking areas, warehouses and storage areas and similar),
- Putting up of areas for depositing of removed rich soil,
- Utilization of filling material, borrow pits, etc.

Monitoring of soil contamination: Usage of the construction machines and heavy trucks for transportation of construction materials as well as installation of equipment and materials may cause contamination of the soil due to spillage of oil, lubricants and fuel which is expressed through:

- Contamination by organic pollutants (light and heavy fractions of hydrocarbons).

All the above mentioned damages have to be evaluated and necessary preventive measures and rehabilitation processes determined through development of suitable programmes and projects.

Monitoring of the soil during the operational phase: Contamination of the soil is very frequent along the heavily trafficked roads. Metals such as lead, zinc, cadmium and chrome remain in the soil for many years. Pollutants from the soil along the motorways penetrate into the food chain of the plants and animals, while due to erosion of the soil they get into other eco-systems. Industrial salts used for salting of the roads during the winter period get into the soil and degrade fertility of the same. Consequences of the traffic and the pollutants' impacts have cumulative effects on the soil as well as on many other aspects of the life in the environment. Due to all the facts mentioned above it is necessary to be familiar with the situation and to monitor all changes along the motorway alignment in order to avoid accident situations or any improvisations with regards to evaluation and assessment of impacts of the future motorway on the environment.

Water resources

A dense network of water flows exists in the motorway zone, the most significant of which is the River Bosna and its small and large tributaries (Tešanjka, Liješnica, Strupinska River, Kardaglijska River, Ozimica, Trebačka River, Gračanička River, Nemilska River, Lepenica etc.). Besides this dense network of surface waters, there are significant resources of underground waters, most of which have not been sufficiently explored.

During preparation of the Environment Impact Study for LOT 2, the Consultants for the water resources aspect contacted the representatives of all eight municipalities, through which area the concerned section passes, as well as the water utility companies in those municipalities. With their assistance, the detailed data on sources used in the public water supply system of cities and suburban settlements have been collected and presented in the Study, as well as data on the sources of local nature. In some cases, municipalities and utility companies did not have data on local sources, so that they had been collected in local communities.

The significant information in relation with the sources for water supply, as well as the assistance in planning of water resources monitoring along the LOT 2 for motorway construction and exploitation phases were obtained from Public Company for Watershed Areas of Sava River catchments in Sarajevo. For consideration and overall view of water resources aspect along the route, and for the needs of Study preparation, all available sources have also been used, which list is given in the reference list of the used literature and documentation at the end of this Study.

The scope of the water resources aspect consideration in the Study was 1 km to the left and to the right from the adopted motorway route for which the Preliminary Design is being prepared. In final lay down of the route, the designer took into account that the sources of the public water supply system of the cities and settlements along the section of LOT 2, as well as their accessory water protection zone are avoided. The water source Klopče, located in the public water supply system of Zenica City, is the only source located in the area of the scope of our consideration. This source is located in section 6: Donja Gračanica – Drivuša (chainage km 58+434.599 to 66+959.592), i.e. between the chainages km 60+000 - 62+000.

In the area of the consideration scope, there area a large number of local sources not included in the public water supply system of the municipalities on which territories they are located.

When planning the route, special attention was paid to exclude sources of public water supplies for the towns and settlements along the section LOT2 and their water protection zones, from the catchment's area of the motorway route (1 km on the left and right from the approved route).

An exception is the Klopče source, a part of the public water supply system of Zenica town, situated in the considered catchment's area of the motorway route. However, a large number of local sources have been left in the considered catchment's area; these sources are not included in the system of public water supply of the municipalities where they are located. These local sources are used for the water supply of the population in the settlements through which the motorway passes or the settlements in the vicinity of the motorway.

On the basis of the analysis of hydro-geological features of the corridor, the Study established 33 sensitive water-bearing areas which are significant resources of good-quality drinking water for meeting the increasing needs. Also, as far as construction and operation are concerned, the Study defines that the banks of the water flows along which the route is planned and which intersect the motorway, are also considered to be sensitive areas, including the surface springs in and out of the water supply system.

One of the difficulties which occurred in the stage of developing of this Study was lack of a detailed hydro-geological map of the more immediate area around the motorway produced on the basis of research works. Taking into account specific conditions at the location and available data, the potential negative impact of the construction and operation of the motorway on surface and underground waters was assessed, and the relevant preventive measures/ minimizing of the negative impact was proposed. In many cases, and within the higher stages of project design, there was a lack of data, and a need to carry out detailed research of some of the water flows in order to establish potential negative impact of the motorway and vice versa.

In principle, the facilities for the treatment of waste waters from the motorway can be located in the areas that are defined as sensitive in the Study, but before the final selection of the location for the facilities, a detailed hydro-geological background of the more immediate area around the motorway in scale 1:5,000 should be consulted. It is necessary to avoid locating the facilities in the aquifer areas in which high water levels of underground waters were established in order to prevent disturbance of the hydraulic regime of underground waters, disturbance of feeding the groundwater etc.

Having in mind the above mentioned, it is necessary to check the anticipated impacts on the waters on the basis of the data that will be available upon the completion of research works, that is hydro-geological maps and length-wise sections of the more immediate area of the motorway in a detailed scale of (1:5,000).

Due to the fact that *the sources which are located within the public water supply system* of the towns Zenica, Žepče, Kakanj, Maglaj and Kiseljak are significantly distant from the motorway route, *no negative impacts are expected to occur* during the construction and operation of the motorway if proposed preventive measures are respected.

During the construction and operation stage, *the local sources of drinking water (sources in villages)* will be most exposed to harmful impacts. This negative impact is estimated as *significant* and the relevant preventive measures/measures for minimization of the impact have been proposed.

Significant negative impacts on the regime and quality of water are possible in all the places where the route is close to permanent or temporary underground water; the locations of the sources have been established through the analysis of hydro-geological structure of ground in the motorway catchment's area.

Also, significant negative impacts are possible in all places where the planned motorway and water flow intersect the motorway, including the areas where the route is situated along the banks of water flow, in the stages of construction and operation. Sensitive areas such as water-bearing areas also may be significantly endangered in the stages of construction and operation.

All expected adverse effects on water resources (underground and surface) in the phase of construction and exploitation could be avoided or reduced with the proposed prevention and minimization measures.

Considering that the motorway causes many changes on water manifestations along the route, which in great extent depend on the way of construction and exploitation. In accordance with that, and taking into consideration the Best Environmental Practices, the prevention measures i.e., measures of minimization of negative impacts have been proposed. The certain impacts on water can be avoided in the planning phase so in that sense, the prevention measures recommend the preparation of appropriate project solutions of external and internal drainage, planning of the bridge constructions with the condition that the bridge openings insures the flows of high waters of the certain phenomena rank and of the height differences defined in the water management conditions issued by the relevant ministries of the water management, designing of horticulture protective zone and planning of the vertical buffer fences along the motorway on the sensitive-marked locations from the aspect of water resources.

All characteristic places of the motorway passage over the watercourse along the LOT 2 per sections are given in the Table 2 that follows. Also, the expected impacts on the surface waters are presented, as well as the planned prevention and minimization measures for the harmful impacts in the construction phase.

Table 2. Characteristic places of the motorway passage over the watercourse along the LOT 2 per sections

Motorway chainage	**Location/ watercourse**	**Length and the way of watercourse training/ Bridge on the watercourse**	**Expected impact on waters**	**Mitigation measures during the construction site preparation and motorway construction**
Section 1. **Karuše – Medakovo** **Km 0+000 – 4+000**			Pollution of the surface waters due to: ➢ Carrying out the construction works (mining, deep excavations, destroying and removal of the natural cover layer, concrete-work, reinforcing and similar). ➢ Accidental spillages or accidental pouring out the oil and oil derivates, disposal of the motor oil or similar waste. ➢ Usage of the inappropriate materials for	➢ Special way of mining not to disturb the directions of the underground flows and of the recharge of surface watercourse. ➢ Good management practice on the construction site and with the traffic to avoid the watercourse pollution. ➢ Disposal not to be carried out in the riverbed and along the banks of the watercourses, or in the sanitary protection zones as well as in the zones defined as sensitive. In the case that these locations are located in the water asset and public water asset, it is necessary to apply for the water management authorization.
Km 0 +750 to 4+250	Balnjača Luke Village Tešanjka River	River training length L= 3,605 m – riverbed trained with the reno mattresses		
Km 0+877.410	Bridge on Tešanjka River	Concrete bridge		
Km 1+763, 190	Bridge on Tešanjka River	Concrete bridge		
Km 3+121,860	Bridge on Tešanjka River	Concrete bridge		
Section 2. **Medakovo – Ozimica** **Km 4+000 – 24+876,40**				

<table>
<tr><th>Motorway chainage</th><th>Location/
watercourse</th><th>Length and the way of watercourse training/
Bridge on the watercourse</th><th>Expected impact on waters</th><th>Mitigation measures during the construction site preparation and motorway construction</th></tr>
<tr><td>Km 4+600 to 4+800</td><td>Obrenovac
Trebačka River</td><td>River training length L= 200 m – riverbed trained with the reno mattresses</td><td rowspan="14">construction
➢ Turbid or in other way polluted surface water can be drained in the coastal underground aquifers and pollute them.
➢ Uncontrolled drainage of the sanitary waters and polluted rainwater at the construction sites.
Change of the surface water regime (quantity) due to uncontrolled disposal of excavated material into the watercourse riverbed.
Possibility of occurrence of more massive disposing of the deposit, and by that also filling of the riverbed by reducing of its flow capacity what can have the adverse consequences during the passage of the high floodwaters.</td><td rowspan="14">➢ All the material excavated, that will not be immediately used in the construction activities must be disposed on locations foreseen for that in accordance with the Design of the construction site organization (dumping sites of the material surplus) protected from the occurrence of the erosion, as well as outside of the defined sensitive zones.
➢ Keep the vegetation cover in the most possible extent, i.e. leave the buffer zones formed from the vegetation cover between the road and the watercourse.
➢ Use only clear material in the vicinity of the watercourse for the embankment, such as gravel, without the earth or other impurities.
➢ Protect the coastal areas sensitive to erosion by means of stabilization and with plants that prevent erosion.
➢ Prohibit any temporary or permanent disposal of the waste material on the surrounding soil, except on the locations foreseen for that by the Design of the construction site organization, as well as to ensure the watertight containers for waste.
➢ Supervise the processes of deposit formation, and organize the cleaning of the bottom and riverbed slopes from the surplus material.
➢ Carry out the frequent and controlled storage of the municipality and hazardous</td></tr>
<tr><td>Km 5+000 to 5+200</td><td>Obrenovac
Trebačka River</td><td>River training length L= 180 m – riverbed trained with the reno mattresses</td></tr>
<tr><td>Km 5+900 to 6+100</td><td>Bare
Trebačka River</td><td>River training length L= 239 m – riverbed trained with the reno mattresses</td></tr>
<tr><td>Km 6+900 to 7+100</td><td>Toplik Trebačka River</td><td>River training length L= 215 m – riverbed trained with the reno mattresses</td></tr>
<tr><td>Km 6+917.00</td><td>Bridge on Trebačka River</td><td>Concrete bridge</td></tr>
<tr><td>Km 8+500 to 8+800</td><td>Dolac
Trebačka River</td><td>River training length L= 320 m – riverbed trained with the reno mattresses</td></tr>
<tr><td>Km 9+150 to 9+350</td><td>Luke
Trebačka River</td><td>River training length L= 215 m – riverbed trained with the reno mattresses</td></tr>
<tr><td>Km 10+150 to 12+820</td><td>Karadaglije
Trebačka River</td><td>River training length 2890 m - riverbed trained with the reno mattresses</td></tr>
<tr><td>Km 10+840</td><td>Čaglići
Trebačka River</td><td>Concrete bridge</td></tr>
<tr><td>Km 11+046</td><td>Čaglići
Trebačka River</td><td>Concrete bridge</td></tr>
<tr><td>Km 11+611</td><td>Zaimovići – Alispahići
Trebačka River</td><td>Concrete bridge</td></tr>
<tr><td>Km 12+748</td><td>Karadaglije
Trebačka River</td><td>Concrete bridge</td></tr>
<tr><td>Km 16+050</td><td>Mladoševica – Stupina
Strupinski stream</td><td>Concrete bridge</td></tr>
<tr><td>Km 16+730</td><td>Mladoševica – Stupina
Strupinski stream</td><td>Concrete bridge</td></tr>
</table>

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 17+980 to 18+340	Galovac Strupinski stream	River training length L=373 m - riverbed trained with the reno mattresses		waste in the prescribed manner. ➢ Establish the continuous supervision during the works performance with the presence of specialist for environment protection. ➢ Sanction the offenders of the determined behavior rules in a disciplinary manner. ➢ To accept used waters from the construction site with the appropriate sewerage systems, collect it in the watertight reservoirs and treat it in a prescribed manner (either at the site, or in the remote location), and before discharge into the recipient or city sewerage. ➢ Inevitably set out the ecological toilets for the needs of the workers on the locations of the construction site. ➢ Insure the areas with he watertight layer for placement and servicing of the construction mechanization, outside of the defined sensitive zones. ➢ Collect the oiled rainwater from the location of the construction site into he watertight reservoirs and treat them in the prescribed manner (either at the site or in the remote location), and before discharge into the recipient or the city sewerage. ➢ Prohibit the repairs of the construction machines, as well as the oil change in the defined sensitive zones. ➢ All construction areas and other impact zones during the construction is necessary to restore during
Km 18+950 to 19+850	Galovac Strupinski stream	River training length L=940 m - riverbed trained with the reno mattresses		
Km 20+150 to 20+250	Ljubatovići Strupinski stream	River training length L=110 m - riverbed trained with the reno mattresses		
Km 21+150 to 21+400	Ljubatovići Strupinski stream	River training length L=230 m - riverbed trained with the reno mattresses		
Km 21+650 – 22+000	Bečkića selišće Strupinski stream	River training length L=390 m - riverbed trained with the reno mattresses		
Km 22+650 to 22+980	Bečkića selišće Strupinski stream	River training length L=350 m - riverbed trained with the reno mattresses		
Km 23+269,90	Ozimica Liješnica River	Concrete bridge		
Km 23+668	Bečkića selišće - Ozimica Strupinski stream	River training length L=348 m - Ozimička petlja and L= 60m Goliješka petlja - riverbed trained with the reno mattresses Concrete bridge		
Section 3 **Ozimica – Poprikuše** **Km 24+876,40 – 37+740**				
Km 28+026,440	Tatarbudžak Stream 50	Concrete bridge		
Km 28+676,440	Tatarbudžak Stream 51	Concrete bridge		
Km 28+876,440	Tatarbudžak Stream 52	Concrete bridge		
Km 29+626,440	Vašarište – Bljuva Bljuva Stream	Concrete bridge		
Km 32+026,440	Papratnica Ljubna River	Concrete bridge		

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 32+526,440	Papratnica Papratnica River	Concrete bridge		the construction in accordance with the Plan of restoration, i.e. depending on the future usage of the area bring that in the original status. ➢ Ask for special water management conditions for locations of construction basis, services, asphalt basis, borrow pits and other structures in the next designing phase. ➢ During construction in the sensitive zones, set out the notices (plates) for workers on the construction site with the warning of the construction works in these zones. ➢ In the case of accidents, spillage of the fuel or lubricants into the environment, the urgent intervention is necessary in accordance with the Plan for fast interventions in the case of accidents.
Section 4 Poprikuše – Nemila Km 37+740 – 46+388,80				
Km 41+690	Kahrimani Sarevački stream	Concrete bridge		
Km 42+970	Topčić field Stream 63	Concrete bridge		
Km 43+170	Topčić field Kočin stream	Concrete bridge		
Km 46+090	Orahovačko field Krivača River	Concrete bridge		
Section 5. Poprikuše – Nemila Km 46+388,80 – 58+434,60				
Km 46+500	Orahovačko field Stream 71	Concrete bridge		
Km 46+800	Nemila Repeljski stream	Concrete bridge		
Km 47+000	Nemila Selački stream	Concrete bridge		
Km 47+540	Nemila Stream 75	Concrete bridge		
Km 47+670	Nemila Stream 76	Concrete bridge		
Km 56+300	Vranduk Stream 80	Concrete bridge		
Km 56+650	Vranduk Jelovik Stream	Concrete bridge		
Km 57+860	Donja Gračanica Gračanička River	Concrete bridge		

Motorway chainage	**Location/ watercourse**	**Length and the way of watercourse training/ Bridge on the watercourse**	**Expected impact on waters**	**Mitigation measures during the construction site preparation and motorway construction**
Section 6. Donja Gračanica – Drivuša Km 58+434,60-66+941,10				
Km 58+537,350	Donja Gračanica Suha River	Concrete bridge		
Km 59+640	Zenica - Dobra voda	Concrete bridge		
Km 61+036	Zenica – Kopilo Babina River	Concrete bridge		
Km 64+540	Zenica – Perin Han Stijenčice Stream	Concrete bridge		
Km 65+580	Zenica – Perin Han Stream 87	Concrete bridge		
Km 65+690	Zenica – Perin Han Đulanova River	Concrete bridge		
Section 7. Drivuša - Kakanj Km 66+941,10 – 82+121,10				
Km 67+691 to 67+941	Drivuša Bosna River	River training length L= 250 m – riverbed trained with the reno mattresses		
Km 68+321,10	Janjići Prihodi Stream	Concrete bridge		
Km 75+537,30	Modrinje Repovački Stream			
Section 8. Blažuj – Tarčin Km 0+000 – 18+885,40				
Km 1+770	Vlakovo – crossing Kulićev Stream	Concrete bridge		
Km 4+050	Kobiljača – Rudnik Rakovica River	Concrete bridge		

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 4+700 – 5+750	Rakovica Kremikovac Stream	River training length L= 850 m – concrete riverbed		
Km 7+400	Azapovići Stream 109	Concrete bridge		
Km 9+300	Kuliješ Stream 113	Concrete bridge		
Km 10+720	Donji Bojakovići Stream 114	Viaduct		
Km 11+120	Solaković Stream 115	Concrete bridge		
Km 11+950	Zabrđe – Mokrine Mlinčići Stream	Viaduct		
Km 12+675	Zabrđe – Mokrine Stream 117	Concrete bridge		
Km 13+037.890	Zabrđe Tisovački Stream	Concrete bridge		
Km 18+330	Tarčin Mlavica Stream	Concrete bridge		
Km 18+300 to 18+500	Tarčin Bijela River	River training length L= 230 m – riverbed trained with the reno mattresses		
Km 18+512	Tarčin Korča River	Concrete bridge		

Implementation of the foreseen measures of prevention and minimization of the impacts in the phase of motorway exploitation (maintenance of the constructed structures for drainage and treatment of wastewaters from the roads, and winter maintenance of the road according to the operational plans) the expected adverse impacts on the quality of the ground and surface waters can be avoided.

With the aim of consideration and valorization of changes in the environment as a result of construction and exploitation phase, i.e. considering the effects of proposed measures of prevention/minimization, as well as introduction of necessary improvements and corrections, the plan for monitoring the surface and ground water manifestations both in the motorway construction period and also the motorway exploitation period has been proposed.

The pollution in the case of accidental situations especially when heavy vehicles participate, which transport a hazardous loads (the traffic accidents, breakdowns) and because of the reason that it is not possible to foresee the time and space presents a special problem during the construction and exploitation phase. In that sense, it is necessary to apply all available measures for reduction of probability of occurrence of these accidental situations. In the case that those situations, however, occur during the construction and exploitation phase, the Study foresees the preparation of plans for fast interventions and the organization and equipment of adequate intervention services in order to ensure the restoration of damages caused by accidents in as short period as possible, and also in order to prevent the occurrence of accidents of larger scale.

Flora

During the Study preparation, the Consultants for the flora aspect realized a detailed region researching (Annex 12.2., photo documentation of most significant ecosystems inherented on region along all sections), conctacted the forest companies and offices in municipalities: Tešanj, Žepče, Zenica, The public Zenica – Doboj cantonal forest company and The public company „Sarajevo forest“ d.o.o. It consulted all available literature for the research region, too.

During the Study preparation, the Consultants for the flora aspect contacted the representatives of the forest offices in municipalities Tešanj, Žepče, Zenica, and Public Company ŠPD of the Zenica-Doboj Canton and Public Company „Sarajevo forests“ the stock company.

For the determination of significant vegetation units on the research region, the EUNIS classification of types of habitats has been used which represents the overall pan European system that stimulates the harmonization of the descriptions and collections of data from all parts of Europe using the criteria for identification of habitats. This classification includes all types of habitats, from natural to artificial, from land to fresh-water and marine-water.
The habitat type is for the needs of EUNIS classification of habitat types defined as: « plant and animal communities as a characterizing element of biotic environment, which together with abiotic factors act on the given scale». All factors, which have been involved in the definition, are being elaborated in the descriptive work shape of habitat classification. The database includes EUNIS habitats and Annex I habitats from EU Habitat directive. The Annex 1 of the Directive 92/43/EEC represents the list of « the types of natural habitats which are of interest for the community whose conservation requests the establishment of special zones for conservation».

On the section 1, there are the community of eco-systems of xerothermic forest of eastern hornbeam and Eastern white oak - Querco–Ostryetum carpinifoliae (EUNIS habitat code G1.7C1) and the community of eco-systems of white willow forest - Salicion albae (Habitat code 91A0).

On the section 2, there are community of eco-system of the xerothermic forest of eastern hornbeam and eastern white oak - Querco–Ostryetum carpinifoliae (EUNIS habitat code G1.7C1) and the community of eco-system of white willow forest - Salicion albae (Habitat code 91A0), the basophilic pine forests on the serpentines (Pinetum silvestris-nigrae serpentinicum)

On the section 3, there are the xerophilic oak forests on the serpentines of the chestnut oak forests with evergreen oak Erico-Quercetum petraea (K. ET L.) HT; heaths, the vegetation of rocks and rocky grounds, the vegetation of rocks, the community of white willow forest ecosystem Salicion albae (EUNIS Habitat code 91A0), the community of hygrophile forest and of alder brushwood eco-system (EUNIS Habitat code 91E08*).

On the section 4, there are the community of eco-system of the oak-hornbeam forests Querco-Carpinetum betuli (EUNIS Habitat code G1.A1A), the community of eco-system of white willow forest Salicion albae (EUNIS Habitat code 91A0), the community of hygrophile forest and alder brushwood eco-system (EUNIS Habitat code 91E08*).

On the section 5, there are communities of eco-systems oak-hornbeam forests Querco-Carpinetum betuli (EUNIS habitat code G1.A1A), of alder forests which differentiate on more communities and most prevalent are:
The forest of Frangulo alni- Alnetum glutinosae
The forest of continental region of Alnetum glutinosae montanum
The forest of crone and Carici elongatae-Alnetum glutinosae

The zone of the mezophile forests prospers most frequently on less steep slopes and significantly developed soils with respect to previous vegetation. This vegetation belongs to the form of foliage- deciduous forests of Fagetalia Bleč. et Lkšić 70 (the montane forests of beech).

On the section 6, there are the communities of eco-system of xerothermic forest of eastern hornbeam and eastern white oak - Querco–Ostryetum carpinifoliae (EUNIS habitat code G1.7C1) and the community of white willow forest eco-system Salicion albae (Habitat code 91A0).

On the section 7, there are the communities of the hornbeam-oak forests Querco- Carpinetum betuli (EUNIS Habitat code G1.A1A), community of eco-systems of xerothermic forests of the eastern hornbeam and eastern white oak Querco–Ostryetum carpinifoliae (EUNIS Habitat code G1.7C1), community of thermophilic forests of chub and eastern oak Aceri obtusati-Ostryetum carpinifoliae (EUNIS Habitat code G1.7C3), the community of the eco-systems of hygrophile forests with common oak and common hornbeam Carpino betuli-Quercetum roboris (EUNIS Habitat code 91F0), the community of eco-system of white willow forest Salicion albae (EUNIS Habitat code 91A0), the community of eco-system with fern Pteridietum aquilini (EUNIS Habitat code E 5.3), the community of eco-system of the hygrophile forests and the alder brushwood (EUNIS Habitat code 91E08*), the community of eco-systems with mezophile meadows (EUNIS Habitat code 6510), the community of eco-systems of hygrophile meadows (EUNIS Habitat code 6410, 2330), and the eco-systems of the tertiary groups of eco-systems of the urban and rural regions.

On the section 8, there are the communities of the eco-systems – the oak and hornbeam forests Querco- Carpinetum betuli (EUNIS Habitat code G1.A1A), the community of the willow and poplar in the class Populetalia albae BR.-BL. 31, the groups of eco-systems the hydrophile forests and the shrubbery of alder (EUNIS Habitat code 91E08*).

The impacts on the flora are expected in all phases of the construction of highway: construction, maintenance and the exploatation of highway. The most important impact is the cutting off the forest vegetation and the potential erosion of the soil, in the construction phase, especially on the sections where the soil is shallow as it is the case with the serpentine complex in the region of Žepče, then the destruction of biological resources or eco-systems that is necessary to protect. The most important negative impact is the pollution because of the emission of engine oil and gases in environment and the waste dumping in natural eco-systems in the exploitation phase. The quantity of the wood biomass that is necessary to remove along the route on LOT 2 amounts to 4.664,5 m3 and on the total length of 7.915 m.

The planting can help in the supporting of a local flora and fauna in the zone of the future highway. It is possible to create the additional habitats with planting and to provide the migration routes for local types of animals and in the same time the erosion protection. The plant types planted on the edges of protection zone should be well resistant on the wind and help in the protection of erosion, especially on the regions of Žepče. The planting should be carried out with use of the native plant types, always when it is possible, because they will likely require less maintenance and to be useful in the preservation of the eco-system integrity.

It is necessary to plant the native plant types along of the watercourses in order to restore the damaged native coastline vegetation and to recreate the favorable ecological requirements (light and shadow) along of the watercourses. The aquatic and marginal plants should be planted on the adequate locations in order to prevent the watercourse pollution. It is necessary to use geo-textile membranes for the slope stabilization, which include the mixture of plant seeds, which stabilize and revegetate the slopes. It is very important for all locations along the highway and especially in the cuttings.

Review of the most significant impacts and prevention measures in relation to the flora are given for each section in LOT 2 in the following Table 3.

Table 3. Significant impacts and prevention measures in relation to the flora for each section in LOT 2

1. SECTION: KARUŠE - MEDAKOVO	Site	• Penavino brdo on the right side of the alignment, 1 km from the starting point; • Matanovićevo brdo on the right side of the alignment 1.5 – 2.0 km from the starting point;.
	Plant community	• Communities of hornbeam and pubescent oak.
	The most important impacts	• Degradation or complete desrtuction of the vegetation due to the clearing of forest.
	Site	• Riparian zone of the river Tešanjka along all section of the alignment.
	Plant community	• Communities of ecosystems of white willow
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive.

2. SECTION: MEDAKOVO - OZIMICA	Site	• Salkovića brijeg on the left side of the alignment at the distance of some 250 m from the alignment and 800 m from the starting point: • Križanovo brdo sa desne strane na udaljenosti od oko 100 m od trase i na udaljenosti od 1.0 do 1.5 km od polazne tačke.
	Plant community	• Community of ecosystems of hornbeam and pubescent oak
	The most important impacts	• Degradation or complete destruction of vegetation cover due to the clearing of the forest.
	Site	• Riparian zone of the Trebačka river at the distance of 2 km from the starting point in the form of the narrow discontinous belt; • Riparian zone of the river Strupinska between willages Čakrame and Ljubatovići.
	Plant community	• Communities of ecosystems of white willow

	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	Site	• Šiljati vrh on the left side of the alignment and just by the alignment, and at the distance from 10.0 to 12.0 km from the starting point..
	Plant community	• Bazophylle pine forests on serpentines
	The most important impacts	• Degradation of the vegetation and habitats of plant species and their communities distinguished by high conservation values.

3. SECTION: OZIMICA - POPRIKUŠE	Site	• Serpentine complex near Žepče, in the zone of Varošište and peak Kamenitovac (288 m), on the left side of the alignment.
	Plant community	• Xerophylle oak forests on serpentines • Heaths • Vegetation of rocks and rocky meadows
	The most important impacts	• Indirect impacts could be even more dangerous than direct ones, and their effects could have larger scope. At the sites where road allows access to the zones which have been relatively undisturbed by human activities, such is protected area near Žepče (wider area by the Papratnica brook), this could have long term effects and cause significant degradation of the quality of natural ecosystems.
	Site	• Riparian zone of the river Bosna and its tributaries in the zone from Brezovo polje to Golubinje.
	Plant community	• Communities of ecosystems of white willow
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	4. SECTION: MEDAKOVO - OZIMICA Site	• By the river Bosna and its tributaries in the zone between Brezovo polje and Golubinje.
	Plant community	• Communities of hygrophylle forests and shrubs with sticky alder.
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive

4. SECTION: POPRIKUŠE - NEMILA	Site	• Between 1.0 and 3.0 km from the beginning of the section, at sites Budakovac, Ravno brdo and Golubinjska šuma
	Plant community	• Communities of ecosystems of oak – hornbeam forests
	The most important impacts	• Construction of the highway will unavoidably lead to the clearing of the forests at site Saravački potok – Kočin potok, by the right side of the river Bosna where are developed communities of hornbeam and oak Carpino betuli – Quercetum roboris, which represent forests with the highest level of production in this area.
	Site	• Riparian zone of the river Bosna between Topčića polje and Hrašće at the site Ada (5.8 km from the beginning of the section)

	Plant community	• Communities of ecosystems of white willow
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	Site	• By the river Bosna, from Topčića polje to Hrašće (3.5 km to 5.5 km of the section).
	Plant community	• Communities of the ecosystem of hygrophylle forests and shrubs of sticky alder.
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive.

5. SECTION: NEMILA – DONJA GRAČANICA	Site	• Allong all this section, on the both sides of the alignment.
	Plant community	• Community of ecosystems of oak – hornbeam forests
	The most important impacts	• Since in this section is planned construction of tunnels, there will be no any significant negative impacts on the flora, except in the vicinity of tunnel opennings.
	Site	• Allong all this section, by the waterways, on the both sides of the alignment
	Plant community	• ecosystem of forests of white willow Salicetum albae • ecosystem of white and fragile willow Salicetum albae-fragilis • ecosystem of forests of willow and poplar Salici – Populetum • ecosystem of white and black poplar Populetum nigro-albae • ecosystem of forests of willow Salicetum triandrae • shrubs with willow Salicetum purpureae
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	Site	• Along all this section by the waterways, on the both sides of proposed alignment.
	Plant community	Forests of glossy buckthorn and sticky alder Frangulo alni-Alnetum glutinosae Forests of sticky alder in the continental areas Alnetum glutinosae montanum • Forests of sticky alder and sedges Carici elongatae-Alnetum glutinosae
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive

6. SECTION: DONJA GRAČANICA -	Site	• From the settlement Donja Gračanica, via Ričica, Kopila, Klopča, to Perinog hana,
	Plant community	• Ecosystem kserotermnih šuma crnog graba i hrasta medunca
	The most important impacts	• Clearing of forests and habitat loss
	Site	• Riparian zone of the river Bosna and its tributaries
	Plant community	• Communities of ecosystems of white willow

	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive

7. SECTION: DRIVUŠA - KAKANJ	Site	• On the slopes on the both sides of the alignment through morphostructure of Vijenac (Okruglo 749 m) to the south and the settlement Donji Lučani.
	Plant community	• Communities of ecosystems of oak and hornbeam forests
	The most important impacts	• Construction of the highway will unavoidably lead to the clearing of oak and hornbeam forests which represent a climatogenous vegetation in the hilly part of the central Bosnia and Herzegovina.
	Site	• Wider area of Gornji and Donji Lučani
	Plant community	• Communities of ecosystems of xerotherm forests of hornbeam and oak
	The most important impacts	• Construction of the highway will unavoidably lead to the clearing of oak and hornbeam forests which represent a climatogenous vegetation in the hilly part of the central Bosnia and Herzegovina.
	Site	• Right side of the river Bosna from Donji Lučani to Kakanj
	Plant community	• Communities of ecosystems of thermphylle forests of sycamore maple and hornbeam
	The most important impacts	• Construction of the highway will unavoidably lead to the clearing of hornbeam and sycamore maple.
	Site	• From Drivuša to settlement Klanci, and from Gornji Lučani to Kakanj, in the form of fragments on the flat areas by the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica
	Plant community	• Communities of ecosystems of hygrophylle forests of sessile oak and hornbeam
	The most important impacts	• Construction of the highway will unavoidably lead to the clearing of the forests of sessile oak and hornbeam.
	Site	• From Drivuša to settlement Klanci, and from Gornji Lučani to Kakanj, in the form of fragments on the flat areas by the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica
	Plant community	• Communities of ecosystems of white willow
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	Site	• By the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica from Drivuša to settlement Klanci, and from Gornji Lučani to Kakanj.
	Plant community	• Communities of ecosystems of hygrophylle forests and shrubs with sticky alder.

	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
8. SECTION: BLAŽUJ - TARČIN	Site	• In the zone of the waterways Trnava, Vidovac, Rakovica, Kremikovac, Krmeljevac, and Mlinčić, and Bijela rijeka and Kalašnica.
	Plant community	• Community of ecosystem of oak – hornbeam forests
	The most important impacts	• Construction of the highway will unavoidably lead to the clearing of oak and hornbeam forests which represent a climatogenous vegetation in the hilly part of the central Bosnia and Herzegovina
	9. SECTION: MEDAKOVO - OZIMICA Site	• Kulielješi – Bukovica – Zabrđe – Toplica.
	Plant community	• Communities of willows and poplars
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	Site	• Narrow riparian zone in the southeast and flat aspects by the river Lepenica and its tributaries Zečji potok and Bukovina.
	Plant community	• Communities of ecosystems of white willow
	The most important impacts	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive

1. SECTION: KARUŠE - MEDAKOVO	Site	• Penavino brdo on the right side of the alignment, 1 km from the starting point; • Matanovićevo brdo on the right side of the alignment 1.5 – 2.0 km from the starting point;.
	Plant community	• Communities of hornbeam and pubescent oak.
	Measures	• All trees should be cut to the standard lenght, cleared from all branhes. Trees suitable for market are all trees which could be used for production of timber. It would be necessary to obtain permit for setting the fire in accordance with existing legislation. All cut trees, branhes, and roots shoud be removed in accordance with existing regulations, rules, and provisions. • Prevention of uncontrolled falling of materials or intentional pushing of material down the slope. • Planting native species such as pubescent oak and hornbeam during finalization of alignment.
	Site	• Riparian zone of the river Tešanjka along all section of the alignment.
	Plant community	• Communities of ecosystems of white willow
	Measures	• Planting with native species such as white willow, poplar, and sticky alder.

2. SECTION: MEDAKOVO - OZIMICA	Site	• Salkovića brijeg on the left side of the alignment at the distance of some 250 m from the alignment and 800 m from the starting point: • Križanovo brdo sa desne strane na udaljenosti od oko 100 m od trase i na udaljenosti od 1.0 do 1.5 km od polazne tačke.
	Plant community	• Community of ecosystems of hornbeam and pubescent oak
	Measures	• All trees should be cut to the standard lenght, cleared from all branhes. Trees suitable for market are all trees which could be used for production of timber. It would be necessary to obtain permit for setting the fire in accordance with existing legislation. All cut trees, branhes, and roots shoud be removed in accordance with existing regulations, rules, and provisions. • Prevention of uncontrolled falling of materials or intentional pushing of material down the slope. • Planting native species such as pubescent oak and hornbeam during finalization of alignment.
	Site	• Riparian zone of the Trebačka river at the distance of 2 km from the starting point in the form of the narrow discontinous belt; • Riparian zone of the river Strupinska between willages Čakrame and Ljubatovići.
	Plant community	• Communities of ecosystems of white willow
	Measures	• Planting with native species such as white willow, poplar, and sticky alder.
	Site	• Šiljati vrh on the left side of the alignment and just by the alignment, and at the distance from 10.0 to 12.0 km from the starting point..
	Plant community	• Bazophylle pine forests on serpentines
	Measures	• Strict prohibition of overcutinng of the trees • It would be necessary to carefully perform planning, management and monitoring of tourist operation in protected area in order to ensure its long-term sustainability.

3. SECTION: OZIMICA - POPRIKUŠE	Site	• Serpentine complex near Žepče, in the zone of Varošište and peak Kamenitovac (288 m), on the left side of the alignment.
	Plant community	• Xerophylle oak forests on serpentines • Heaths • Vegetation of rocks and rocky meadows
	Measures	• Identification and strict prevention of destruction of protected flora, • Prohibition of overcutting of the trees.
	Site	• Riparian zone of the river Bosna and its tributaries in the zone from Brezovo polje to Golubinje.
	Plant community	• Communities of ecosystems of white willow
	Measures	• Planting with native species such as white willow, poplar, and sticky alder.

	Site	• By the river Bosna and its tributaries in the zone between Brezovo polje and Golubinje.
	Plant community	• Communities of hygrophylle forests and shrubs with sticky alder.
	Measures	• Planting with native species such as white willow, poplar, and sticky alder.

4. SECTION: POPRIKUŠE - NEMILA	Site	• Between 1.0 and 3.0 km from the beginning of the section, at sites Budakovac, Ravno brdo and Golubinjska šuma
	Plant community	• Communities of ecosystems of oak – hornbeam forests
	Measures	• Planting with native species such as oak and hornbeam.
	Site	• Riparian zone of the river Bosna between Topčića polje and Hrašće at the site Ada (5.8 km from the beginning of the section)
	Plant community	• Communities of ecosystems of white willow
	Measures	• Planting with native species such as white willow, poplar, and sticky alder.
	Site	• By the river Bosna, from Topčića polje to Hrašće (3.5 km to 5.5 km of the section).
	Plant community	• Communities of the ecosystem of hygrophylle forests and shrubs of sticky alder.
	Measures	• Planting with native species such as white willow, poplar, and sticky alder.

5. SECTION: NEMILA – DONJA GRAČANICA	Site	• Allong all this section, on the both sides of the alignment.
	Plant community	• Community of ecosystems of oak – hornbeam forests
	Measures	• Planting with native species such as oak and hornbeam. • All trees should be cut to the standard lenght, cleared from all branhes. Trees suitable for market are all trees which could be used for production of timber. It would be necessary to obtain permit for setting the fire in accordance with existing legislation. All cut trees, branhes, and roots shoud be removed in accordance with existing regulations, rules, and provisions.
	Site	• Allong all this section, by the waterways, on the both sides of the alignment
	Plant community	• ecosystem of forests of white willow Salicetum albae • ecosystem of white and fragile willow Salicetum albae-fragilis • ecosystem of forests of willow and poplar Salici – Populetum • ecosystem of white and black poplar Populetum nigro-albae • ecosystem of forests of willow Salicetum triandrae • shrubs with willow Salicetum purpureae
	Measures	• Planting with native species such as white willow, poplar, and sticky alder.
	Site	• Along all this section by the waterways, on the both sides of proposed alignment.
	Plant community	Forests of glossy buckthorn and sticky alder Frangulo alni-Alnetum glutinosae Forests of sticky alder in the continental areas Alnetum glutinosae montanum • Forests of sticky alder and sedges Carici elongatae-Alnetum glutinosae

	Measures	• Planting with native species such as glossy buckthorn and sticky alder.

6. SECTION: DONJA GRAČANICA - DRIVUŠA	Site	• From the settlement Donja Gračanica, via Ričica, Kopila, Klopča, to Perinog hana,
	Plant community	• Ecosystem kserotermnih šuma crnog graba i hrasta medunca
	Measures	• Clearing of forests and habitat loss
	Site	• Riparian zone of the river Bosna and its tributaries
	Plant community	• Communities of ecosystems of white willow
	Measures	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive

7. SECTION: DRIVUŠA - KAKANJ	Site	• On the slopes on the both sides of the alignment through morphostructure of Vijenac (Okruglo 749 m) to the south and the settlement Donji Lučani.
	Plant community	• Communities of ecosystems of oak and hornbeam forests
	Measures	• Construction of the highway will unavoidably lead to the clearing of oak and hornbeam forests which represent a climatogenous vegetation in the hilly part of the central Bosnia and Herzegovina.
	Site	• Wider area of Gornji and Donji Lučani
	Plant community	• Communities of ecosystems of xerotherm forests of hornbeam and oak
	Measures	• Construction of the highway will unavoidably lead to the clearing of oak and hornbeam forests which represent a climatogenous vegetation in the hilly part of the central Bosnia and Herzegovina.
	Site	• Right side of the river Bosna from Donji Lučani to Kakanj
	Plant community	• Communities of ecosystems of thermphylle forests of sycamore maple and hornbeam
	Measures	• Construction of the highway will unavoidably lead to the clearing of hornbeam and sycamore maple.
	Site	• From Drivuša to settlement Klanci, and from Gornji Lučani to Kakanj, in the form of fragments on the flat areas by the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica
	Plant community	• Communities of ecosystems of hygrophylle forests of sessile oak and hornbeam
	Measures	• Construction of the highway will unavoidably lead to the clearing of the forests of sessile oak and hornbeam.
	Site	• From Drivuša to settlement Klanci, and from Gornji Lučani to Kakanj, in the form of fragments on the flat areas by the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica
	Plant community	• Communities of ecosystems of white willow

	Measures	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	Site	• By the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica from Drivuša to settlement Klanci, and from Gornji Lučani to Kakanj.
	Plant community	• Communities of ecosystems of hygrophylle forests and shrubs with sticky alder.
	Measures	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive

8. SECTION: BLAŽUJ - TARČIN	Site	• In the zone of the waterways Trnava, Vidovac, Rakovica, Kremikovac, Krmeljevac, and Mlinčić, and Bijela rijeka and Kalašnica.
	Plant community	• Community of ecosystem of oak – hornbeam forests
	Measures	• Construction of the highway will unavoidably lead to the clearing of oak and hornbeam forests which represent a climatogenous vegetation in the hilly part of the central Bosnia and Herzegovina
	Site	• Kulliješi – Bukovica – Zabrđe – Toplica.
	Plant community	• Communities of willows and poplars
	Measures	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive
	Site	• Narrow riparian zone in the southeast and flat aspects by the river Lepenica and its tributaries Zečji potok and Bukovina.
	Plant community	• Communities of ecosystems of white willow
	Measures	• Loss of the vegetation and habitats of plant species and their communities which are distinguished by high conservation values and which are enlisted in Annex I of EU Habitat Directive

Protected natural areas

From the point of natural values protection, the most significant section of the motorway is the hairpin-bend complex which is especially developed in the zone of Papratnice, situated immediately by the proposed route on the left side, from the starting point of this section between the 7th and 8th km of the route. This area has been protected by the decision of the relevant authority of Žepče Municipality.

The hairpin-bends are subject to erosion and landslides. This process has been especially present on the locations where cutting of woods takes place, which is inevitable during the motorway construction. Because of that, very often large surfaces of bare land with rocks can be found at such locations. Plants grow on such surfaces and they are most important for hairpin-bends flora. Construction of the motorway can additionally endanger rare species developed in the area.

The protected area in the vicinity of Žepče has been established primarily for the purpose of preservation of the hair-pin bend complex which has very significant biological diversity and many endemic species of plants. The construction of the motorway will result in an increase of the number of visitors coming to this area who want to understand and appreciate the values of the protected area, and to gain some personal benefits.

Tourism in the protected area primarily depends on the preservation of the quality of the ecosystems. This is essential for the maintenance of the economy and life quality. Thus, it is necessary to carefully plan, manage and monitor tourism in the protected area in order to provide its long-term sustainability. Otherwise, negative impacts will occur.

Fauna and hunting

Data on composition of animal species on the analysed area of the motorway Vc alignment (Lot-2) was collected on the basis of conversations and consultations with the local inhabitants, while for additional data on the state of hunting game population, the hunting clubs from existing municipalities were consulted. In the data about fauna composition there is also data about hunting game, which as such presents the main and most distinctive part of fauna from the scientific as well as from expert point of view.

During preparation of the Study, those who elaborated the aspects of fauna and hunting, contacted the hunting representatives in the Public Company FES (Forest Economic Society) of the Zenica-Doboj Canton, and hunting clubs: “Borje” Teslić, “Jeleč” Žepče, “Klek“ Zavidovići, “Zmajevac” Zenica, “ Zec and Stari Zec” Busovača, “Srndać” Kakanj, “Srndać” Visoko, “Bjelašnica” Sarajevo Canton (Blažuj-Tarčin) Hadžići, “Ljestarka” Kiseljak. During elaboration of data about fauna for each section of the LOT 2, data from Earth Museum from Sarajevo was used, and Hunting Clubs and local inhabitants were consulted. For the analysis of important species, the IUCN's Red List was applied, and recommendations of the Council Directive 92/43EEC.

On the basis of field visits (in July and September 2005) and by using the recommendations of European directives, the red list of IUCN, legal regulations on fauna in B&H, the situation by sections of the motorway was prepared.

Having in mind dense population, plants are still well protected, which means larger biodiversity of fauna in this area. 26 bird species have been identified, and for some of them, flying over this area is an integral part of their migrations, while others have nests in the area. Eight types of pigeons (mane pigeon, seagull, woodpecker, etc.) are protected species by Annexes II and III Council Directive 79/409EEC.
Besides birds, species of amphibians have been recorded in the swamp areas from Karuše to Ozimice. Well preserved forest habitats resulted with well developed game, both small and large. In section 8 there are wolves and bears and they occur in the sections around Zenica as well. Deers, boars, rabbits, foxes, pheasants and quails are frequently met. Protective measures do not anticipate a large number of passages for animals because the solutions which include tunnels, viaducts and bridges have significantly mitigated negative effects on the fragmentation of habitats and free migrations. The crossings for animals and protection fence are foreseen in the following stretches of the motorway:

- Chainage km 6+072,546 do 7+166,545
- Chainage km 17+465,017 do 18+304,836

- Chainage km 25+240,114 do 26+000
- Chainage km 46+388,80 do 49+122,716
- Chainage km 13+182 do 13+275,3
- Chainage km 19+100 – protection fence

Impact on fauna is considered individually for land and aquatic, so that the negativites are , first of all, determined by degradation of plant covering and impacts on abiotic conditions in water.

Fauna composition research results for the investigated parts of the alignment are shown in the following tables with impacts and mitigation measures.

Table 4. Fauna composition research results for the investigated parts of the alignment

SECTION 1. KARUŠE-MEDAKOVO	Site	Penavino hill from the right side of the alignment, 1.5-2 km from the starting point	**PROTECTION AND MITIGATION MEASURES**
	Fauna	Rare bird species, squirrels, rabbits	
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected	• Enable withdrawal of these species into the deeper parts of ecosystem, and installation of barriers in order to prevent their losses on the motorway, when they try to cross them
	Site	Usora River 0,207.684 km	• Fast rehabilitation of the vegetative cover (trees)
	Fauna	Endemic species of water moth *(Trichoptera)*	
	Impact	During removal of bank vegetation, vanishing of this specie can directly be caused, or even its dying.	

SECTION 2. MEDAKOVO-OZIIMICE	Site	Part of the alignment with the plant communities Salkovića hill, Križanovo hill, Šiljati vrh (Sharp Peak), Tešanj – Crni vrh (Black Peak)	PROTECTION AND MITIGATION MEASURES
	Fauna	Birds: wryneck, quail, pheasant, squirrels, rabbits, foxes and wild boars	• Passages for large game in form of underpasses
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected	
	Site	River: Trebačka, 2km from the beginning of the section, Strupinska River between the Cakrame village and Ljubatovići	• Installation of net around the construction site and control of oil and lubricant leakage .
	Fauna	Birds, insects that are water dependant during the larva period	
	Impact	Rare bird specimens will move to the more peaceful parts due to the noise created during construction. During cutting of bank willow vegetation, there will be direct impacts on habitats and composition of fauna hydro-bionates, in water ecosystems, which shall lead to its degradation in this part of the watercourse	

SECTION 3. OZIMICE-POPRIKUŠE			PROTECTION AND MITIGATION MEASURES
	Site	24+901,587 km to 34+000.00 km	
	Fauna	• Birds: roller, swift, pigeon, quail, pheasant; • mammals: squirrels, rabbits, foxes and wild boars with dense populations	• passages for large animals and net to prevent crossing of small mammals, small houses for nesting birds.
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected	
	Site	Žepče surroundings	• Building of small houses for nesting birds due to removal of dendro-flora and enabling other species to change their flying corridor.
	Fauna	Birds	
	Impact	Due to general degradation of vegetative cover and noise, all species will withdraw to deeper parts of habitats, and this should be performed with the smallest possible losses	

SECTION 4. POPRIKUŠE-NEMILA			PROTECTION AND MITIGATION MEASURES
	Site	From 38+617,44 km to 39+618.00 km	
	Fauna	Rare specimens of birds, squirrels, rabbits, foxes	
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected	• Enabling unobstructed withdrawal of species by construction of paths and adequate management of the heavy machinery movement, with limited construction site. • Restoration of vegetation in the shortest period possible
	Site	Jezeračka mountain -Nemila	
	Fauna	Birds: type of pigeon *Columbia palumbas* which is protected specie according to the IUCN´s Red List and Bird Directive	• Precise identification of habitats and relocation of species to more favourable conditions
	Impact	Because of the construction works there is a possibility of species withdrawal, but also possible vanishing	
	Site	Bosna River	• Water at the construction site should be treated by sand filters, • Only after this treatment it can be discharged into the watercourse. • It would be necessary to fence the construction site with the 2 m high fence. • At certain moment you cannot make up for the cut bank vegetation, and it is thus necessary to additionally plant new trees, which would result in adequate management of the fauna at the bottom.
	Fauna	Important place within the aquatic fauna belongs to the densely populated colony of cyprinid type of fish, while in the other part of aquatic fauna, the dipterous insects are dominant, sparsely bristled animals, and leech as typical inhabitants of polluted running water	
	Impact	Because of the construction works, the excess situations are possible, leakage of lubricants, oil, or sliding of land which will probably condition the losses of aquatic fauna or their movement, which is especially related to ichthyo-populations	

SECTION 5. NEMILA-DONJA GRAČANICA			PROTECTION AND MITIGATION MEASURES
	Site	Vranduk km 50+000 -51+000	
	Fauna	Birds: gull, pigeon, *Otus scopus* i *Cuculus canorus*. The type of gull registered in this area is one of the protected species according to the European Directive – Annex II – III, rare specimens of small game.	• Construction of small houses for nesting, which would enable undisturbed reproduction of nesting birds populations. • Installation of nets in order to prevent passage of these small animals, which would to some degree mitigate negative effects on these populations.
	Impact	Due to construction works there is a possibility of losing some species and not having enough space for nests.	

SECTION 6. DONJA GRAČANICA-DRIVUŠA	Site	Bosna River bank zone	**PROTECTION AND MITIGATION MEASURES**
	Fauna	Rare specimens of birds, ducks Water fauna: well developed cyprind fish fauna, aquatic species of insects, rare specimens of crayfish, leech, snails	• Water at the construction site should be treated by sand filters, • Only after this treatment it can be discharged into the watercourse. • It would be necessary to fence the construction site with the 2 m high fence. • At certain moment you cannot make up for the cut bank vegetation, and it is thus necessary to additionally plant new trees, which would result in adequate management of the fauna at the bottom.
	Impact	Because of the motorway construction there is a possibility of bank erosion and covering of sediments, changes in the composition of zoo benthos, which will impact the change in composition and numerosity of ichthyo-populations	
	Site	Zenica (60+000 to 64+000)	• Enable withdrawal of birds to preserved parts of ecosystems
	Fauna	Birds: gull, *Pluvialis apricaria, Corcius garrulus and Otus scopus*	
	Impact	Withdrawal of birds to other habitats with smaller losses	

SECTION 7. DRIVUŠA-KAKANJ	Site	Kakanj from 75+000 to 80+000 km – Bosna River bank	**PROTECTION AND MITIGATION MEASURES**
	Fauna	Migratory bird types: gull, pigeon, magpie, wryneck, swift	For the nesting birds, construction of small houses, and for other species enabling of their unobstructed withdrawal and change in the movement corridor
	Impact	Cutting of the flying corridor and its changes	
	Site	Vijenac (Okrugla) – Donji Lučani – oak and hornbeam forest	• Construction of underpass or "green bridge" for crossing of larger game • For smaller game, nets should be installed along the motorway in order to prevent their coming out to the motorway.
	Fauna	Squirrels, rabbits, quails, pheasants, rare specimens of reptiles	
	Impact	Fragmentation of habitats, which will until the adaptation time indicate destruction of a larger number of individuals	
	Site	Bosna River with smaller tributaries	• should be treated by sand filters, • Only after this treatment it can be discharged into the watercourse. • It would be necessary to fence the construction site with the 2 m high fence. • At certain moment you cannot make up for the cut bank vegetation, and it is thus necessary to additionally plant new trees, which would result in adequate management of the fauna at the bottom.
	Fauna	Cyprinid fish types, barbel, sparsely bristled animals, leeches, dipterous insects	
	Impact	Because of the motorway construction, negative impacts on water ecosystems of Bosna River as well as of the streams flowing into this watercourse are possible, which will initiate movement of aquatic fauna	

SECTION 8. BLAŽUJ-TARČIN	Site	Lepenica	**MJERE ZAŠTITE I UBLAŽAVANJA UTJECAJA**
	Fauna	Water fauna: Trout, Miller's thumb, water moth, large diversity of water flowers, wheateater, crayfish	• Water at the construction site should be treated by sand filters,

	Impact	Because of the degradation of bank vegetation the movement of water insects or their vanishing is possible, and also sliding of land is possible and changes in the composition of zoo benthos, which can cause disappearance of movement of ichthyo-populations.	• Only after this treatment it can be discharged into the watercourse. • It would be necessary to fence the construction site with the 2 m high fence. • At certain moment you cannot make up for the cut bank vegetation, and it is thus necessary to additionally plant new trees, which would result in adequate management of the fauna at the bottom.
	Site	Bijela River – crossroads Tarčin-Kreševo	• If possible, avoid works near the watercourse.
	Fauna	Appearance of crayfish, which is according to the IUCN´s Red List the rare and endangered species	
	Impact	Species very sensitive to the anthropogenic impacts and every activity can initiate its vanishing	
	Site	Blažuj	• Due to the cutting of dendro-flora, fast revitalisation is necessary • Small houses for nesting birds
	Fauna	Birds flying over this area: eagle-owl, bee-eater	
		Cutting of the flying corridor	

Note:
In the measures for fauna protection, in form of green bridge, underpass, nets on the motorway, small houses for birds, precise location cannot be determined (in meters). During the motorway construction the monitoring will also be performed, and geologists will, according to the character of geological ground and other abiotic conditions, be able to determine the exact location in the field, and any premature judgment would be too audacious and not objective.

Also, data about impacts on aquatic fauna at places where the alignment is crossing over the watercourses are shown in the following table with mitigation measures.

Table 5. Impacts on aquatic fauna at places where the alignment is crossing over the watercourses

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Section 1. Karuše – Medakovo Km 0+000 – 4+000			The food source is being reduced for the aquatic organisms and habitats of water insects disappear by river training of the riverbed due to the removal of the vegetation. Due to the works that follow the bridge construction The additional covering and filling the riverbeds	• First and only mitigation measure during the construction is limited construction that will be fenced with net, • The control of the oil and petroleum discharge which must not be poured out into the watercourses • River training should provide revitalization of the coastal vegetation and prevent and additional covering of the riverbed
Km 0 +750 to 4+250	Balnjača Luke Village Tešanjka River	River training length L= 3,605 m – riverbed trained with the reno mattresses		
Km 0+877.410	Bridge on Tešanjka River	Concrete bridge		

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 1+763, 190	Bridge on Tešanjka River	Concrete bridge	will occur which will have significant impact on the composition and numerosity of fauna. This impact reflects in the form of direct stress that will directly and indirectly have impact on reduction of populations or disappearance of the individuals of especially sensitive species. Removal of coastal vegetation, mining and similar. Can cause additional losses of microhabitats Due to operation of large marines, there is a possibility of discharge of oil or petroleum into the river course and it can lead to change of abiotic conditions that will initiate withdrawal of hydro bionates toward the lower parts of watercourses and what is necessary to provide	➢ Provide easy passage for fish species (rare) regulated with smaller paths and similar
Km 3+121,860	Bridge on Tešanjka River	Concrete bridge		
Section 2. **Medakovo – Ozimica** **Km 4+000 – 24+876,40**				
Km 4+600 to 4+800	Obrenovac Trebačka River	River training length L= 200 m – riverbed trained with the reno mattresses		
Km 5+000 to 5+200	Obrenovac Trebačka River	River training length L= 180 m – riverbed trained with the reno mattresses		
Km 5+900 to 6+100	Bare Trebačka River	River training length L= 239 m – riverbed trained with the reno mattresses		
Km 6+900 to 7+100	Toplik Trebačka River	River training length L= 215 m – riverbed trained with the reno mattresses		
Km 6+917.00	Bridge on Trebačka River	Concrete bridge		
Km 8+500 to 8+800	Dolac Trebačka River	River training length L= 320 m – riverbed trained with the reno mattresses		
Km 9+150 to 9+350	Luke Trebačka River	River training length L= 215 m – riverbed trained with the reno mattresses		
Km 10+150 to 12+820	Karadaglije Trebačka River	River training length 2890 m - riverbed trained with the reno mattresses		
Km 10+840	Čaglići Trebačka River	Concrete bridge		

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 11+046	Čaglići Trebačka River	Concrete bridge		
Km 11+611	Zaimovići – Alispahići Trebačka River	Concrete bridge		
Km 12+748	Karadaglije Trebačka River	Concrete bridge		
Km 16+050	Mladoševica – Stupina Strupinski stream	Concrete bridge		
Km 16+730	Mladoševica – Stupina Strupinski stream	Concrete bridge		
Km 17+980 to 18+340	Galovac Strupinski stream	River training length L=373 m - riverbed trained with the reno mattresses		
Km 18+950 to 19+850	Galovac Strupinski stream	River training length L=940 m - riverbed trained with the reno mattresses		
Km 20+150 to 20+250	Ljubatovići Strupinski stream	River training length L=110 m - riverbed trained with the reno mattresses		
Km 21+150 to 21+400	Ljubatovići Strupinski stream	River training length L=230 m - riverbed trained with the reno mattresses		
Km 21+650 – 22+000	Bečkića selišće Strupinski stream	River training length L=390 m - riverbed trained with the reno mattresses		

Motorway chainage	**Location/ watercourse**	**Length and the way of watercourse training/ Bridge on the watercourse**	**Expected impact on waters**	**Mitigation measures during the construction site preparation and motorway construction**
Km 22+650 to 22+980	Bečkića selišće Strupinski stream	River training length L=350 m - riverbed trained with the reno mattresses		
Km 23+269,90	Ozimica Liješnica River	Concrete bridge		
Km 23+668	Bečkića selišće - Ozimica Strupinski stream	River training length L=348 m - Ozimička petlja and L= 60m Goliješka petlja - riverbed trained with the reno mattresses Concrete bridge		
Section 3 **Ozimica – Poprikuše** **Km 24+876,40 – 37+740**				
Km 28+026,44 0	Tatarbud žak Stream 50	Concrete bridge		
Km 28+676,44 0	Tatarbud žak Stream 51	Concrete bridge		
Km 28+876,44 0	Tatarbud žak Stream 52	Concrete bridge		
Km 29+626,44 0	Vašarište – Bljuva Bljuva Stream	Concrete bridge		
Km 32+026,44 0	Papratnic a Ljubna River	Concrete bridge		
Km 32+526,44 0	Papratnic a Papratnic a River	Concrete bridge		

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Section 4 **Poprikuše – Nemila** **Km 37+740 – 46+388,80**				
Km 41+690	Kahriman i Sarevački stream	Concrete bridge		
Km 42+970	Topčić field Stream 63	Concrete bridge		
Km 43+170	Topčić field Kočin stream	Concrete bridge		
Km 46+090	Orahovačko field Krivača River	Concrete bridge		
Section 5. **Poprikuše – Nemila** **Km 46+388,80 – 58+434,60**				
Km 46+500	Orahovačko field Stream 71	Concrete bridge		
Km 46+800	Nemila Repeljski stream	Concrete bridge		
Km 47+000	Nemila Selački stream	Concrete bridge		
Km 47+540	Nemila Stream 75	Concrete bridge		
Km 47+670	Nemila Stream 76	Concrete bridge		

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 56+300	Vranduk Stream 80	Concrete bridge		
Km 56+650	Vranduk Jelovik Stream	Concrete bridge		
Km 57+860	Donja Gračanica Gračanička River	Concrete bridge		
Section 6. Donja Gračanica – Drivuša Km 58+434,60-66+941,10				
Km 58+537,350	Donja Gračanica Suha River	Concrete bridge		
Km 59+640	Zenica - Dobra voda	Concrete bridge		
Km 61+036	Zenica – Kopilo Babina River	Concrete bridge		
Km 64+540	Zenica – Perin Han Stijenčice Stream	Concrete bridge		
Km 65+580	Zenica – Perin Han Stream 87	Concrete bridge		
Km 65+690	Zenica – Perin Han Đulanova River	Concrete bridge		
Section 7. Drivuša - Kakanj Km 66+941,10 – 82+121,10				

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 67+691 to 67+941	Drivuša Bosna River	River training length L= 250 m – riverbed trained with the reno mattresses		
Km 68+321,10	Janjići Prihodi Stream	Concrete bridge		
Km 75+537,30	Modrinje Repovački Stream			
Section 8. **Blažuj – Tarčin** **Km 0+000 – 18+885,40**				
Km 1+770	Vlakovo – crossing Kulićev Stream	Concrete bridge		
Km 4+050	Kobiljača – Rudnik Rakovica River	Concrete bridge		
Km 4+700 – 5+750	Rakovica Kremikovac Stream	River training length L= 850 m – concrete riverbed		
Km 7+400	Azapovići Stream 109	Concrete bridge		
Km 9+300	Kuliješ Stream 113	Concrete bridge		
Km 10+720	Donji Bojakovići Stream 114	Viaduct		
Km 11+120	Solaković Stream 115	Concrete bridge		

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters	Mitigation measures during the construction site preparation and motorway construction
Km 11+950	Zabrđe – Mokrine Mlinčići Stream	Viaduct		
Km 12+675	Zabrđe – Mokrine Stream 117	Concrete bridge		
Km 13+037.890	Zabrđe Tisovački Stream	Concrete bridge		
Km 18+330	Tarčin Mlavica Stream	Concrete bridge		
Km 18+300 to 18+500	Tarčin Bijela River	River training length L= 230 m – riverbed trained with the reno mattresses		
Km 18+512	Tarčin Korča River	Concrete bridge		

For the protection of water flows which in the hydrosphere cycle provide the main supply of underground waters, monitoring has been planned, which includes a biological component (fit-benthos, macro-invertebrate and ihtio-population).

Landscape

Guidelines presented in the environmental study for “the Corridor Vc Motorway“is the basis for informing the public. It is necessary to make possible communication with the interested parties, including the needs of the community which is one of the very important elements.

The public, which is an integral part of the environment, should be stimulated in the project design stage in order to receive proposals and suggestions on time. Environmental study encompasses three areas which treat the issues of landscape form:

Due to the increase of the level of material and social development, researches and measures which refer to the form and protection of landscape presented in the Study are becoming a need and long-term interest of the population and communal and political institutions. Because of that, implementation of goals and tasks in this project can be successfully implemented only through active participation of all interested parties. Main guidelines of the landscape form around the motorway and its fitting into the existing surrounding area have been presented in the study.

This was done by taking care for the protection of natural and ambient values. The landscape shaped in this way will provide clarity of the route, safe traffic and meeting of functional and aesthetic requirements.

It is obvious that the route of the motorway is very significant for the environment. Consequences of the impact are most frequently manifested as damage to the environment, decrease or destroying of some parts of the landscape. Environmental study precisely identifies the possibilities of such manifestations and the protective measures.

Negative impacts on the settlements located in the vicinity of the motorway are manifested as noise, dust, pollutants, wind etc. For all these negative impacts, adequate protective measures have been presented. Special attention has been paid to identification of different categories of the existing natural resources and their preservation.

The protection in the form of green areas around the special-purpose facilities in the vicinity of the route (hospitals, schools, residential and public buildings, etc.) has been planned.

Environmental study includes landscape shaping of newly created leisure locations for different purposes (rest areas, dividing lanes, intersections, motels, gas stations and car parks). Regardless of the type of green area, these surfaces complement and enrich the existing plant population. Some of them may be picnic areas for passive and active recreation of the population in the nearby settlements.

Environmental impacts during construction stage caused by measures and acts of construction organization and technology

Construction of a motorway is a large and significant technical operation in the landscape followed by different, mainly intensive impacts on the environment: impacts on population, air, water, land, flora and fauna, cultural, historical and natural heritage, landscape, microclimate, etc. Organizational and technical measures are available for avoiding or mitigating these impacts.

Obligation of the Investor is to select the contractor with a clearly defined policy of good-quality management (product, environment and health management) approved in practice (approved by certificate and everyday work) and to perform transfer of environmental responsibility to the contractor. The key requirement and important criterion for the selection of a specific contractor is the development of complete and good Project of technology and organization of implementation of motorway construction works, which would include all necessary studies, solutions, annexes and documents.

Such project, besides the usual items, has to contain an assessment made by the contractor of the impact on the environment during the construction stage of the motorway – based on findings and recommendations of the environmental study – with detailed description of the measures and list of needed funds, with a note who will implement the measures.

This means that specific WORK RULES and detailed MANUALS should be defined at the level of the construction site, which provides that the goals established in the good-quality management are fulfilled. Such project of technology and organization of construction works should be revised by the relevant professional institution, approved by the developer of the study and project documentation and officially approved by the investor, as an integral part of the contract on handing over the works.

Relevant governmental authorities should demand from the contractor a complete project of technology and organization of construction works in order to issue suitable urban consents for all preparation works, that is technical solutions for the protection of the environment during the work implementation stage on the basis of which inspection monitoring during the construction will be made.

Air quality

Concentrations of polluting materials along the route are result of emission (traffic and background sources), meteorological parameters and terrain configuration. Measures of polluting material in the atmosphere, which will be incorporated into the Study, were done with software for emission calculations and concentration of polluting materials close to motorways MLuS 02 (calibrated in Germany). Recommended program values were used as input data since relevant data about air quality in subject area where neither relevant nor reliable. For the sections where modeling was done, the values used were those for highly polluted (rural) environment. With assumed values of a specific vehicles emission for 2008, above mentioned is considered a pessimistic scenario.

Other input parameters, adopted from relevant planning study made for design Motorway in a Vc Corridor, are as follows:

1. Road category: Motorway – design speed 120 km/h
2. AADT: 23848 vehicles
3. Percentage of heavy vehicles in traffic: 15,3%
4. Alignment gradient: 0%
5. Climatology data: average wind speed 2 m/s and average relative air humidity 30%.

Modeling was done for the section with biggest average annual (daily) traffic (PGDS) and at location relatively densely inhabited and close to tunnel portal[4]. After analyzing the results of modeling air quality on section Lašva krak1-Kakanj end at location Donja Gračanica, following can be concluded:

- There is no need for further calculations since results appear to be in accordance with regulations for the section with biggest PGDS and location which is in the zone of enlarged concentration of polluting materials. Building on abovementioned it can be concluded that regulations are satisfied for the whole area subject of analysis (area close to motorway route in a Corridor Vc – Lot 2.)
- Traffic on a Motorway in Corridor Vc – Lot 2 should not influence the concentration of polluting material in the area close to future motorway route with negative impact on health of a people who live in analyzed area.
- It is reasonable to assume that in short terms standard values concerning human health could be exceeded for LČ10 and NO2, and only in areas with high background pollution in the vicinity of future motorway and especially close to tunnel portals. Individual residential buildings would then have to be protected with sound barriers which lower diffusion of emitted polluting material and tunnels should have to be supplied with vertical ventilation tubes.

[4] Higer concentration is usual for vicinity of tunnel portals because emmissons are acumulated inside tunnels.

- It is possible that acceptable limits air quality concerning ecosystem protection for NOx might be exceeded. However, this standard cannot be applied to the areas in a vicinity of the motorway, which were analyzed in this study.

It is worth mentioning that pollution of air and soil with lead is not likely to happen because Law on air protection (Official Gazette FB&H) prohibits usage of gasoline with lead in FB&H after January 1, 2010.
In cases where it was not possible during design to include measures which contribute to prevention of impacts from vehicles to air quality[5] i.e. in sections/locations where influence is unavoidable, following measures must be introduced:

- Designing of sound barriers, which at the same time lower diffusion of emitted polluting material;
- Designing of vertical ventilation tubes in tunnels in order to decrease concentration of polluting material at tunnel portals;
- Introducing stricter speed limit in areas with high background concentration;
- Planting of dense green vegetation in area between road and houses in order to filter the pollutants.

Locations where above-mentioned measures are to be taken into account are shown in table 1.

In a period of exploitation:

Growth of PGDS for 3,20% to 5,60% per year is predicted in a period 2013. - 2042. At the same time, concentration of polluting material should not follow the growth of PGDS having in mind further development of motorcar technology, expanding need for alternative fuels and standards in force for new vehicles concerning gases emission.

In any case, constant monitoring of polluting material is recommended, as a basic protective measure during exploitation of corridor Vc. Monitoring should be done in accordance with Monitoring rule-book, at all locations where motorway runs through settlements, in sections with bigger alignment gradient and PGDS and in a vicinity of tunnel portals.

When monitoring area in LOT 2, locations shown in Table 1.2 should be considered as wider choice. Concentration of LČ10 and NO_2 depends on wind direction and strength. This implies that it is important to take position of settlements into consideration in a relation with wind rose when selecting monitoring locations on motorway.

[5] Capacity designing in order to avoid traffic jams and suden changes in driving regime, chosing of routes, placement of interchanges and tunnel tubes close to settlements, schools and working places etc.

Table 6. Locations for consideration regarding stated mitigation measures [6]

Section	Chainage	Location
1: Karuše - Medakovo	0+450 do 1+200	Tešanjka
	2+250 do 2+800	Luke
	3+525	petlja Medakovo
2: Medakovo - Ozimica	4+000 do 5+070	Obrenovac
	11+300 do 12+880	Koprivci
		Karadaglije
	23+300 do 24+400	Ozimica
3: Ozimica - Poprikuše	28+600 do 29+700	Tatarbudžak
	31+770 do 32+120	Rosulje
	32+350 do 32+600	
	37+200 do 37+810	Poprikuše
4: Poprikuše - Nemila	41+390 do 43+560	Topčić Polje
	45+450 do 45+610	Nemila
	46+040 do 46+120	
	46+200 do 46+390	
5: Nemila - Donja Gračanica	46+390 do 47+070	Nemila
	47+130 do 47+800	
	51+200 do 51+850	Vranduk
	52+150 do 52+600	Ponirak
	57+630 do 58+540	Donja Gračanica
6: Donja Gračanica - Drivuša	58+530 do 58+830	Donja Gračanica
	59+150 do 59+920	
	62+900 do 63+420	Krčevine
	63+730 do 67+060	
		Drivuša
7: Drivuša - Kakanj	67+060 do 67+600	Drivuša
	68+450 do 69+370	Janjići
	72+650 do 74+350	Lučani
		Bilješevo
	77+700 do 79+400	Krivače
	79+400 do 80+950	Dumanac
	80+950 do 82+260	Karaulsko Polje
		Slivnice
8: Blažuj (Vlakovo) - Lepenica	1+500 do 5+750	Šamin Gaj
		Rakovica
	9+060 do 9+570	Homolj
		petlja Lepenica
9: Lepenica - Tarčin	11+200 do 13+500	Bojakovići
		Solakovići
		Bukovica
		Zabrđe
	13+800 do 14+230	Toplica
	18+240 do 18+710	Tarčin

[6] Ove lokacije primarno porediti sa lokacijama na kojima su predviđeni zidovi za zaštitu od buke, te ukoliko isti nisu predviđeni, sprovesti neku drugu mjeru zaštite.

Final selection of locations and their number and means available will be in accordance with laws in force.

During motorway construction, following can be proposed:

- Spraying of non-paved access roads with water
- Covering of trucks that transport material
- Limiting the speed on non-paved (access) roads
- Avoiding idling of mechanization
- Using modern and efficient mechanization.

Socio-economic analysis

Socio-economic analysis made within Study is divided into 2 parts:

Socio-economic propositions – Detailed examination of influenced area, demographic settlement characteristics and analysis of economic parameters. A main characteristic for the analyzed area is the densest concentration of settlements and inhabitants. Area under direct influence includes 93 settlements located in 9 municipalities (Maglaj, Usora, Tešanj, Žepče, Zenica, Kakanj, Ilidža, Hadžići, Kiseljak). According to estimate 132.322 inhabitants lived in the area under direct influence in 2004.

Zonal plans and Municipality development plans are thoroughly presented on Background for Documentation of the Plan – LOT 2. This document is completed together with the Study for further phases of zonal plans preparation. Area of Zenica-Doboj, Srednja Bosna and Sarajevo cantons, through which motorway route in a Corridor Vc runs are areas with highest level of economic development: Gross production value and (GDP), modern indicator of economic development.

Structure of employment in these three cantons, according to standardized field classification, shows the highest percentage of employment in industry 47.253 (53.3% in FB&H, and 28,8% in analyzed area), commerce 25.329 (16,9% in analyzed area), public administration and services 19.096 (10,7%% in analyzed area), and education 16.636. Traffic and connections employ 14.710 workers which amounts to 53% of employed in traffic for whole FB&H.

Socio-economic influence from motorway in Corridor Vc construction – analysis of influence from construction and utilization: Motorway construction in analyzed area will increase the speed of a traffic flow, division of traffic and other changes which can be expected along motorway and at locations where interchanges will be constructed.

New motorways could foster separation/division of local communities and severing traditional traffic lines. Alternate routes for local transport could become longer after motorway is constructed, which directly affects business and non-mechanized transport. Whether urban or rural, the existing transportation routes should remain in function where possible. In rural areas, existing normal connections between villages and fields could be interrupted, so construction of underpasses or over-bridges should be considered.

Tenth chapter in document Background for Documentation of the Plan - LOT 2 pinpoints measures addressing the avoidance of or decreasing of abovementioned possible conflicts. Interchanges position, space collisions with motorway route and meeting the needs for traffic connections have been analyzed.

Relatively high number of waterways regulations and displacement of local roads was analyzed together with construction of high number of de-leveled passages between local inhabitants and regional roads or arable areas. Further, specific locations at chosen motorway route in Corridor Vc – LOT 2 are shown:

Because of technical solution for route in the edge part of Nemila settlement (Sector II), which consists from connected tunnels, interchange construction is under question mark. Position of neighbor interchanges (Poprikuše and D. Gračanica), justifies further analyses.

Sector III is bypass around Zenica regional center (administrative center of Zenica-Doboj canton). In the vicinity of adopted motorway route, there is relatively high number of individual residential houses. Due to conceptual change in design solution on connection between motorway route and existing road in Drivuše area (relocation of section in collision is proposed), construction of proposed semi-interchange Lašva – branch2, in Janjići settlement is being rethought. Adopted route in Preliminary solution was changed in Lepenica location, following request from Kiseljak municipality and due to the vicinity of a primary school. Because of cemetery location in Toplica settlement (municipality Kiseljak), it is necessary to construct short tunnel instead of deep cut which was foreseen in Preliminary design. Further, concerning the fact that social unity of settlements is disturbed and large number of residential houses is endangered with positions of Ozimica and Donja Gračanica interchanges, it is advisable to change micro locations of these interchanges.

Finally, positions of existing and planned infrastructure facilities (overhead transmission lines, gas pipelines and telecommunication capacities) have been analyzed. Conflicts with future motorway route are identified and recommendations are being made. Construction of a motorway should result in a rational connection between B&H regions and neighboring countries and regions, and should help foster stabilization and development of our country. Improvements of transport conditions will improve life quality which will be manifested through:

- Decreased road lengths and shorter traveling time for goods and passengers;
- Lower transport expenses for both goods and passengers;
- Increase in employment in different branches
- Increase in value in geo-traffic sense for B&H
- Increase in competitiveness of B&H economy in the gravity area of the corridor;
- Start of new projects and enlargement of private investment in regional economy;
- Improved access to markets for goods transported through future motorway in the Corridor Vc
- Improved access to work and more employment posts;
- Decrease of accidents with pedestrian involvement and related socio-economic expenses due to decrease of current overlapping transit and local traffic;
- Positive influence to the houses and business in the vicinity of motorway route related to easier access due to displacement of high intensity traffic away;
- Business opportunities for local companies in sectors of road construction, transport, exploitation and raw material processing (rocks, pebbles, cement, asphalt etc.)
- Construction works will open short termed and farfetched working opportunities.

On the other hand, project will have some negative implications, especially local society-economic influences:

- Loss of houses and property (agricultural land and forest)
- Limited private land exploitation
- Losses in agricultural production (loosing of smaller incomes and arable land could influence household economy)

- Decrease of resident property values due to vicinity of motorway, which is globally known effect from construction of big transport infrastructure structures
- Influences to a business/industry due to conflict with motorway route.

Infrastructure systems

Through motorway route selection and design, potential area conflict with infrastructure systems and utilities was solved, i.e. suggestions where given for locations where measures must be undertaken in order to avoid these conflicts.

Motorway route was chosen with respect to all criteria set, avoiding where possible areas planned for water accumulations like Toplice accumulation and water protection area in municipalities Tešanj and Maglaj. Route alignment is made in accordance with elevations of maximum gradient on hydro-energy structures on river Bosna. Further, the attention was paid to motorway influences on city water supply primary structures in Zenica and Žepče. Route is in accordance to reservoir position and city system purifiers. Locations where motorway route leads through rural areas, with big number of smaller-individual and rural water supply systems, are identified as possible conflict points. This primarily applies to municipalities of Maglaj and Kiseljak. In these areas, problem of route crossing over smaller supply pipelines requires application of certain technical solutions of pipelines' relocation through delevelled local roads passages.

All electro-magnetic capacities, high voltage transformer stations and distributive transmission lines are identified. Existing high voltage overhead transmission lines of 400 kV, 220 kV, 110 kV and 35 kV, intersect with motorway corridor area. Reconstruction of these overhead transmission lines could be required according to security and technical regulations.

A natural gas pipeline exists in the observed area of municipalities Kakanj and Zenica through which runs the part of motorway. Zonal natural gas pipeline Semizovac – Kakanj – Zenica L=54km runs along the existing M17 route in the region of Kakanj (on the right-hand side facing in the direction of Zenica). In the region of Karaula and Donji Kakanj it crosses to the right bank of river Bosna and across notch Mioc enters into area of municipality Zenica, place Perin-Han. In this municipality the pipeline and planned route of the motorway cross at several points at the section Perin-Han – Crkvica which will have to be dealt with accordingly in IDEJNI PROJEKAT by solving collision points of motorway and natural gas pipeline.
Natural gas pipeline branch for the supply of towns in Northern Bosnia is planned. There is planned introduction of Gas supply for the city of Kiseljak and primary Gas pipeline is planned to run along the existing regional road Blažuj - Kiseljak. Routes of all planned pipelines must be made in accordance with adopted motorway route.

Analyzed area is covered by two different systems for mobile and wired phone services. Part of the observed area is covered by Eronet provider. As there are many points of collision of phone wiring and planned motorway route it requires minor reconstructions in volume and occasional reconstructions and protections at the interchanges which also applies to all other telecommunication wiring. At the planning and design of new telecommunication capacities the locations must be made in accordance with planned motorway route. This applies for all Base Transceiving Stations including the ones in tunnels. Having in mind the fact that all roads intersect with motorway in two levels it is estimated that telecommunication cables would not have to be reallocated and all what will need to be done is providing additional protection for them. Already installed telecommunication wiring is mostly placed along the existing roads.

Climatology characteristics

Climatology of the LOT 2 – sector is relatively favorable. Influence from moderate continental climate from "Pannonian plain" follows River Bosna valley all the way to Sarajevo basin. This is the reason why the change of temperature according to altitude is smaller than usual. Change of the annual middle temperature from Doboj to Tarcin is 2,5^{o}C, although the altitude difference is 514m. This can also be applied to other meteorological parameters related to elevation.

Regime of precipitations is different for different locations. The driest area is Zenica basin related to surrounding relief, although in other areas the sum of precipitation is related to altitude. In Zenica basin the intensity of precipitations is smaller. Relief of this sector is extremely complicated, and some parameters like meteorological conditions, differ at different locations in the sector. In canyons (stretch Maglaj-Vranduk tunnel and wider area of Lasva river mouth-Visoko) the biggest problems are fog and decreased visibility, together with dew, ice on the pavement end other effects due to increased humidity. Danger arising from above described is vehicles sliding on the motorway.

In basins and cuttings, winds are stronger, so adequate protection must be designed. At these locations, daily temperature amplitude is bigger due to stronger insulation, especially during winter when difference between morning and max daily temperature reaches 18-20^{o}C. This is also very important in a respect to snow and ice melting, and sharp shifts from shade to sunny areas.

Apart from fog, visibility is often affected by sunlight blindness, especially during winter time due to low sun position, and depending to direction of motorway route and disposition of motorway structures.

Noise protection

Motorway noise comes from 4 sources: (a) vehicles (b) friction between vehicles and motorway pavement (c) drivers' behavior and (d) construction and maintenance. Noise from vehicles comes from engine activity, transmission, exhaust, differential system and is most intensive at speeding up on the uphill sections, using engine to break, on poorly maintained roads, and during "stop and go" traffic conditions. Poor maintenance of motor vehicles contributes to increased noise level on the roads. Motorway noise is the result of the friction on the contact point of the vehicle wheel and road surface and contributes to overall traffic noise emission. Noise level depends on tire and road surface condition. Friction noise is very high at high speeds and breaking. Drivers' behavior contributes to the increase in noise by using sirens, playing loud music, kick-starting and intensive breaking. Building and maintenance require the use of heavy construction vehicles which during use increases to noise level

Until today there are no legally defined noise levels in Bosnia and Herzegovina or in any of the entities who are in charge of environmental protection. Therefore, the rules and regulations used are those of canton Sarajevo.

Traffic on the motorway will result in high levels of noise emission due to planned PGDS. Noise level during night will exceed standard value of 50dB (A) in the vicinity of the motorway. The noise will have negative impact on settlements surrounding the planned motorway route. Knowing that rural settlements along the planned route have both residential and commercial character it will be classified as IV Zone. Therefore, in this study the acceptable levels of noise used are 60 dB (A) during the day and 50 dB (A) during the night. In cases when object or objects belong to groups I, II or III the noise levels corresponding to respective groups were used. Standards of 60/50 dB(A) applied are comparable to those of WHO and regulations for the EU countries.

For estimate of noise impact, night level noises were used as criteria being generally more restrictive than daytime levels. Contour noise lines during the night are represented in Noise maps. Results represent noise impact on objects placed in the vicinity of the motorway. Noise maps resemble two scenarios. First scenario represents Noise map in the situation without protective measures introduced and other represents the situation with protective measures introduced.

Noise map without protective measures defined possible length of acoustic wall in inhabited areas endangered by noise levels since the noise levels are higher than the standards for the nighttime. Noise map without protective measures is made upon the calculation analyzing situation with 2D and 3D models for the planned motorway route containing characteristics of both terrain and route. Motorway characteristics represent defining daytime and nighttime traffic and standard used for calculation of noise levels. PGDS is taken over from the Traffic study as well as the relationship between daytime and nighttime traffic and percentage of heavy vehicles in daytime traffic.

Tabele 7. Necessary measures for mitigation of noise impact

Section	Chainage (km)	Wall at the right side of the motorway[7]		Wall at the left side of the motorway		Area of the wall (m2)	Recommended number of structures for passive protection
		Wall height (m)	Wall lenght (m)	Wall height (m)	Wall lenght (m)		
Section I 0+000-04+000 km	0+81,5-0+191	1-5	109,5	--	--	438	17
	0+010-0+150	--	--	1-5	140,0	530	
	0+455,5-0+646,5	1-5	152	--	--	600	
	0+485-1+144	--	--	1-5	659	2678	
	0+785-1+199	1-5	414	--	--	1943	
	1+590-1+770	--	--	1-5	180	630	
	2+324-2+590	--	--	1-5	266	1237	
	2+220-3+280	1-5	1060	--	--	3610	
	3+280-5+152,5	1-5	1872,5	--	--	7307,5	
	3+699-4+075	--	--	1-5	376	1662	
Section II 04+000-24+901 km	4+243,5-4+812,5	--	--	1-5	569,5	2470,5	133
	5+175-5+664,5	--	--	1-5	489,5	2407,5	
	7+804-8+064	1-5	260	--	--	1180	
	8-900-10+280	1-5	1380	--	--	3330	
	9+367-9+567	--	--	1-5	200	900	
	9+596-9+676	--	--	1-5	80	340	
	10+153-10+191,5	--	--	1-5	38,5	192,5	
	10+271-10+949	1-5	678	--	--	2895	
	11+007-11+107	1-5	100	--	--	100	
	11+205-11+825	1-5	620	--	--	2950	
	10+414-10+745	--	--	1-5	331	1210	
	11+197-12+037	--	--	1-5	840	3980	
	17+037-17+237	1-5	200	--	--	600	
	17+437-17+808	1-5	371	--	--	1629,5	
	17+929-18+849	1-5	920	--	--	4220	

[7] Direction follows the chainage of the road.

Section II 04+000-24+901 km	18+900-19+300	1-5	400	--	--	1840	
	19+308-19+688	1-5	380	--	--	1800	
	16+764-16+824	--	--	1-5	60	300	
	16+888-16+988	--	--	1-5	100	340	
	17+090-17+264	--	--	1-5	174	810	
	18+020-18+620	--	--	1-5	600	2410	
	18+647-19+444	--	--	1-5	797	3502,5	
	19+695-19+935	--	--	1-5	240	1200	
	20+166-20+226	--	--	1-5	60	300	
	20+445-20+705	--	--	1-5	260	1270	
	20+745-20+845	--	--	1-5	100	490	
	21+120-21+676	--	--	1-5	556	2334	
	21+676-22+036	1-5	360	--	--	1680	
	22+680-23+011	1-5	331	--	--	1153	
	23+010-24+750	1-5	1740	--	--	7170	
	21+520-22+089	--	--	1-5	569	2680,5	
	22+200-22+520	--	--	1-5	320	1270	
	22+830-23+350	--	--	1-5	520	1840	
	23+359-24+659	--	--	1-5	1300	5660	
Section III 24+876-37+726	27+849-28+501	3	652	--	--	1956	82
	28+649-29+724	3	1075	--	--	3225	
	31+776-32+130	3	354	--	--	1062	
	32+336-32+612	3	276	--	--	828	
	32+926-33+266	3	340	--	--	1020	
	35+376-35+630	3	254	--	--	762	
	37+376-37+839	3	463	--	--	1389	
	24+890-26+008	--	--	3	1118	3354	
	26+250-26+768	--	--	3	518	1554	
	27+856-28+506	--	--	3	650	1950	
	28+600-29+748	--	--	3	1148	3444	
	31+750-32+103	--	--	3	353	1059	
	32+336-32+610	--	--	3	274	822	
	32+880-33+300	--	--	3	420	1260	
	35+120-35+547	--	--	3	427	1281	
	37+199-37+752	--	--	3	553	1659	
Section IV 38+617-46+289 km	41+390-42+488	3	1196	--	--	3588	16
	42+660-43+488	3	828	--	--	2484	
	43+870-44+241	3	371	--	--	1113	
	46+040-47+062	3	1022	--	--	3066	
Section V 46+289-58+434 km	46+964-46+972	3	8	--	--	24	70
	47+022-48+768	3	1746	--	--	5238	
	49+988-50+304	3	316	--	--	948	
	51+269-51+787	3	518	--	--	1554	
	54+944-55+113	3	169	--	--	507	
	55+992-56+646	3	654	--	--	1962	
	57+516-58+733	3	1217	--	--	3651	
	58+311-58+733	--	--	3	422	1266	
	57+553-58+275	--	--	3	742	2226	
	51+212-52+504	--	--	3	1292	3876	
	59+053-59+868	3	815	--	--	2445	
	59+908-60+166	3	258	--	--	774	
	60+169-60+554	3	388	--	--	1164	
	60+899-61+600	3	701	--	--	2103	
	61+678-61+896	3	218	--	--	654	

Section VI 58+434-66+959 km	62+804-63+342	3	538	--	--	1614	108
	63+476-67+070	3	3594	--	--	10782	
	59+908-60+166	--	--	3	258	774	
	60+169-60+562	--	--	3	393	1179	
	61+113-61+589	--	--	3	476	1428	
	61+670-61+888	--	--	3	218	654	
	62+804-63+342	--	--	3	538	1614	
	63+930-65+352	--	--	3	1422	4266	
	65+517-66+401	--	--	3	884	2652	
	66+568-66+981	--	--	3	413	1239	
Section VII 66+959-82+559 km	66+864-68+669	3	1835	--	--	5505	145
	68+701-69+266	3	565	--	--	1695	
	72+530-74+388	3	1858	--	--	5574	
	74+597-75+744	3	1147	--	--	3441	
	76+597-77+315	3	718	--	--	2154	
	78+092-79+023	3	931	--	--	2793	
	79+148-81+614	3	2466	--	--	7398	
	66+857-67+665	--	--	3	808	2424	
	69+064-69+295	--	--	3	231	693	
	72+404-74+403	--	--	3	1999	5997	
	75+578-76+273	--	--	3	695	2085	
	77+440-80+108	--	--	3	2668	8004	
	80+738-81+850	--	--	3	1112	3336	
Section VIII 0+000-18+800 km	1+510-2+540	3	1030	--	--	3090	158
	2+680-3+043	3	363	--	--	1089	
	3+225-5+894	3	2669	--	--	8007	
	6+010-6+363	3	353	--	--	1059	
	7+185-8+131	3	946	--	--	2838	
	9+080-9+868	3	788	--	--	2364	
	10+140-12+231	3	2091	--	--	6273	
	12+405-14+239	3	1834	--	--	5502	
	18+240-18+717	3	477	--	--	1431	
	1+450-3+946	--	--	3	2496	7488	
	4+153-5+000	--	--	3	847	2541	
	5+105-5+602	--	--	3	497	1491	
	7+185-8+131	--	--	3	946	2838	
	9+250-9+848	--	--	3	598	1794	
	10+140-10+881	--	--	3	741	2223	
	11+302-12+989	--	--	3	1687	5061	
	13+110-13+684	--	--	3	574	1722	
	18+240-118+717	--	--	3	477	1431	

Motorway management and monitoring system

Although detailed analysis and sometimes even calculations have been done, some of the environmental impact estimates, which were basis for design solutions, could be unreliable. Further, environmental conditions change in time and so does the environmental legislature. This is the reason why some of the planned measures for decrease of environmental impacts, could turn out to be insufficient or even not applied. Therefore, the state institutions are tasked with organization of environmental monitoring. Strictly, the monitoring means following of pollutant emission (to air, water etc) and changes in environmental parameters (quality of air, noise level, river water quality, changes in soil quality etc.) In wider sense, it includes monitoring of social-economic parameters, like motorway influence to inhabitants migration for example. Aim of monitoring system is control of all systems influencing the environment quality (motorway water purification, maintenance of these devices, regularity in a case of accident (leak of chemicals on the motorway etc.). Additional organizational and investment measures are taken on a basis of monitoring results.

Monitoring is with multiple purposes: (i) managing, (ii) data obtaining, including basis for planning and (iii) scientific purpose. Monitoring can be done in a real time, when information must be submitted and used promptly (accident), or through annul reports for last year. Monitoring project is not a precondition for Environmental Permit issuing, but is necessary for tendering on construction financing and motorway maintenance. Impacts to the motorway are followed by impacts to surrounding and could be classified as favorable, necessary and unfavorable. Favorable impacts are planned changes in landscaping including motorway, and wider economic effects. Necessary effects are, for example, excepted changes in purpose of fertile soils or acceptable level of noise. Unfavorable impacts are oil leaking into a river during accidents, air pollution over acceptable limits or deforestication during construction.

Monitoring should identify:

1. State in the moment of Study on Environmental Impacts preparation,
2. State in the moment of construction works beginning,
3. State in the moment of construction works finish, and
4. State during exploitation.

This practically means that monitoring system must be established instantly. Of course, the system can not start with full capacity, since it is not built yet, but must be designed and developed from the beginning, having in mind institutions responsible for its start, functioning and data dissemination. It is obvious that responsibility falls on state institutions (body in charged for motorway project in general and state institutions in charged with environmental protection. The whole system can be divided into three phases: Zero state monitoring, Monitoring in a phase of construction and Monitoring in a phase of motorway exploitation.

Monitoring does not include only parameters following, but also following the state institutions' capability to organize monitoring and dissemination of results.

Zero state monitoring should follow the conditions in a period between Study preparation and start of construction. It should: (i) point out whether any of environmental parameters have changed in an unpredicted way prior to the construction, and (ii) to obtain additional basis for Main design preparation, and to define the environmental conditions, necessary for construction permit issuing. Zero state monitoring should particularly include:

- Changes in area purposes (plans and physical changes): plans for construction of auxiliary and alternative roads, changes in area and town-planning documents, construction or removal of important structures,
- Water,
- Soil,
- Eco-systems.

Monitoring in a phase of construction is related to the period between planning and site preparation to the end of construction works**.** It includes the influences in the phase of material preparation within the corridor area, transportation of material and mechanization, and construction (impacts from mechanization work and maintenance and consequences from these impacts). Monitoring expenses should be included in motorway construction expenses. Essential is the presence of archeologist during construction. All areas where archeologist presence is necessary during construction are marked in a Study.

Monitoring in a phase of motorway exploitation should include:

- Following of socio-economic parameters' changing (indicators) related to motorway wider area (changes in number of inhabitants, development of settlements close to motorway, changes in economic development parameters),
- Following of possible changes in water supply and possible water pollution
- Following of soil quality and possible soil pollution
- Following of air quality and ambient noise

Cycles of environmental quality insurance is finished, and new one starts with responsibilities and actions by state institution in charged with motorway management. This primarily includes monitoring functions in prevention of ice on motorway pavement, cleaning of snow, maintenance of motorway water purifiers, organization and maintenance of emergency systems etc.

This system must start functioning from the moment of Study adoption, and state institutions in charged of monitoring must be clearly identified. Of course, the system can not start with full capacity, but it is important that it starts functioning and develops itself in time. If this does not happen, Studies on environmental protection might seem to be made only for procedural formalities, and not in order to provide sustainable development of motorway corridor area nor of State.

Measures connected to transportation conditions by accidents

Environmental impacts in most cases are considered to be continuous events (e.g. pollution of air by fuel combustion in engines). However, accidents may also occur and significant impacts on the surroundings may occur in a very short period of time. Accidents may be natural or caused by humans. Also, the accidents may occur on the road or outside of it. They may cause damages of different proportions. They can not be fully avoided and it is necessary to manage them through Risk management. Procedure for the risk includes: (i) risk assessment, (ii) risk management, and (iii) risk communication.

In the case of a motorway, the accidents may be connected to: (i) usage of the motorway, and (ii) activities which are implemented in the immediate surroundings of the motorway. Use of a motorway results in accidents which can be caused by the following: inadequate driving conditions which are not in accordance with features of the road, traffic conditions or weather conditions, fatigue of the driver, including other conditions which influence quality of driving, and lack of adaptation of traffic conditions to the specific load which is transported. Risk is higher on bridges, overpasses and underpasses, and especially in tunnels. Here, it is necessary to pay special attention during the design phase of the road, and in case of longer tunnels a special risk management programme should be made which includes constant monitoring and a team for prevention of accidents and fast reaction.

The issue of traffic accidents is one of significant criteria which describe the relation between planned options of motorway with respect to environment. Detailed research of the issue of traffic accidents has to be done within traffic research and for the purpose of comparing optional solutions in the Technical study phase. The presented data show that the planned motorway has a very high degree of traffic safety and that environmental impacts are within the allowed limits for such a facility.

The planned motorway has been identified as a road used for intensive transport of dangerous materials because it connects areas of international significance. Dangerous materials mean such materials which are very toxic, can oxidize, explosive, ecologically toxic, combustible, self-combustible, and otherwise dangerous for people and the environment. Every road has some role in transport of dangerous materials due to its position in a network, and possible consequences are especially important in biologically valuable areas and in locations with concentrated traffic flow, which is one of the characteristics of the planned motorway.

Activities in the immediate surroundings of the motorway are connected to accidents which can be caused by: (i) industry in the motorway influential area (ii) operation of facilities (petrol stations etc.) along the motorway. Type of industry in the motorway influential area requires transport of special materials, from liquid fuels and oils to specific chemicals. It is necessary to assess risks for every potential material transported, and for working conditions of industrial and other plants outside the road, and to have recovery measures in case of accident (funds and responsibilities). Besides transport which is performed on the motorway, it is necessary to identify and analyze the process of handling liquid fuel at petrol and natural gas stations.

Pollution that can be a consequence of operation of such facilities is constant and determined relatively by time and space, and it is primarily the result of: fuel spillage, operation of systems for washing of vehicles (automatic and manual), depositing of exhaust gases, wearing out of tires, load spillage, disposal of organic and inorganic waste. Accidents which may occur at the site of petrol and natural gas stations as a result of accidents with vehicles which transport petrol derivatives or accidents when fuel is poured happen rarely and it is very difficult to quantify them precisely. A special problem is the fact that these are almost immediate, very high concentrations that can not be anticipated either in terms of space or time. Also, accidental spillage during the process of pouring of fuel at petrol stations should be taken into account. In order to prevent petrol derivate from damaging the surroundings, it is necessary to remove the pollutant. The removal should be one of the petrol station's environmental protection measures.

Having in mind other countries' experience, it is necessary to define conditions for: selection of adequate absorbent; purchase, transport and storing of absorbent; application of absorbent; method of collection after application; regeneration (if absorbent is regenerative); disposal of absorbent. Having in mind the above mentioned, it is necessary to ensure that the laws which refer to transport of dangerous materials are obeyed (law on transport of dangerous materials (Official Gazette RBH 13/94, Rules on the way of transport of dangerous materials in road traffic (Official Gazette RBH 13/94)), as well as international guidelines on transport of dangerous materials. In case of accident it is necessary to inform the police. On the road, there should be information on telephones for calling the police, ambulance and fire brigade, including an arrangement with telecom companies on constant coverage of the route by GSM signal. The police, ambulance and fire brigade should be in contact with utility and other companies (even scientific) on the ways of cooperation and acting in case of accident in accordance with the prescribed and practiced procedures. Fire brigades have to have information on special features of the load in the accident in order to provide a suitable response. The police, ambulance and fire brigade should know general phrases of safety and risk (S and R phrases) in order to be ready to react in case of accident.

Large industrial plants are situated in the motorway zone, especially in the towns of Zenica and Kakanj. These plants require a lot of transport (railway and motorway), but these are mainly internal materials (ore, iron products, coal, ash, slag,). Transport vehicles can slow down traffic and increase the need for overtaking. Also, since this section includes an arterial railway, it is necessary to encourage transport by railway.

The biggest risk of environmental accident is the result of possible spillage of harmful/poisonous materials into water flows (and afterwards land). One example is uncontrolled spillage of fuel and oil which are used for the operation of construction machines and vehicles. There is no efficient (reliable) measure for reduction of such impact, but there is general technological discipline, strict monitoring of the implementation of safety measures by the contractor (its managerial staff). However, reduction of impact can be implemented by informing all concerned parties situated downstream from the location of an accident, in order to implement preventive measures, before the polluted spillage reaches them – afterwards, curative measures should be introduced (filtering etc.).

An organization project should anticipate the system of reaction in the case of accidents and disasters, and to ensure the necessary means for dealing with it: communication, first aid, efficient transport vehicles and suitable channels/ways for emergency transport of intervention teams or injured people.

Conclusion

Analysis of Environmental conditions was made within Environmental Impact Study, including documentation on Initial estimate of environmental impact, in accordance with Environmental law, Official gazette FB&H No. 33/03, and corresponding rule books. These analyses are necessary for issuing of town-planning permit and they identify:

(a) measures for area conflict avoiding due to motorway route selection

(b) measures for environmental impact decrease and following of law requirements during motorway construction and exploitation.

Proposed measures within this Study must be followed by everybody involved in project in phases of:

(i) further design documentation making (designer),
(ii) period between issuing of environmental permit to start of construction works (state institution responsible for construction and motorway maintenance),
(iii) during construction (institution in charged with contracting of works, construction operations and inspections) and
(iv) after the construction (state institution responsible for motorway construction and maintenance).

Prior to the construction, Investor must provide Construction Permit. Apart from proofs on fulfillment of demands from town-planning permit, Investor must present:

(v) results on zero state monitoring,
(vi) Landscaping and horticulture design.

During construction, inspections should

(vii) monitor the application of environmental protection measures (organizational and technical) identified within the Study.

Request for Construction Permit must include Zero State Monitoring, changes and additions to the Study due to the results obtained during zero state monitoring.

2. INTRODUCTION

2.1. Basis for Estimate of Impact on Environment

All forms of traffic systems, with related current features, represent sources of significant pollution of the living environment. In that sense, planning, designing, construction and exploitation of highways represent very significant problem in relation to preservation and protection of living environment. In the framework of exposed opinion, with certainty can be claimed that planning and consequently construction of bigger capacity road directions, as Corridor Vc, always lead to facing with series of conflicts on relation highway-environment.

Global analysis of highway impacts on environment shows that all effects appear in the framework of four basic forms of impacts:

- decision on activity's type (selection of corridor for several types of equipment for traffic and communication),
- decision on change of purpose of some space,
- impacts which appear as a consequence of construction of some structure and which are mostly of temporary character and
- impacts which are consequence of highway's exploitation (traffic and maintenance).

Impacts on environment, which appear as consequence of highway's existence in space and its exploitation through the time, have mostly permanent character and they are subject to detailed analysis. All processes, inside of this complex relation highway-environment, develop based on mutual dependence between numerous relations, and many changes happen as result of these relations. Changes are going from completely insignificant to so drastic that some elements completely lose their basic characteristics. Systematic approach to above mentioned relations, through the analysis of some criterions, in majority of cases gives acceptable results only at their real quantification and consistent respect of methodology steps' hierarchy.
Every criterion can have predominant importance under certain conditions, but former practice underlines basic matrices of relations, what does not mean that in future with developing of certain knowledge and strengthening of ecology awareness these matrices will not be subject to certain changes, based on which we define majority of influences. In the framework of this investigation, considering all influences of the planned motorway route, and local space relations, basic criterions have been considered, which through the acts of quantification have been transformed to indexes, with basic aim that further relations would be detailed quantified and their real nature defined.
Every human act in nature excerpt influence on it: and we talk about negative influence, because a positive influence on nature does not exist, so in further text only influence will be given as expression. Therefore, the analysis of environmental highway influences is based on the following principles:

- prohibition and restrictions (exclusion of an area and limitation of influence based on developing plans of the area and legal conditions),
- minimization of influence and
- harmonizing of socio-economical development and natural requests and conditions, considering requests and conditions of formerly built environment.

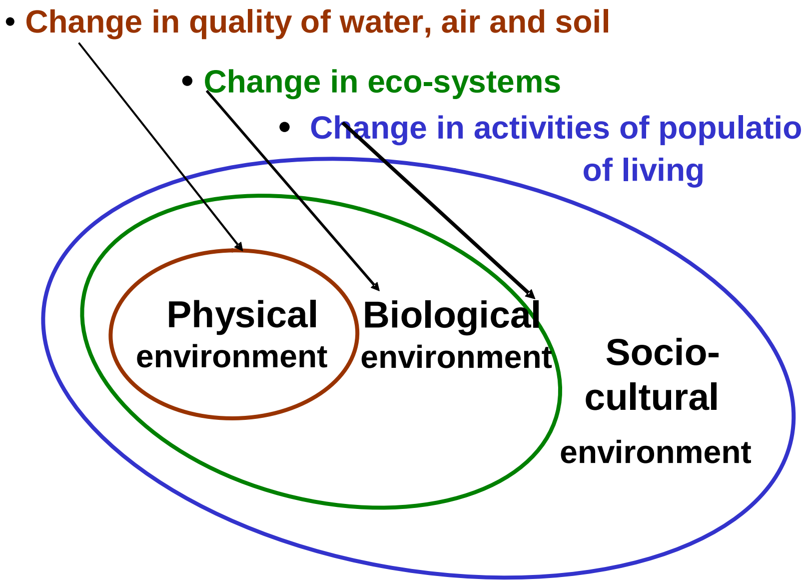
The analysis and evaluation of present state of environment, and estimate of possible influences which are consequence of the planned highway construction show that only an all-inclusive analysis can give clear quantified data. All previous experience in domain o this problems show that today we can speak about known matrix of influence with sufficient reliability, having in mind that such matrix represents changeable category in time and space and that relative importance of certain influences and their absolute limits must be observed always in real space relations. These facts mean, first of all, that every influence must be quantified by verified processes and have defined real importance depending on concrete local relations.

In order that importance of every influence could be quantified on a suitable way, it is necessary to join series of indexes to every influence, for concrete conditions. The indexes have to represent exact values that easily can be used in process of defining the necessary protection measures. Part of problems concerning the relation between highway and environment lie in fact that for some influences, although it is known that they exist, it is not possible to define exact indexes, and that a part or complete influence develop in sphere of subjective relation, what requires inclusion of not only entire series of scientific disciplines, but also inhabitants, politicians, stakeholders and all other affected by the project.

Influences from the motorway are defined as influences at the illustration 2.1.

- social (society) system – motorway, some of social categories gain , while some of them lose,
- economic system – profit which will be realized by better and more safe traffic flow and economic loss of some categories of population, and
- natural system – unavoidable loss of bio-diversity, and influence on eco-systems, communities and kinds in area of the motorway.

Illustration 2.1: Levels of influences on environment



Influence on each of these systems is not analyzed exclusively (separately), inside of itself, but it is necessary to analyze changes in all three systems commonly and in the framework of integral approach in order to come to optimal solution for today's and future generations (approach of sustainable development). All this could not be done only in framework of the Study, but ecologists during the preparation of the Study closely collaborated with designers and planners of society, so many of findings from this Study have been incorporated into design, and also requirements and opinions of designers and planners took the place in the Study.

2.2 Legal Regulations

In the framework of preparation of the Impact Environment Study the following regulations have been used:

Official Gazette of Bosnia and Herzegovina

International agreements:

Title of document	Number
Decision on ratification of Convention about control of over border transport of dangerous waste materials and its deposit	Off. Gazette B&H 31/00
Decision on ratification of Framework convention of United Nations about change of climate	Off. Gazette B&H, 19/00,20.07.2002.
Decision on ratification of Convention about bio-diversity, Rio de Janeiro, 5th June 1992	Off. Gazette B&H No. 13 from 31.12.2002.
Decision on giving the consent for ratification of International convention on protection of vegetation	Off. Gazette B&H Addition: International agreements 10/03, 21.07.2003.
Decision on giving the consent on ratification of Framework Agreement about the Sava river basin	Off. Gazette B&H Addition International agreements 10/03, 21.07.2003.
Decision on ratification of International convention on protection of vegetation	Off. Gazette B&H, 8/03, 30.06.2003 – addition

Nature, inheritance, forests, soil:

Title of document	Number
Decision on national monuments	Off. Gazette B&H, 15/03, 05.06.2003
Law on protection of vegetation health Decisions on proclamation of national monuments	Off. Gazette B&H 23/03, 07.08.2003
Law on forests	Off. Gazette B&H, 20/02, 29.05.2002.
Commission on protection of national monuments - Decisions	Off. Gazette B&H 43/03, 29.12.2003
Decision on change of criterion for proclamation of properties as national monuments	Off. Gazette B&H, 15/03, 05.06.2003

Quality of fuel:

Title of document	Number
Decision on quality of liquid fuel (oil)	Off. Gazette B&H 27/02

Instruction for the way of putting into effect decision on quality of liquid fuel (oil)	Off. Gazette BH 27/02
Changes and amendments to the Book of regulations for defining of quality of liquid fuel (oil)	Off. Gazette F B&H 58/04, 30.10.2004.

Official gazette of the Federation of Bosnia and Herzegovina

Space and construction:

Title of document	Number
Correction in translation of the text concerning Decision of the High Representative number 147/03 by which is proclaimed the Law on building land of the Federation B&H (Off. Gazette of the Federation B&H , 25/03) Book of regulations for amendments to the Book of regulations concerning the work conditions, organization and other conditions of the work of stations for technical control of vehicles	Off. gazette F B&H, 16/04, 27.03.2004
Decision on passing the Law on building land of the Federation B&H	Off. Gazette F B&H no.25/03, 12.06.2003
Law on space development	Off. Gazette B&H", no. 52/ 0 from 28.10.2002.
Law on building	Off. Gazette F B&H", no.55/2002 from 6.11.2002.

Soil:

Title of document	Number
Instruction for establishing of permitted quantities of harmful and dangerous matters in soil and methods of their investigation	Off. gazette FB&H 11/99
Law on agricultural land	Off. gazette FB&H 2/98

Water:

Title of document	Number
Law on water (Bosnian language)	Off. Gazette F B&H 18/98-454
Book of regulations on types, way and scope of measuring and investigation of used water, waste water and taken material from water current (Bosnian language)	Off. Gazette F B&H 48/98-2168, 36/00;addition 35/01;20/03;56/04
Book of regulations on conditions for determination of the zones of sanitary protection and protective measures for the sources of water which are used or planned to be used for drink (Bosnian language)	Off. Gazette F B&H 51/02-2297
Book of regulation on conditions that have to fulfill authorized laboratories and contents and way of the authorization giving	Off. Gazette F B&H, no,54/99
Decision on borders of water areas	Off. Gazette F B&H 37/98
Decision on borders of the main river basins	Off. gazette F B&H 37/98

Waste

Title of document	Number
Law on waste management	Off. Gazette F B&H 33/03, 19.07.2003.

Agriculture

Title of document	Number
Law on agriculture land	Off. Gazette F B&H 2/98

Culture heritage, nature

Title of document	Number
Law on changes and amendments to the Law on protection of properties which have been proclaimed as national monuments by decisions of the Commission for protection of national monuments	Off. Gazette F B&H 27/02, 28.06.2002. Off. Gazette F B&H 8/02, 28.02.2002.
Law on protection of properties which have been proclaimed as national monuments by decisions of the Commission for protection of national monuments B&H	Off. Gazette F B&H 02/02, 21.01.2002.
Law on changes and amendments to the Law on forests Law on changes and amendments to the Law on procedure for entering of Juristic person in Court Register Law on changes and amendments to the Law on economic associations	Off. Gazette F B&H, 29/03, 30.06.2003
Law on change of the Law on forests	Off. Gazette F B&H, 37/04, 10.7.2004.
Law on protection of nature	Off. Gazette F B&H 33/03, 19.07.2003.

Environment

Title of document	Number
Law on environmental protection	Off. Gazette F B&H, 19/04,
Book of regulations on sections and plants for which estimation of environmental impacts is obligatory; and sections and plants which can be constructed and let into operation only if they have environmental permit.	Off. Gazette F B&H 33/03, 19.07.2003.

Air

Title of document	Number
Law on air protection	Off. Gazette F B&H 33/03, 19.07.2003.

Regulations in FB&H taken over from the former SR B&H and SFRJ

Water:

Title of document	Number
Law on water (Bosnian language)	Off. Gazette F B&H 18/98-454
Book of regulations on types, way and scope of measuring and	Off. Gazette F B&H

investigation of used water, waste water and taken material from water current (Bosnian language)	48/98-2168, 36/00;addition 35/01;20/03;56/04
Book of regulations on conditions for determination of the zones of sanitary protection and protective measures for the sources of water which are used or planned to be used for drink (Bosnian language)	Off. Gazette F B&H 51/02-2297
Book of regulation on conditions that have to fulfill authorized laboratories and contents and way of the authorization giving	Off. Gazette F B&H, no,54/99
Decision on borders of water areas	Off. Gazette F B&H 37/98
Decision on borders of the main river basins	Off. gazette F B&H 37/98

BOSNA I HERCEGOVINA	
Rulebook and acts	***Broj***
The rulebook about danger substances wich couldn`t indulge in waters	Off. gazette SFRJ 3/66,7/66
Act on clasification and categorization of watercourses	Off. gazette SR BH 42/67
The rulebook about types, manners and scope of measurments and investigations of used and exploited wastewater	Off. gazette SR BH 38/76
The decision about identification of the margins of main river basin areas on SR BiH region	SOff. gazette R BH 7/77, Off. gazette F BH 37/98
Decree on Flood Control Plan	Off. gazette SR BH 5/78
Act on clasification and categorization waters and coastal sea waters in Jugoslavija - SR BiH area	Off. gazette SR BH 19/80
The rulebook about types, manners and scope of measurments and investigations of used and exploited wastewater	Off. gazette SR BH 39/85, 20/90
The decision about maximal permitted concentrations of radionucleids and danger substances in betweenrepublic watercourses , betweencountries waters and coastal sea waters	Off. gazette R BH 13/94, (2/92), Sl. l SFRJ 8/78
Act about clasification betweenrepublic watercourses, betweencountries waters and coastal sea waters in Yugoslavia	Off. gazette R BH 13/94 (2/92),Sl. list SFRJ 6/78
Conventions and protocols	
Conventions about cooperation on protection and sustainable usage of river Dunabe (Convention about protection of river Danube), Sofia 1994.; Bosna and Herzegovina Prezidency on 08.12.2004. - Decision about ratification , announced together with convention text	Off. gazette – International agreements, 01/05 od 25.01.2005.
Convention about Mediterranien Sea protection of polutions - 16.02.1976., Barcelona. Take effect: 1978.	Off. gazette – International agreement, nr. 12/77
Convention about Mediterranien Sea protection of polutions due to landbased activities, Atina, 1980. (Take effect: 17.06.1983.). Modified in Syrakusi (Italy) 1996.	Off. gazette R BH 13/94, Off. gazette SFRJ MU 1/90
The protocol about specially protected areas and biodiversity in	Off. gazette R BH

Mediteraniean areas, Monako, 1996. (Take effect: 23.3.1986.)	13/94, Off. gazette SFRJ MU 9/85
International convention about suppression of Mediteranian sea pollution with crude (oil), London, 1954. (Take effect: 26.07.1958.)	Off. gazette R BH 13/94, Off. gazette SFRJ MU 60/73, 53/74
International convention about protection of polution of boats, London, 1973. (Take effect: 02.10.1983.)	Off. gazette R BH 13/94, Off. gazette SFRJ MU 2/85
Agreements	
Framework agreement about Sava river basin	
Betweencountries agreements (BiH and Republic Croatia) about cooperation in water management (1996.) Signed by the Federation. Republic of Srpska has not ratified it yet, and therefore it has still not entered into force.	
EU Direktive	
The Urban waste water treatment directive 91/271/EEC of 21 May 1991 concerning discharges of municipal and some industrial waste waters)	
The Drinking water directive 98/83/EC of 3 November 1998 concerning potable water quality)	
The Water framework directive 2000/60/EC of 23 October 2000 concerning water resources management	
The Fish Water Directive 78/659/EEC	
Revised Bathing Water Directive 2006/7/EC	

Having in mind the fact that most of specific relationships within the environment domain related to the construction of one road direction, was not worked out within existing legislation for the purpose , so for the purpose of this work it was used the regulations and guidelines of other countries widely verified in international public.

There are especially used the guidelines that cover general problems, Merkblatt zur Umnjeltverträglichkeitsstudie in der Strassenplanung, and special noise problems, Richtlinien für den Lärmschutz an Strassen (RLS-90), aeropollution problems, Merkblatt über Luftverunreinigungen an Strassen (MLus-92), and water pollution problems, Richtlinien für Bautechnische Massnamen an Strassen in Wassergenjinnungsgebieten.

Also, there were used the technical documents of World Bank, i.e.: "The World Bank technical paper No.376: Roads and the Environment, A Handbook", The World Bank Washington, D.C.

BOSNIA-HERZEGOVINA STANDARDS (BAS) (caa 300 standards)

- Standards in field of environmental management,
- Standards in field of air
- Standards in field of waters

EU Directive

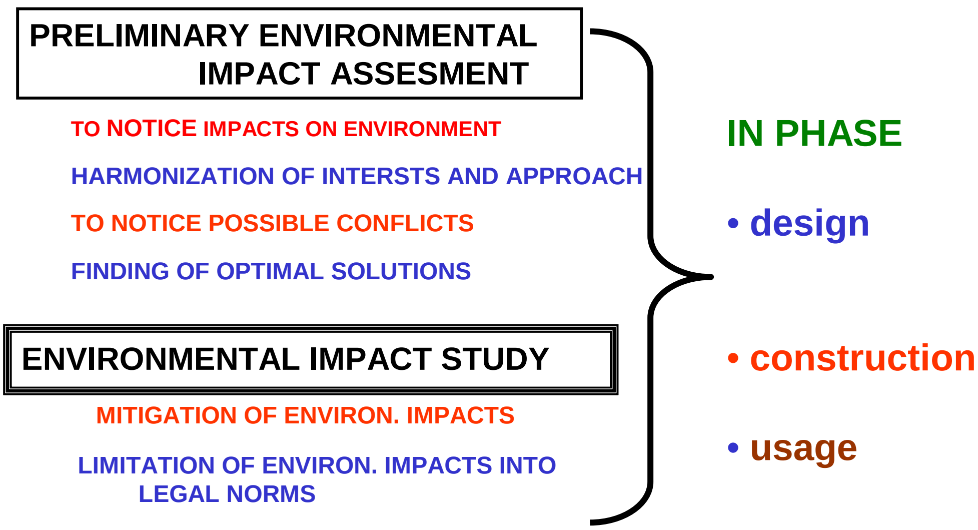
EU Habitat directive 92/43/EEC

2.3. Methodology of EIS Preparation

In accordance with legal legislation FB&H from 2003, environmental analyses are done in two levels at complex plants (illustration.2.2.):

- Preliminary Environmental Impact Assessment which is done by competent ministry based on documentation for preliminary estimate and
- Issuing of environmental permit by competent ministry based on Terms of reference of the Ministry and Environmental Impact Study done based on the Terms of reference.

Illustration 2.2: Scope of necessary documentation concerning environment



Preliminary Environmental Impact Assessment was done in period June/July 2005. based on Documentation that the Designer issued to the Investor 15. April 2005. Although the aim of Preliminary Assessment was only:

- To establish state of environment in area of observed corridor,
- Identification of potential influences on environment and possible losses in environmental quality,
- Identification of those influences which must be avoided because of legal requirements or valuable qualities of natural and cultural heritage,

as a basis for public discussion and expert judgment of the Ministry. In the framework of this activity, the analysis of several variants of the route alignment was carried out, and two variants were chosen, variants which fulfill the following conditions:

- Zones where the route cannot be placed (protected areas, already occupied, especially valuable contents of the space) were avoided,
- Valuable contents of the space were avoided as much as possible (for example fertile agriculture land), and
- Measures for mitigation of impacts on environment from selected route were identified.

On this way
-In the framework of preparation of the Documentation for preliminary assessment, it was carried out an analysis

- Impact of the route on environment, and

- In the framework of preparation of the Environment Impact Study, it was carried out the analysis:

- From the aspect of the motorway construction (organization of site, location of machinery, impacts from the work of machinery, manipulation with construction material, borrow pits and dumps...)
- From the aspect of traffic (prevention of noise, polluted air and water), and
- From the aspect of managing and maintenance of the motorway (monitoring of impacts, cleaning of filters for treatment of captured waste waters).

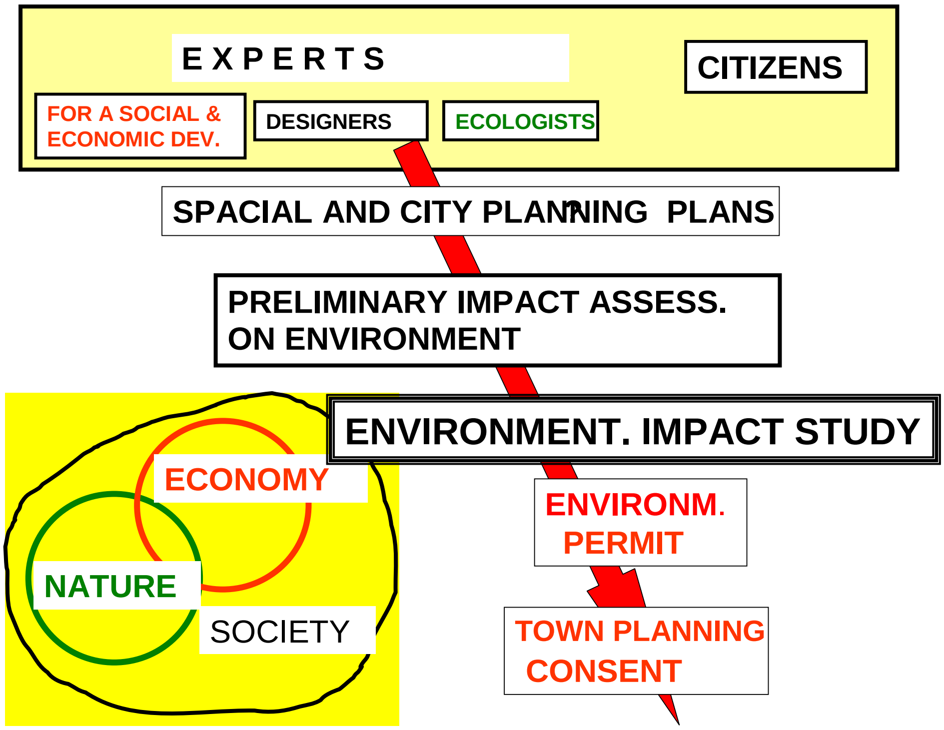
The Documentation for preliminary environmental impact assessment and the Environmental Impact Study were done- for the first time in B&H – in parallel work of three expert groups (illustration 2.3):

- Ecologists (experts for assuring of the quality of water and air, soil, biological diversity, cultural heritage, landscape ...)
- Planners of space and economical development and
- Designers (including geologists, seismologists, hydrologists).

Every group of experts has analyzed in details contents of wider area of corridor from its aspect, and pointed out to sensitivity of the space on construction and exploitation of the motorway (does its field of specialization require exclusion of the motorway at certain micro location, could the motorway be accepted if there is no other solution, could be accepted with some limits, or the motorway could be accepted without any limit?). Every group made their map of limitations in regard to usage of the space, and each requirement was analyzed on behalf of experts from all three groups.

Knowledge got on this way was the basis for preliminary environmental impact assessment, and then after getting of citizens opinions on public discussions and opinion of the Ministry, the basis for the Environmental Impact Study. In contrast to activities on preparation of the Documentation for preliminary environmental impact, in the framework of which was selected the route and where conflicts in space have been minimized and avoided, in framework of this Study the measures for minimization of impacts on environment have been worked out, as well as measures necessary to undertake in order to get minimizing realized.

Illustration 2.3: Participation of stakeholders and legal procedure



The Recommendation for protection of cultural monuments, endangered by carrying out of public and private works, General Parliament of the UNESCO, Paris,15. X - 20. XI 1968, defines cultural historical heritage on the following way: "Expression, cultural monuments, includes not only architectonic, archeological and historical monument entirety and monuments, recognized or under law protection, but also remains of past which have never been listed or placed under law protection, and modern monument entireties which are of artistic or historical importance." For the needs of preparation of this Study, in accordance with above mentioned definition of cultural monuments, contained in the Recommendation of the UNESCO, which defines relation towards cultural heritage in cases of carrying the public works out, as construction of the highway, the following criterions have been used for identification of cultural-historical heritage properties:

- Legal basis – formal protection by which properties that have status of national monuments are included
- Planning basis – properties that have been noted into record in Spatial plan of Bosnia and Herzegovina, Strategy of spatial development and planning in Bosnia and Herzegovina or spatial – planning documents for areas of municipalities;
- Scientific basis – properties that have been investigated through individual studies and published research studies or data on entering into register of protected monuments before1995.

"National monument is property which Commission for protection of national monuments proclaimed as national monument, in accordance with paragraph V and VI of the Annex 8 of the Common Framework Agreement for Peace in Bosna and Herzegovina, and properties registered on the Temporary List of National Monuments of Bosnia and Herzegovina, until the Commission proclaims final decision about their status, although there is no limit in time for that action and no matter if requirement for concerned property was submitted or not», as it is

defined by the Law on carrying out decisions of the Commissions for protection of national monuments, established according to the Annex 8 of the Common Framework Agreement for Peace in Bosnia and Herzegovina -“Official Gazette of the Federation B&H”, no. 2/02, 27/02 and 6/04. The following regulation is related to above mentioned properties:”
In any case, when the Commission makes decision by which some property is proclaimed as national monument, Entity, on which territory that property is located, is obliged to:

- Make every effort in order to undertake appropriate legal, scientifically, technical, administrative and financial measures needed for protection, preservation, presentation and renovation of the property, and
- To abstain from undertaking of any intending actions by which that property could be damaged. » Annex 8 of the Common Framework Agreement for Peace in Bosnia and Herzegovina, article V, and paragraph 5).

Up to now, Commission for protection of national monuments passed 245 final decisions on proclamation of cultural properties as national monuments. 777 properties have been placed on the Temporary list of national monuments.
Methodology included identification of existing (identified up to now) buildings of heritage, and establishing of measures for their protection during the process of the route selection (what was done in the frame of preparation of the documentation for Preliminary Environmental Impact Assessment), and listing of general and concrete measures of protection during the construction and exploitation.

Scope of cultural monuments has been established based on:

A. Decisions of the Commission for protection of national monuments on proclamation of national monuments B&H with 19th session inclusive (March 2005):
B. Temporary list of monuments in Bosnia and Herzegovina[8]
C. Petition for proclaiming of properties for national monuments issued to the Commission for protection of national monuments (properties that are temporary protected one year after submission of the petition or until the Commission makes the final decision)

Measures – actions in case that during construction some new monuments would be discovered, or at least suspicion that such structure could appear have been given separately.
Very important task of the Study is estimation of the soil conditions and agricultural land, on defined route of highway before its construction and its impact during the construction period and exploitation. The following methodology was used in process of the work:

- Methodology basis,
- Methodology actions

Methodology basis: Standard methodology basis and criterions for evaluation and assessment were used in realization of obligations taken on:

- Bases of land indemnification (bonity class- rating),
- Criteria for defining of the depth up to which fertile soil shall be removed,
- Limit values for contamination of the soil by organic pollutants and heavy metals.

Basis for defining of land bonity class
One of the most often used systems of land categorization is «Land capability classification», adapted to the conditions in Bosnia and Herzegovina. This categorization includes eight

[8] Listu je usvojila Komisija/Povjerenstvo za očuvanje nacionalnih spomenika u prethodnom sazivu, na 15. sjednici održanoj 14.06.2000. godine

categories ranked from the best (I category) to the worst (VIII category). In framework of categorization of agricultural land only, all categories could be divided in two groups:

- Lands appropriate for cultivation of I, II, III and IV category and
- Lands less appropriate and inappropriate for cultivation of V, VI, VII and VIII category.

According to the «Instruction for usage of specific criterion for categorization of land» (Off. Gazette. FB&H no. 49/98), and in accordance with paragraphs 6. 7. And 8. land is divided into 8 bonity categories, where the first (I) category present the best land, and the eighth (VIII) the worst category of soil.

I bonity category (90 – 100 points), includes deep and very deep soils, deep more than 120 cm, mostly argil, medium permeable, well drained, of neutral reaction, with underground water below 120 cm, at the flat terrain with slope up to 3%, protected against flood, without skeleton and stony material, which number of dates with vegetation period is bigger of 240, with favorable ratio SET/PET 0,8; easy and favorable for mechanical cultivation and irrigation.

II bonity category (80 – 90 points), includes soil deep over 90 cm, argils and clays, permeable to medium permeable, well and moderate drained, neutral and poor sour reaction, with underground water below 100 cm, at flat and sloped terrain up to 8%, exposed to surface and very poor erosion, and to very rear and short floods, easy and medium difficult, favorable for mechanical cultivation and irrigation.

III bonity category (60 – 80 points), includes medium deep soil and deep over 60 cm, argils and clays, permeable to poor permeable, well drained to incompletely drained, poor alkaline to medium sour reaction, with underground water below 80 cm, in plain and slope to 16% (at the slope exposed to a mild form of erosion), exposed to periodical and short floods, easy for cultivation to difficult with some limitations in regard to usage of mechanization, to which the protective measures against erosion and flood are necessary.

IV bonity category (40 – 60 points), includes medium deep soils from 40 – 60 cm, argils and clays which can have up to 30% of skeleton, and 10% of clay could be in sandy land, alkaline and very sour reaction, poor drained, permeable to poor permeable, with underground water, during short period over moistened, in plain and slope to 30% (at slope exposed to all forms of erosion), in plain are medium deep and regularly flooded during the short periods of time, protective measures against erosion and flood and land-reclamation measures are necessary. This category is divided onto:

IVa bonity subcategory which includes soils well and poor drained, with skeletons up to 10%, at flat terrain, mostly flooded and under impact of stagnant water, and

IVb bonity subcategory which includes soils that are less drained, on sloped terrain up to 30%, with presence of up to 30% of skeletons.

V bonity category (30 – 40 points), includes soils that are medium deep and shallow less than 40 cm, which contain 50% of skeleton particles, with extremely sour reaction, medium long period over moistened, regularly and long period flooded, in plain and at slope up to 45% (at slope – exposed to all forms of surface and weak ravine erosion), protective measures against erosion and land-reclamation measures are necessary.

VI bonity category (20 – 30 points), includes mostly shallow soils, which contain up to 70% of skeletons, long period covered by water, eroded up to the surface, regularly and long period flooded, in plain and at slope up to 45% (at slope – endangered by all forms of surface and medium ravine erosion), alkaline up to very sour reaction, medium damaged and degraded, long period over moistened with high level of underground water, protective measures against erosion and flood are necessary.

VII bonity category (10 – 20 points), includes mostly very shallow soils, which contain more than 70% of skeletons, at the slope of 60% (at slope – endangered by strong ravine erosion), strongly damaged and degraded, alkaline up to very sour reaction, protective measures against erosion are necessary, and can be solely used as meadow, pasture and forest.

VIII bonity category (do 10 points), includes exploitation areas, lines of communications, water accumulations and very shallow soils, which contain up to 90% of skeleton, at the slope more than 65% endangered by the strongest forms of erosions, and which are used as pasture.

Criterion for defining of the depth of fertile soil removal
Defining of the depth of fertile soil removal is in direct correlation with bonity value of the soil where the following categories are defined:

Bonity category of agriculture land	Depth of soil removal in meters	Average depth of removal In meters
I	0,50 – 0,60	0,55
II	0,40 – 0,50	0,45
III	0,30 – 0,40	0,35
IVa	0,25 – 0,35	0,30
IVb	0,20 – 0,30	0,25

Limit values of soil contamination by organic pollutants and heavy metals
A group of hydrophobic components, polycyclic aromatic hydrocarbons (PAH) has very important role due to their human and eco toxicity and their resistance. PAH include more of 100 individual components, and all are composed of at least two firm gasoline rings. Resistance on biology and chemical transformations characterize it, and it is hardly soluble in water. Due to these characteristics, PAH is considered as immobile inside unsaturated soil mass.

Limit values of elements in soil in mg/kg

Heavy metals				Hydrocarbons	
Lead Pb	Zinc Zn	Cadmij Cd	Chromium Cr	Light fractions	Heavy fractions
100 mg/kg	300 mg/kg	100 mg/kg	100 mg/kg	100 mg/kg	1000 mg/kg

Methodology actions
In realization of undertaken obligations a standard methodology has been used which includes the following:

- Preparatory works
- Processing of data and material
- Terrain investigation
- Preparation of maps with limitations (state)
- Processing of results and investigations

Preparatory works
Preparatory works included collecting of materials and adequate data, (topographical maps M1:25.000, ortho-photo photographs and geodetic plans M1:5.000) maps with motorway route drawn in AutoCAD program in digital form and one plotted sample per sections (8 sections).

Processing of data and materials
Examination of the layout, prepared on ortho-photo photographs, and state in which is land, topographic plans and maps was done in order to get general insight into conditions of the areas through which the motorway route passes.

Terrain works
These works included the following actions:
- Itinerary visit of foreseen motorway route (recognizing of terrain),
- Defining of participation of soil types (participation of pedal-systematic units) based on sondage of terrain and opening of control profiles,
- Description of terrain and way of land usage with drawing the state of terrain in working maps, per sections, where the basic categories were separated (agricultural land, forests, urban areas, rivers and others),
- Defining of categories of agriculture land (cultivated fields, orchards, meadows, pastures and barren soils),
- Defining of borders between bonity categories of agricultural land based on estimate of slope, depth and soil characteristics (sounding of terrain), and defining of water impact (surface and underground).

Preparation of maps with limits (state)
Based on processing of maps, data and works on terrain, appropriate maps with limitations in space were done in relation to the impact of the motorway in zone wide 500 m:

- Map with types of soil in scale 1:25.000 (automorphic and hydromorphic soils)
- Map with soil categories and bonity categories (I-VIII) of agricultural land in scale 1:5.000 (agricultural, forest, urban land, rivers and others),
- Map of agricultural land usage in scale 1:5.000 (cultivated field, orchards, meadows, pastures and barren soils).

Processing of investigation results
After preparation of the maps with limitations, digitalization and vectorization of data were done in order to get adequate balance of conditions, based on which, direct impacts have been defined (in zone of 50m) in phase of construction and indirect impacts (in zone of 500m) in phase of motorway exploitation and mitigation measures have been proposed.

3. DESCRIPTION OF PROPOSED PROJECT

3.1 The Project Purpose and Objectives

In the Analyzed area of Corridor Vc Motorway in Bosnia and Herzegovina live more then 50% of population, which create 60 % of GDP. Important roads and railways within European transport network are part of the Corridor Vc. This is “natural way” (through B&H it passes river valleys, through Croatia and Hungary it crosses the Panonian plane). The motorway should give key impulse to economic activities in Bosnia and Herzegovina and also enable connection to main European traffic flows and integrated European economic system.

Ministry of Transport and Communications as the main promoter of this Project strengthens the development component of the Project not only for Bosnia and Herzegovina, but also in the wider regional context. The Corridor Vc Motorway is a part of Trans-European Network of inland corridors and it connects in its end points the central part of the Adriatic See coast with Budapest in Hungary, as a hub for many key Trans-European communications. Especially considerable changes are noticed in inflow of foreign direct investments in individual segments of production sector in the country and in its immediate environment[9], mainly located within the impact area of the future motorway in the Corridor Vc. These investments will surely contribute to further development of the production and service economic sectors in the country through new investments, but they will also create new transport demands.

The general objective of the promoter of this Project is to establish the possibilities of the construction of the Corridor Vc Motorway in Bosnia and Herzegovina as response to the needs for improvement of service quality level in the road transport. As a key result of this Study, it is necessary to determine social-economic and financial feasibility of the Project in order to continue with activities of the Ministry of Communications and Transport of Bosnia and Herzegovina with the aim to secure financing means and conditions. Besides that, the results of the Pre-feasibility Study need to be also presented to the international financial institutions, which should consider the modalities of their involvement in realization of the Project afterwards.

Purpose of the project is to enable better connection of Bosnia and Herzegovina with neighboring countries and regions, giving impulse for the country development. Better conditions of transport service supply mean better conditions of life and work for the local population.

Specific objectives of this Project are as follows:

- savings in travel time for passengers and in transport time for goods in relation with the existing sections of the relevant network, which is in fact connected to the route of the trunk road M5/M17 on direction B. Šamac/B. Brod-Sarajevo-Mostar-Ploče (R. Croatia),
- savings in vehicle operation costs for all types of vehicles compared with the above stated network and direction,
- savings in costs of consequences from the road accidents compared with the above stated network and direction,
- savings in negative environment effects, diverting a part of the traffic from the existing relevant network to the future motorway route,

[9] As examples, the following are stated: (the Port of Ploče) Luka Ploče (R. Croatia), Aluminijum Mostar, Mittal Steel Zenica, GIKIL Lukavac, Birač Zvornik etc.

- impact on increasing competition of local economies through better access to other markets by use of the motorway,
- impact on increasing investments in new projects and local economies, located in the impact area of the Corridor Vc.

3.2 The Project Description

The network of pan European – Trans European corridors includes the system of most significant land communications, which are motorways and railways. Corridor Vc through B&H, is made of motorway and railway line along route: Osijek - B.Šamac - Doboj - Sarajevo - Ploče. Existing main railway line B.Šamac -Sarajevo - Čapljina/Ploče as a part of Corridor Vc, should reach through improvement of infrastructure parameters reach standard defined in AGC/AGTC agreements and TER[10]. Functional connection of motorway and railway line in Corridor Vc is linked to distribution of freight and passenger transport according to „natural orientation“ toward corresponding transport mode. Mass and long-haul transport will be directed to the main railway line (gravitation area of Tuzla, Zenica, B. Luka, Doboj, Ploče), while single and more valuable goods transport as well as individual passenger transport will be directed on future motorway. Considering the motorway design solutions, there are no specific solutions for freight manipulation from one transport mode to another. However, the state should regulate stimulation of railway freight transport, to reduce road (freight) transport and so reduce probability of traffic accidents.

In preliminary phase of Corridor Vc Motorway construction, Council of ministers of Bosnia and Herzegovina made decision on "preparation of planning- study documentation". Due to better operability during preparation of planning- study documentation, the project area from the river Sava (northern border with Republic of Croatia) to Southern border with Republic of Croatia is divided in four LOTs:

- LOT 1 : Donji Svilaj - Doboj South (Karuše);
- LOT 2 : Doboj South (Karuše) - Sarajevo South (Tarčin), without Kakanj - Blažuj section;
- LOT 3 : Sarajevo South - Mostar North;
- LOT 4 : Mostar North – Southern Border with Croatia.

Due to better design operability and layout, LOT 2 route, which is subject of the Study analysis is further divided in following five sections.

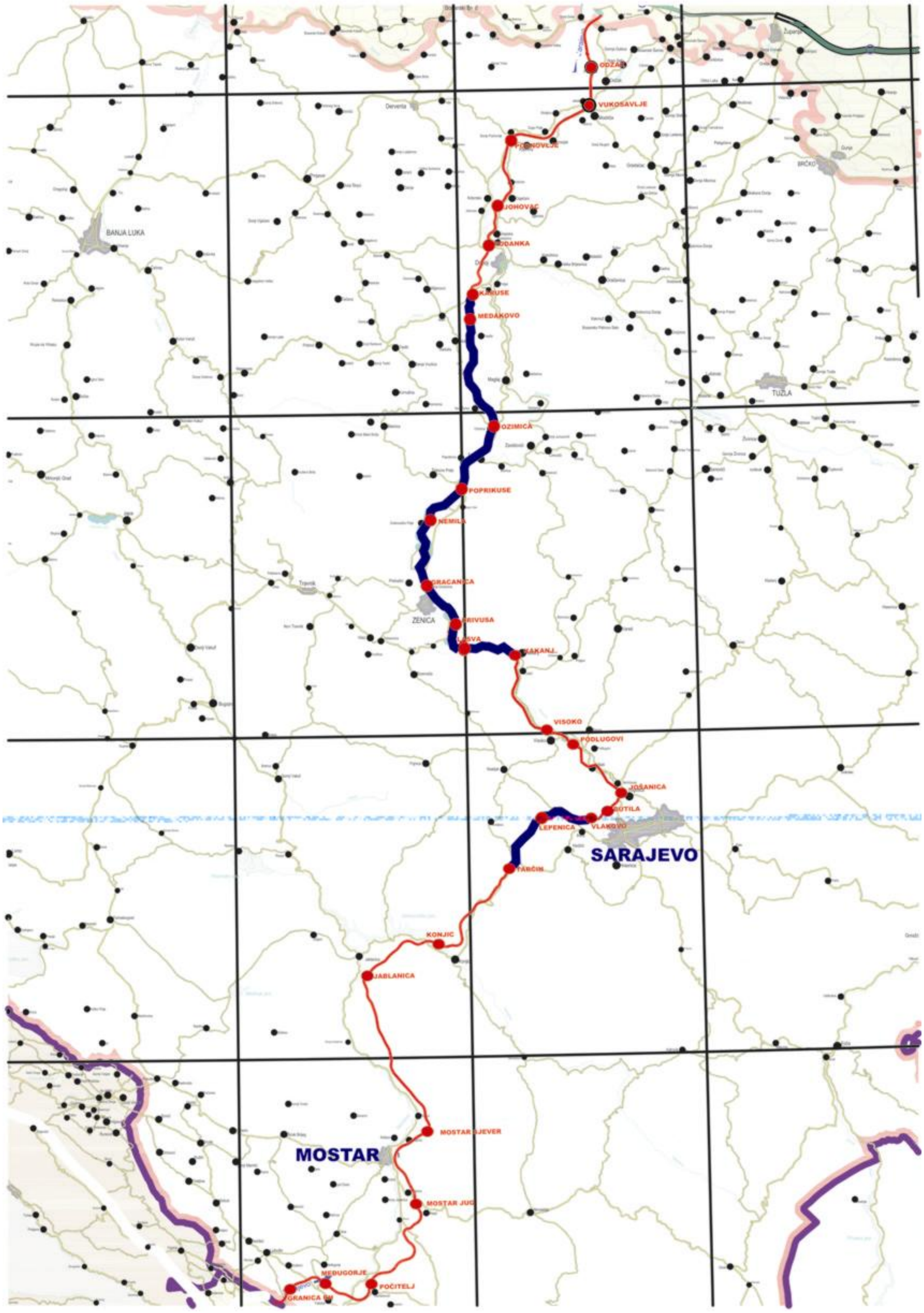
- Section I, Karuše (Doboj jug) – Ozimica, 24,9 km long.
- Section II, Ozimica – Donja Gračanica, 33,4 km long.
- Section III, D. Gračanica – Drivuša, 8,5 km long.
- Section IV, Drivuša – Kakanj, 15,6 km long.
- Section V: Vlakovo-Tarčin, 18,8 km long.

Section Vlakovo-Tarčin, which is the integral part of Corridor Vc Motorway, is adjacent section to the motorway sector Kakanj-Vlakovo along with already constructed section Jošanica-Podlugovi and sections with construction or preparation for construction that are in course[11] These sections will be constructed before the start of construction of other sections within the motorway of Corridor Vc. Total length of sections: link to Sarajevo Bypass-Jošanica, Jošanica-Podlugovi, Podlugovi-Visoko and Visoko-Kakanj is around 45 kilometers.

[10] TER = TRANSEUROPEAN RAILWAYS; TEM =TRANSEUROPEAN MOTORWAYS.
[11] Construction of Podlugovi-Visoko section is in progress. Besides that, preparation of the Detailed Designs for Visoko-Kakanj section and Sarajevo Bypass is in the final phase.

Planed route of the Corridor Vc Motorway, LOT 2, is located in the central part of B&H. Next figure shows the project location (Corridor Vc Motorway) with marked sections of LOT 2.

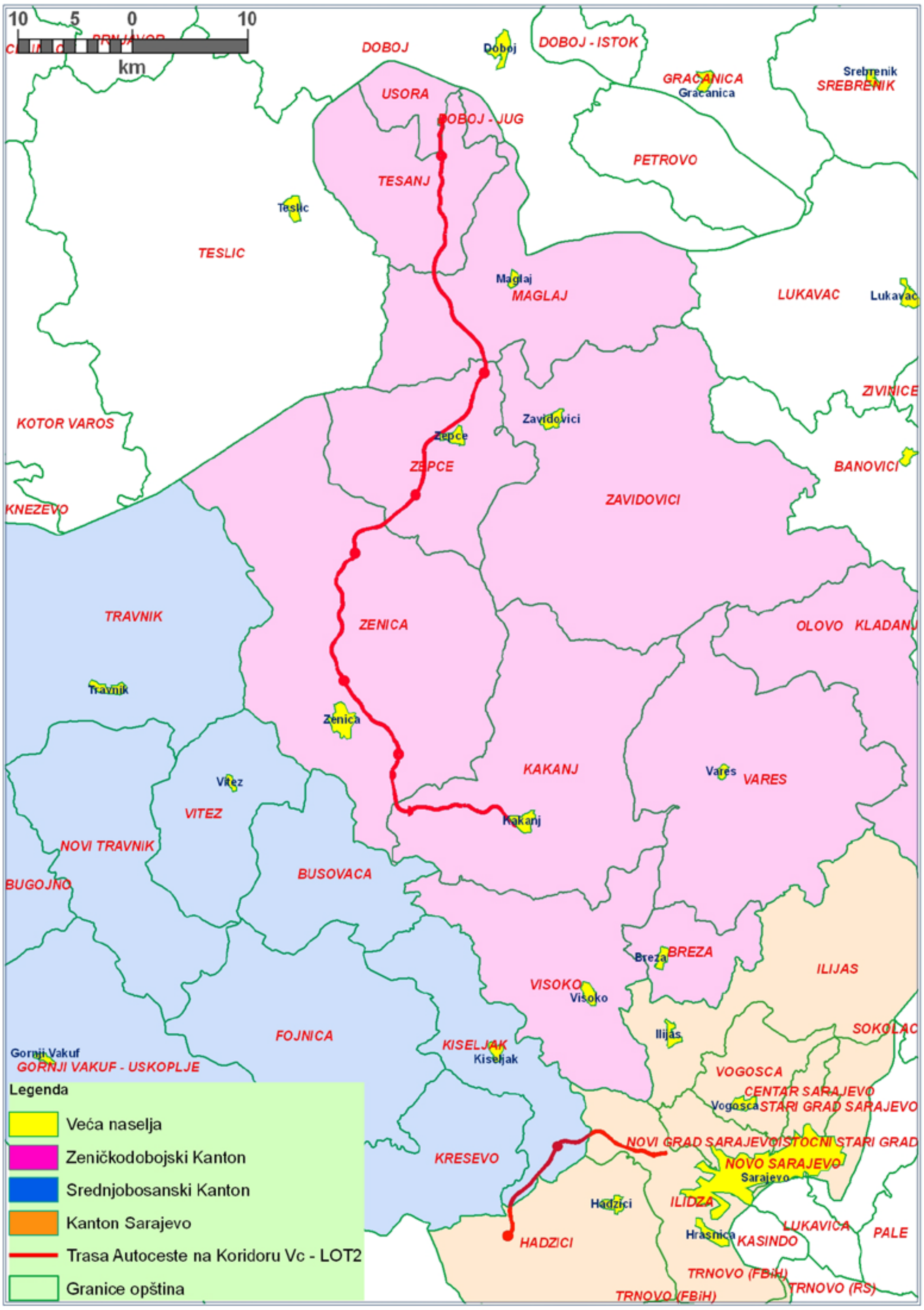
Illustration 3.2.1. The Project Location



3.3 Spatial-planning Documentation of the Analyzed Area

Planned route of Corridor Vc motorway, LOT 2, is passing through municipalities Usora, Tešanj, Maglaj, Žepče, Zenica and Kakanj in Zenica-Doom Canton. In Canton Sarajevo route passing through Ilidža municipality (from Vlakovo) and Hadžići municipality (to Tarčin). In Srednjebosanski Canton adopted route passing through Kiseljak municipality.

Illustration 3.3.1. Adopted Route for LOT 2 and Administrative Units along the route



Preparation and adoption of The Spatial plan for Bosnia and Herzegovina, for the period 1981-2000 initiated preparation of municipal spatial plans in Bosnia and Herzegovina. The Spatial plan for Bosnia and Herzegovina determines the routes of European roads (E 73, E 661, E 761 and E 762), emphasizing the fact that the area on the direction of trans European motor-way "North - South" , which overlaps the road E 73, going down the Bosna and Neretva river valleys, should be protected.

The Spatial plan for Bosnia and Herzegovina for period 1981-2000 – edited text ("Official Gazette SRB&H ", No. 33/88), contains a certain change in terms of the motorway route position, that was determined in the Draft of the Spatial plan (1982). Due to the afore mentioned reason, planned and protected motor-way routes from the Spatial plans of the municipalities of Tešanj, Ilidža, and from the Resolve concerning the protection of the motorway corridors on the territory of the municipality of Kiseljak, are not in accordance with the adopted Spatial plan B&H – edited text, but rather with the planned motorway route or motorway variant solutions from the draft of the spatial plan.

Table 3.3.1. Spatial-plan and urban documentation overview

Canton	Existing spatial-plan documentation	Period of plan	Plan enacted	New generation of plans
Zeničko-Dobojski	PPO Tešanj- amendments and additions	1999.-2015.	Yes	Cantonal spatial plan in the production phase I – Spatial basis
	PPO Maglaj	1984.-2004.	Yes	
	PPO Žepče	1986.-2000.	Yes	
	PPO Zenica	1980.-2000.	No	
	UP Zenica	1980-2000.	Yes	
	PPO Kakanj	1985.-2010.	Yes	
Sarajevski	PP Sarajeva (10 municipalities)	1986.-2000./ 2015.	Yes	Cantonal spatial plan in the production phase I – Spatial basis
	UP Sarajeva amendments and additions	1986.-2015.	Yes	
Srednjobosanski	PPO Kiseljak Resolve on the protected zone along the motorway	–	Yes	Cantonal Spatial plan

In accordance with the decision of The Assembly SRB&H, held on the Jan 28th 1975, the production of the Spatial plan for Bosnia and Herzegovina began. The plan was conducted on the basis of the Urban-planning Law and the methodology, adopted in 1976 by the Committee for urban-planning, protection and improvement of human environment. After the 1974 enactment of the Instructions for the obligatory and unique methodology concerning the preparation and production of spatial plans, the production of the spatial plans for municipalities began, resulting in the fact that now almost all the municipalities the Corridor Vc passes through have produced and enacted spatial-plan and urban documentation. Spatial plans of the municipalities, with the Tešanj municipality excepted, cannot be the basis for obtaining the

urban approval for motorway construction in the LOT 2 area, in accordance with law regulations. There is no need for production of an appropriate spatial document that would serve as a legal basis for the position of the motorway in the zone of LOT 2.
Sarajevo and Zenica with their population number and economy structure represent the generators of growth. They do not, however, have the capacities for spatial growth; therefore the model of homocentric development must be abandoned and replaced by the polycentric one, distributing the functions throughout the places in the wider area.

These places for the city of Sarajevo lie in the direction of Hadžići, Ilijaš, Breza and Visoko. Current traffic connection, especially upon the inclusion of motorways, creates the possibility for establishing and developing the urban community that would comprise Kiseljak, Fojnica and Kreševo in addition to Hadžići, Ilijaš, Breza and Visoko.

A particularly limiting factor for the development of Zenica is space. The city agglomeration has completely taken up the Zenica valley with its physical structure. This is to be solved through connection to the Lašva valley in the direction of Vitez, and further through the co urban union with Novi Travnik, Travnik and Busovača. Current traffic connection of these areas, due to the construction of motorway in Corridor Vc and the realization of a high speed road that is a motorway in the Corridor Xc, which is to pass through the Lašva and Vrbas valleys, creates a strong basis for development of the urban community in this area.

The third spatial section encompasses the cities of Maglaj, Zavidovići and Žepče. In the triangle they create, there are spatial possibilities for the placement and development of numerous functions that would unite these places into the unified co urban whole, keeping the relevant complexes of high quality agricultural land in the municipality of Žepče.

A significant problem which represents a limiting factor for the development of municipalities in the Bosna river valley is the unresolved issue of water supply. The Spatial plan for B&H provides a concept of a long term water supply solution that involves the water accumulation "Krajinići" on the Krivaja river in the municipality of Zavidovići, including the usage water reserve "Plava voda" in the municipality of Travnik. The accumulation "Toplice" on the Lepenica river is proposed in the plan for the city of Sarajevo and the municipality of Kiseljak, and it will be located in the municipality of Hadžići and Kiseljak respectively. However, the municipality of Zavidovići did not adopt a municipal spatial plan, refusing to accept the concept of water accumulation on the Krivaja River, while the usage of water reserve "Plava voda" in Zenica still remains an open issue. The issue of water supply of this area has to be considered within the framework of the whole development concept in the wider area of Corridor Vc, requiring in turn a valid foundation in the spatial plan of FB&H. An alternative for the water accumulation "Krajinići" in the municipality of Zavidovići is the water accumulation on the Ribnica River in the municipality of Kakanj.

3.4 Socio-economical Importance of the Project

Preparation of study-planning documentation for the motorway in Corridor Vc that passes through Bosnia and Herzegovina is realized in an ambient in which is very difficult to get common national, political, regional, and economic and any other consensus on any issue, what is consequence of relations damaged by the war. One of rear positive exceptions is general consensus in regard to construction of the concerned motorway, what in current conditions has special importance. Project of the motorway construction is proclaimed as development project of first priority and state interest, and it is treated as “developing project of the century". Such treatment becomes from its general socio-economical and political importance for Bosnia and Herzegovina.
Besides the other facts, the following facts point out on wider socio-economical importance:

a) On the third Pan-European conference about transport (Helsinki 1997), transport corridor Budapest – Osijek – Sarajevo - Ploče was included in Pan-European transport network as Corridor Vc, by which it was confirmed its wider international importance. Corridor Vc is going through middle part of Bosnia and Herzegovina in north-south direction, through the valleys of the Bosnia and Neretva rivers, more exactly, through the area with the biggest concentration of population, natural and resources created by the work;

b) In zone of the Corridor, 40km wide (on less than 20% territory) live more than 50% of population that creates more than 60% of total GDP in Bosnia and Herzegovina. Inside of this area are located administrative-cultural, sport and economic center and capital town of B&H - Sarajevo, cultural- sport and tourist–economical center and the biggest town of Herzegovina - Mostar, mining-metallurgic center B&H-Zenica, the biggest traffic road and railway center - Doboj, and large number of other important industrial-energetic, tourist-caterer, sport-recreational, cultural-historical and religion centers, as Park of nature - Hutovo Blato, center of religion tourism - Međugorje, centers of winter tourism around Sarajevo on Olympic mountains Jahorina, Bjelašnica and Igman, and on mountain Vlašić near Travnik, system of hydroelectric power stations at Neretva river with artificial accumulations, sanatoria-health capacities Ilidža, Fojnica, Teslić, Steam power plant and Mine Kakanj, industry of wood Zavidovići, of cellulose Maglaj, refinery of oil Modriča etc.

c) The main existing two lanes road, wide 7,00 m, which passes along the Corridor (road M17), do not satisfy traffic needs for a long time concerning the level of service and traffic safety. The road M17 passes through all bigger towns, so some of its sections becomes city or suburban streets on which transit, long distance source – target and local city – suburban traffic are mixed, with all negative consequences, as for environment as for traffic itself (appearance of long lines of cars, congestion with longer stoppages, large number of accidents, air pollution, overloud noise etc.). Such situation results in too high costs of traffic users, huge losses in time, reduction in productivity, reduction in competition capability, decreasing of market scope, dissuading of potential foreign Investors from action and etc. By removal of traffic limits which are consequence of existing unsatisfactory situation of transport infrastructure, through realization of the construction of high rank road, more exactly of the motorway, conditions for reduction of transport costs participation in operational costs, reduction of non-productive time in contribution to productive time will be created, and increase of total work productivity reached, accessibility to productive and consumption centers will be easier, what will lead to balanced market conditions, easier process of cooperation, spatial and productive-technological restructuring in production, bigger mobility of labor, and all of that will influence on faster and comprehensive development of Bosnia and Herzegovina and strengthening of competitiveness of its economy.

d) Radical improvement of accessibility to tourist centers, religion-recreational and caterer complexes, hunting areas, health and other contents for rest and recreation will bring special privileges to this sector of economy. Construction of the motorway, which approximate value is estimated at 6,20 billion KM, for sure will lead to opening of large number of work positions, to bigger intensity and increase of production in existing facilities, and to opening of new production capacities, especially in sector of civil engineering, production of construction materials and equipment, agricultural- food industry and services. After letting the motorway into operation it will come to direct additional employment in jobs in relation to control and maintenance of the motorway, and numerous services.

e) The motorway construction impact on employment and increase in production will cause a chain reaction in a wide range of indirect producers and suppliers of articles of consumer goods, material and equipment, and by that, effect will be multiplied. Engagement of domestic civil work group machinery on such big and complex jobs will make possible its personnel, technical and technological strengthening and preparation for appearance on worldwide markets and recovery of its prewar reputation and position. Engagement of domestic high skilled personnel on giving consultancy services in preparation phase, work performance and project managing during exploitation, will create personnel structure capable for own creation of developing strategy and policy and managing of other developing projects.

f) Practice that attention of ecologists and experts for environmental protection is focused on negative project impacts on environment became customary at such projects. That is good in any case, because it results in measures which will eliminate those negative impacts that doubtlessly exist; or mitigate to acceptable measure. With such approach, the most often we disregard positive effects and impacts. In this case, construction of planned motorway with bypasses around bigger towns, will significantly relieve city road network, mitigate problems of congestion and on that way postpone the need for investments; mitigate noise, reduce emission of pollutants, and on that way will improve general living conditions in towns. Taking into consideration that above mentioned negative impacts from dense populated and urban zones, in which protection against these impacts is practically impossible or very difficult, will transfer into non populated zones with application of protective measures, it is not difficult to make conclusion that total impact of motorway construction on environment will be positive.

g) Redirecting of transit traffic out of narrower city zones will enable appropriate usage of space, more favorable disposition of different city contents, more exactly, it will help to their more rational and functional development. Although it could be expected that in certain limited areas along the motorway it comes to reduction in value of real estates (land and structures), because of closeness of the motorway and effect of "obstacle", it is for certain that in bigger scope and in wider areas will come to increase of real estates values. Increase in Investments, production, trade, grow of GDP value, will lead to increase of fiscal incomes of socio-political communities. As reverse positive effect that could influence on reduction in tax rates and other fiscal obligations, that is an additional stimulus to economic progress.

It is not possible to quantify and to state in monetary units above mentioned positive impacts of the motorway on entire economic development. Some of them are included in effects of transportation users in cost-benefit analysis (operational vehicle cost, time of traveling for goods and passengers, accidents), but it will for sure come to significant indirect effects. Some efforts were done to estimate an indirect impact of the motorway construction on general economy development of Bosnia and Herzegovina. Results of the expert estimates of that impact are given for illustration only.

According to analysis and estimates[12] of experts Doc. Ph.D. Faruk Jašarević, Ph. D. Branko Beroš and Velibor Peulić, during the motorway construction and after it, significant indirect developing effects inside of narrower and wider gravity area will appear.

Starting from preliminary estimate that the costs of the construction will amount around 6 billions KM, the authors made an estimate of direct benefits which will be realized in 42 economic activities during the construction (Table 3.4.1). Also, the authors estimate that letting the motorway into traffic will initiate new and improve total economic activities, especially inside of narrower gravity area, but also in whole B&H. By estimation that average grow of GDP ratio in municipalities of narrower gravity areas, in next period of time, from expecting 5,5% annually, in case of the motorway construction could reach ratio of 6,2%, the authors came to the effects of 323,7 million KM in 2013 to 857,2 million in 2020, and 1495,5 million in 2025 .

[12] "Economic benefits and other effects of Corridor Vc before, during and after construction" Sarajevo 2005.

Table 3.4.1. Development outputs during the motorway construction on economy

Economic activity	Value of direct benefit divided per economic activities during the motorway construction in Corridor Vc (mill. KM)
Electrical industry	141.18
Production of coal	48.06
Coal treatment	30.06
Production of oil and gas	50.04
Oil derivatives	201.18
Iron ore	14.12
Heavy metallurgy	398.12
Ores of colored materials	19.41
Non ferrous metals	48.30
Non-metals	117.18
Processing of non metals	25.46
Metalworking industry	254.12
Production of machinery	74.12
Traffic means	80.54
Electrical machines and apparatus	138.32
Chemical products	45.60
Processing of chemical products	46.92
Stone and sand	197.70
Civil construction materials	636.00
Lumber	53.82
Final wooden products	24.42
Paper treatment	47.04
Textile	22.62
Processing of textile products	9.78
Production of leather shoes	6.24
Rubber	8.12
Food production	25.41
Drinks	0.24
Food for cattle	0.84
Tobacco	0.00
Different products	2.33
Agriculture and fishery	20.12
Forestry	34.70
Waterpower Engineering	43.41
High-rise building	26.12
Insulation works	211.41
Traffic and communications	554.12
Trade	374.12
Hotel management and tourism	0.74
Craft services	314.12
Communal services	37.41
Other production services	164.12

Acceleration of economic growth due to the motorway construction will lead to opening of new working positions. According to estimate of the authors, besides engagement of large number of workers during the construction, on serving and maintenance of the motorway in exploitation will be permanently employed around 1.000 workers, while employment in different economy sectors, from industry, trade to tourism, will result in around 10.000 additional working places.

3.5. The Technical Description of Selected Route

The LOT 2 starts at Karuše interchange, from which the route follows river Tešanjka and its affluent river Trbačka. The motorway route has several collisions with these rivers.
The motorway route is placed parallel to local road which connects the part of settlement Tešanjka in the area of Municipality Usora with Tešanj. This local road is jointed on the main road Doboj - Banja Luka near settlement Tešanjka. The interchange in this section is designed at locality of Medakovo.

The route is going further to settlement Zaimovići, directly before the saddle Crni vrh. The route is passing next to settlements Koprivci and Kardaglije then, and after those settlements enters into tunnel "Crni Vrh" (L=2608m). Further, the route is following the valley of Strupinska stream and Strupinska River, and passes by Ozimica settlement, trough village Luke. The interchange is designed directly after Ozimica settlement.

The motorway route is placed in the south-west part of Maglaj municipality and traverses the territory of populated places Mladoševica, Radojčići, Novi Šeher and Strupina. After tunnel "Tupanovac", route follows the valley of river Bosna, up to Nemila, as much as technical elements and the conditions on ground allows, since the valley of Bosnia is almost in its whole length interceded in favor of existing state road Doboj – Zenica, railroad Vrpolje - Sarajevo, and number of local roads. The motorway route tangents the urban territory of Žepče from west side (settlements: Tatarbudžak, Vašarište, Varošište and Ravne Dunje) and on locality of the settlement Papratnica crosses with the viaduct to the right side of river Bosnia. Further towards south, by settlement Golubinja, it goes back to the left side of river. Then the motorway route enters into the tunnel and goes to the settlement Topčić Polje, and after that, with a lot of objects, comes into region Nemila. The interchange was predicted before the entrance into Nemila, but because lack of space it is dislocated into Poprikuše.

The routes passes through the canyon of river Bosnia, crosses its flow several times, traverses the two short tunnel, and after exit from tunnel "Srednje Brdo" (l=2440 m) it comes down to the valley of Zenica in Vraca region. On line from Vraca to Donje Gračanice and Ričice the route is more open type with a few more significant viaducts and two tunnels. The biggest settlement in this rayon D. Gračanica is abridged with one longer viaduct L=465 m. The interchange is predicted in the area of D. Gračanica.

From the interchange in Donja Gračanica to the interchange in Putovičko Polje (Drivuša), the route passes through the urban territory in northeast periphery of the town Zenica. The route is placed on mild slope in rayon of settlement Dujmovići with a slight ascendance towards "Babina Rijeka" with one shorter tunnel and the bridge. Hereafter, the route is placed along slope, until the entry into tunnel "Lanišća" which is the dominant object on route with the length L=910 m. After exit from this tunnel, the route is placed on the brim of settlement and entrances rayon Perin Han avoiding collision with populated territories. On descent towards Drivuša the route abridges small settlement and the river Bosnia with one longer object (L=620 m). The interchange is predicted in Drivuša at the junction with the existing state road.

From interchange Drivuša to semi interchange which is planned in settlement Janjići (connection of state road M-5 in direction of Zenica), the motorway route is placed over existing state road M-17. After settlement Janići, the motorway route crosses on the right river-bank Bosnia between settlements Putovići and Gorica, and entrances into tunnel "Vijenac" (L = 2964 m). The semi interchange is located on exit from tunnel as connection of state road M-5 in the direction of Sarajevo. The motorway route from Biljeÿevo to entrance to Kakanj is identical with the route of existing state road M-17.

From interchange in Vlakovo motorway route traverses the settlements Rogačići, Gladno Polje and Rakovica and between settlements Kobiljača and the Rudnik exits with the tunnel on territory of the Kseljak municipality in populated place Gornji Azapovići. After that, the route comes down towards south through settlements Kulиješ, Gojkovac Solakovići, Zabrđe and Toplica, whence enters into community Hadžići with the tunnel in settlement Tarčin, where the LOT-2 ends.

Basic technical data:

- Standards for designing: TEM standards.
- In cross section the motorway is designed with 2x2 traffic lanes, wide 3,75 m each; 2x1 lanes for vehicles out of order, wide 2,50 m each, central reserve 4,00 m wide and shoulders wide 2,00 m each.
- Curvature and height parameters depend on terrain configuration, with extreme values according to TEM standards.

Basic elements of pavement structure:

• AB SMA	5 cm;
• BNS (bituminous base course)	10 cm;
• Cement stabilization	20-25 cm;
• Subbase	17-25 cm;
• Strengthened road foundation (subgrade)	20-25 cm.

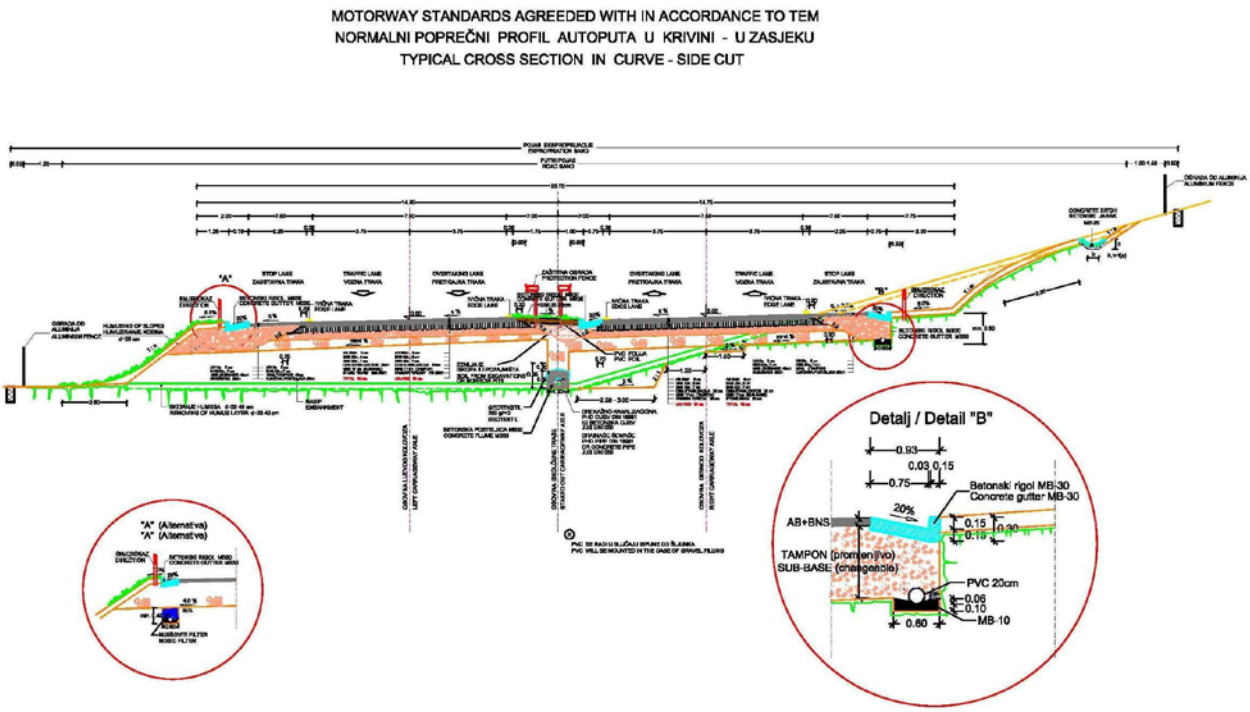
Remark: Depth of pavement structure is different depending on section, but composition is the same.

Intechange (loops):
Nine loops are foreseen to be at locality Medakovo, Ozimica, Poprikuše, Nemila, D.Gračanica, Perin Han, Janjići, Dolipolje, Lepenica.

Rest area:
Five rest areas are foreseen to be placed at localities Tugovići, Strupina, Dujmovići, Bilješevo and Lepenica.

Center for maintenance:
Two centers are foreseen to be at localities „Crni vrh“ and Zenica south.

Illustration 3.5.1. Typical cross section



3.6. Spatial Research Limits in Framework of EIS

The research limits include the zone along selected route of corridor Vc motorway - LOT2, whose description is given in the previous section. Every single one analysis requests different approach in defining borders of research, depending on diffusion and level of potential negative environmental impact.

By their proportions, environmental impacts could be local, regional and global. The local are those which impact on narrow space, from several meters to several hundreds of meters. The regional impacts treat the significant part of state or even the region of several states. The global impacts are those which treat the whole planet. The construction of new motorway is an example of complex impact on environment on regional level, and that will be elaborated with more details hereafter.

Space for research from the aspect of water resources, flora, and protected parts of nature, fauna and hunting game includes the zone wide one kilometer from the both sides of the last motorway contour line, including the route itself. In situations, where that was justified from technical, hydro geological and aspect of underground water protection, while defining spatial limits, it was adopted a natural border between water-bearing area and waterproof area, as contour border, taking into consideration fact that in such encirclement appearance of sources , springs or water supply pumping facilities are often present.

Spatial limits for estimate of noise protection measures relate to the settlements located 200m far from the motorway axis from left and right side.

3.7. Environmental Impact of the Project

Environmental impacts of construction of motorway have time dimensions besides the spatial dimensions. We are distinguishing (i) change of purpose of area as impact before process of construction, (ii) impacts in motorway construction phase, and (iii) impacts during the exploitation of motorway and roadside facilities.

The change of purpose of area treats making of space narrower or the intersection of the significant ecosystems, the subjugation of space especially the one which is suitable for farming or for forestry, the attraction of significant number of man toward corridor and setting in motion the various economic activities which become the sources of polluting, the changes in peoples moves with the problems of acclimatization, if it is migration of large groups, the loss of property. The motorway corridor increases the economic development of its area, and in some cases the parts of country which are far away from the corridor. The motorway corridor is area with violations of ecosystem, interrupts in water supply and area where the ground-waters are endangered, firstly as consequent of traffic accidents. In valleys of Neretva and Bosnia rivers, thus in the area of corridor Vc, today is concentrated around 50 % of B&H population, and with the construction of motorway this number will be even larger. This adverse environmental impact should be prevented through the network of roads which are connected with motorway, and through inducing of life in other parts of country.

The change in purpose of space causes microclimate changes which, conditionally, can be positive and negative. They are results of changes in relief, as well as changes of the contents and colors of the ground. Dark surfaces and the plants absorb the energy during the day, and during the night emit that energy, while glowing surfaces reflects energy during the day. This means that the absence of dark soil and the plants increases daily temperature amplitudes. During the winter, impacts are opposite. After removing of snow, the soil gets warm faster and temperature amplitudes decreases. The local impacts are noise and air pollution. In some countries the traffic air pollution has some elements of regional impact, but not in B&H.

During the road construction progress, there is one significant change, which is not related nor to exhausting of the resources, nor to polluting. Its name is *rucksack*. It is about moving a large quantities of earth (bringing of earth from borrow pits or depot formation from excavated earth). This causes the relief change, and if we do that functionally and eye pleasant, then we call that the landscape editing. Landscape editing also includes removal of the earth if landscape planner requests. The rucksack may be able to cause the loss of humus, and extra care should be taken about it.

During the constriction progress the impact can be related to insufficient sanitation of construction site (source of disease), and for the behavior of workman. Mechanization noise should be added as well as the ugly picture of building site, damaging of the local roads, covering of local asphalt roads with mud.

During exploitation of the motorway, the basic environmental impact is increasing of traveling speed, i.e., reducing the time necessary for transportation. The significant impact is enjoyment during driving through arranged landscape.
The unavoidable companion of these important functions is the hazards and the accidents. The hazard is possibility for the accident consequent upon fast driving, imperfect technical

characteristics of the vehicle and the road, the time proviso, etc. The accident is digression from appropriate driving conditions, such as sliding of vehicles, driving too close with another vehicle, etc. If accidents coincide with the set of events (presence of another vehicles, no stop lane ...), it leads to disaster. The disaster is unavoidable environmental impact. The disasters are controllable appearances, and their number is possible to minimize,
The consequences also can be controlled and reduced.

The motorway project should be performed in such way to make safe the sustainable development of corridor area and entire country. The sustainable is attaining in:

- in the sphere of the social influences: positive social impact should be significantly larger then negative,
- in the sphere of the economic influences: the positive economic impact should be significantly larger from negative,
- in the sphere of the impact on nature: the loss of bio-variety, bio-masses and quality of ecosystem should be smaller from net positive economic and social impacts,

bearing in mind the needs of present and future generations, including necessity for natural base as main prerequisite for existence and development of civilization.

During the exploitation of the motorway, waste waters from the motorway appear. These waste waters should be collected and treated by the system of internal drainage with auxiliary facilities/structures. Limit values of emissions in these waste waters should be satisfied and harmless for entire environment. For the values of limits, as directive, it can be recommended to adopt values defined in the “Book of regulations on conditions for letting of waste waters in surface waters” Official Gazette RS, number 44/01, or in “Book of regulations on conditions for letting of waste waters in public sewerage system” Official Gazette RS, number 44/01, taking into consideration fact that such relevant legal act was not issued until now in FB&H.

4. DESCRIPTION OF ENVIRONMENT THAT COULD BE ENDANGERED BY THE PROJECT

4.1. Demography and Economy

4.1.1. Population

There is a real problem in observation of real demographic trends in Bosnia and Herzegovina due to the fact that there are no reliable data with regards to the number of inhabitants and that the last population census was made some fifteen years ago. The entities offices of statistics as well as the Office of Statistics of Brčko District carry out annual assessments of the number of inhabitants, which are the subject of criticism. However, because of a lack of more reliable data we are going to use the official estimates of population figures, which besides being natural also respect some essential migration trends.

According to the statistical data[13], Bosnia and Herzegovina had 3.864.255 inhabitants in 2004, of which 2.322.263 or 60,1% are in the Federation of B&H, 1.467.843 or 38,0% in the Republic of Srpska, and 74.149 or 1,9% in the Brčko District. Compared to pre-war period (in 1991), there are 512.8 thousands less inhabitants in Bosnia and Herzegovina, what is direct consequence of war activities, deportations and displacing (period 1992-1995).

Table 4.1.1.1. Population 1961-2004

Period	Average annual rate Increase/Decrease [14]
1961-1971	1,34%
1971-1981	0,97%
1981-1991	0,60%
1991-1996	-3,13%
1996-2004	0,58%

According to the register from the year 1991, the urban areas were populated with 157.389 people, that is 36,4% of all the municipalities' population. The most populated urban areas are those within the municipalities of Zenica, Žepče, Tešanj and Kiseljak. The areas of Zenica (34.1%) and Žepče (34.1%) encompass the largest surface in the total direct impact area. The highest population concentration is recorded in the urban areas of Zenica, populated with 70% of the population in the narrow impact area. The evaluation of the urban areas' population was performed on the basis of migration tendencies, vital statistics quotas, and evaluation of the population number in the municipalities for the year 2004.

Trusty information on age, sex and national structure of population in analyzed municipalities/settlements are not available at the moment. A total of 1,29 million inhabitants (33,45% of the total population in B&H) lives in the zones through which the route of the future

[13] Data from the Office of Statistics FBiH, Republic Office of Statistics RS and Statistical Office of Brčko District.

14 Procjena, Izvor: Republički zavod za statistiku BiH, Statistički godišnjak, Sarajevo, 1991., Federalni zavod za statistiku, Statistički godišnjak/ljetopis Federacije Bosne i Hercegovine, 2004., Sarajevo, 2004.; Republički zavod za statistiku Republike Srpske, Demografska statistika, 2001. godine, Demografska statistika, br.7/2004, Banja Luka, 2004.; Podaci Statističkog biroa Distrikta Brčko.

Corridor Vc Motorway traverses (12 zones[15]). In zones that are immediate analyzed area of the future motorway route, or to say 8 zones in immediate proximity of the future motorway, some 720,7 thousand inhabitants live or 18,65% of the total number of inhabitants in Bosnia and Herzegovina. That means two millions inhabitants in total, representing some 52.1% of the total population of Bosnia and Herzegovina, live in the zones through which the future motorway will actually traverse or which will be in immediate catchments are of the future motorway.

Table 4.1.1.2. Population in municipalities in 2004 - estimation 2004.

No.	Municipality	Population in 2004		
		In settlements along the corridor		
1	Usora	2.406	7.100	33,9%
2	Tešanj	10.405	48.904	21,3%
3	Maglaj	1.643	21.520	7,6%
4	Žepče	25.622	30.843	83,1%
5	Zenica	89.294	128.657	69,4%
6	Kakanj	3.234	44.215	7,3%
7	Ilidža	1.585	48.105	3,3%
8	Hadžići	1.786	20.251	8,8%
9	Kiseljak	3.347	21.367	15,7%
Total		139.322	370.962	37,6%

Afore mentioned nine municipalities, creating catchments area, according to the zoning system used in pre-feasibility study located in following five zones:

- Tešanj Zone includes municipalities Maglaj, Zavidovići, Doboj jug, Usora and Tešanj;
- Zenica Zone - Municipality Zenica area;
- Kakanj Zone includes Vareš, Ilijaš, Olovo, Breza, Kladanj, Visoko and Kakanj municipalities area;
- Travnik Zone includes Kreševo, Fojnica, Kiseljak, Busovača, Novi Travnik, Vitez and Travnik municipalities area;
- Hadžići Zone - Municipality Hadžići area.

Review of population and projection for period 2010 - 2040 by the zones adopted route for LOT 2 is passing through is given in the following table:

Table 4.1.1.3. Projection of the population growth by the zones

Zone	2004.	2010.	2015.	2020.	2025.	2030.	2035.	2040.
Tešanj	149.694	160.016	166.606	171.238	173.822	176.445	177.329	178.218
Zenica	128.604	137.472	143.133	147.113	149.333	151.586	152.346	153.109
Kakanj	122.839	131.309	136.717	140.518	142.639	144.791	145.516	146.245
Travnik	154.833	165.509	172.325	177.117	179.789	182.502	183.417	184.336
Hadžići	21.000	22.448	23.372	24.022	24.385	24.753	24.877	25.001

Source: The Study Team Projections

[15] Consultant find usefull to compare results of previous researches and so decided to adopt zonal division as it was in Master Plan Study for B&H (B&H was divided in 41 Zones).

Looking at the zone groups, it is to expect the continuation slowly highlighted urbanization process of Bosnia and Herzegovina. The internal migration of population will continue from villages, settlements and minor towns to administrative, industrial, cultural and education centers of regions. In those areas relatively bigger growth of population is expected.

4.1.2. Settlements Structure

According to the evaluations, the urban areas were populated with 139.322 people in 2004, that is 18.067 (11,5%) less than in 1991. The population number in the municipalities is 14% lower in comparison to 1991. Decrease of the population number lowered the population density. Therefore, population density of the narrow impact area decreased from 3,2 people/ha in 1991 to 2,8 people/ha u 2004. The following table provides a detailed overview of the population and its density in 93 settlements of the LOT 2 catchments area.

Table 4.1.1.4. Overview of settlements by municipalities - population and population density

Municipality		Settlement		Surface (ha)	Population 1991	Population 2004 - estimation	Population density 1991	Population density 2004
I	Usora	1	N. Selo	26	859	865	33,0	33.3
		2	Tešanjka	110	768	530	7,0	4,8
		3	Žabljak	328	801	1.012	2,4	3,1
Total Usora		3		464	2.428	2.406	5,2	5,2
II	Tešanj	1	Čifluk	215	547	530	2,5	2,5
		2	Čaglići	334	646	445	1,9	1,3
		3	Jablanica	384	831	1119	2,2	2,9
		4	Karadaglije	1.028	789	857	0,8	0,8
		5	Koprivci	245	494	523	2,0	2,1
		6	Kraševo	344	1.218	1.319	3,5	3,8
		7	Lepenica	440	1.382	1.536	3,1	3,5
		8	Medakovo	504	781	786	1,5	1,6
		9	Novo Selo part	255	859	864	3,4	3,4
		10	Ripna	264	158	183	0,6	0.7
		11	Tešanjka part	40	279	192	7,0	4.8
		12	Trepče	910	1.659	1.667	1,8	1.8
		13	Tugovići	321	394	384	1,2	1,2
Total Tešanj		13		5.284	10.037	10.405	1,9	2,0

III	Maglaj	1	Mladoševica	529	306	159	0,6	0,3
		2	Novi Šeher	416	1.802	870	4,3	2,1
		3	Radojčići	463	577	263	1,2	0,6
		4	Strupina	697	749	351	1,1	0,5
Total Maglaj		4		2.105	3.434	1.643	1,6	0,8
IV	Žepče	1	Begov Han	272	1.041	1.302	3,8	4,8
		2	Bljuva	235	401	532	1,7	2,3
		3	G. Golubinja	849	483	590	0,6	0,7
		4	Goliješnica	583	798	1019	1,4	1,7
		5	Golubinja	435	398	520	0,9	1,2
		6	Grabovica	299	411	351	1,4	1,2
		7	Ljubatovići	315	564	945	1,8	3,0
		8	Mračaj	2.148	687	954	0,3	0,4
		9	Ozimica	1.285	1.546	2.071	1,2	1,6
		10	Papratnica	2.076	1.130	1.542	0,5	0,7
		11	Ravne Donje	130	141	253	1,1	1,9
		12	Selište	104	166	239	1,6	2,3
		13	Tatarbudžak	315	571	754	1,8	2,4
		14	Varošište	26	118	147	4,5	5,7
		15	Vašarište	75	327	422	4,4	5,6
		16	Željezno polje	4.054	4.384	6.254	1,1	1,5
		17	Željeće	1637	410	584	0,3	0,4
		18	Žepče	666	5.571	7.144	8,4	10,7
Total Žepče		18	15.504		19.147	25.623	1,2	1,7
Municipality		Settlement		Surface (ha)	Population 1991	Population 2004 - estimation	Population density 1991	Population density 2004
V	Zenica	1	Gorica	457	801	674	1,8	1,5
		2	D.Vraca	867	979	838	1,1	1,0
		3	G Vraca	310	509	432	1,6	1,4
		4	Gladovići	996	558	460	0,6	0,5
		5	Gumanci	368	28	48	0,1	0,1
		6	Janjički Vrh	325	70	59	0,2	0,2
		7	Janjići	204	1.020	931	5,0	4,6

		8	Koprivna	595	319	245	0,5	0,4
		9	Kovanići	2.256	549	400	0,2	0,2
		10	Lašva	390	693	491	1,8	1,3
		11	Mutnica	246	382	318	1,6	1,3
		12	Nemila	1823	2505	1730	1,4	0,9
		13	Novo Selo	215	259	254	1,2	1,2
		14	Ponirak	537	507	411	0,9	0,8
		15	Putovičko Polje	31	893	492	28,8	15,9
		16	Putovići	307	799	673	2,6	2,2
		17	Sviće	700	692	566	1,0	0,8
		18	Tišina	372	339	641	0,9	1,7
		19	Topčić Polje	1.021	1.257	1.072	1,2	1,0
		20	Vranduk	561	625	569	1,1	1,0
		21	Zenica	4.281	96.027	77.990	22,4	18,2
Total Zenica		21		16.862	109.811	89.294	6,5	5,3
VI	Kakanj	1	Biljeŝevo	318	239	175	0,8	0,6
		2	D. Lučani	221	114	79	0,5	0,4
		3	Donji Kakanj	66	60	76	0,9	1,2
		4	Dumanac	295	607	481	2,1	1,6
		5	G.Lučani	260	400	269	1,5	1,0
		6	Groce	73	272	170	3,7	2,3
		7	Karaulsko Polje	55	252	128	4,6	2,3
		8	Mioči	424	182	134	0,4	0,3
		9	Slivnice	72	453	231	6,3	3,2
		10	Tičići	620	940	695	1,5	1,1
		11	Želj. st. Kakanj	28	628	796	22,4	28,4
Total Kakanj		11		2.432	4.147	3.234	1,7	1,3
VII	Ilidža	1	Gladno Polje	153	*	97	*	0,6
		2	Kobiljača	150	375	234	2,5	1,6
		3	Rakovica	765	1374	925	1,8	1,2
		4	Rogačić	327	*	98	*	0,3
		5	Rudnik	396	417	231	1,1	0,6

Municipality		Settlement		Surface (ha)	Population 1991	Population 2004 - estimation	Population density 1991	Population density 2004
Total Ilidža		5		1.791	2.166	1.585	1,2	0,9
VIII	Hadžići	1	Do	366	110	81	0,3	0,2
		2	Luke	510	661	544	1,3	1,1
		3	Medvjedice	196	14	41	0,1	0,2
		4	Mokrine	446	264	204	0,6	0,5
		5	Tarčin	328	1.005	916	3,1	2,8
Total Hadžići		5		1.846	2.054	1.786	5,3	1,0
IX	Kiseljak	1	Toplica	386	93	78	0,2	0,2
		2	Azapovići	452	807	672	1,8	1,5
		3	Boljkovići	96	92	65	1,0	0,7
		4	Bukovica	278	452	374	1,6	1,3
		5	Čubren	575	239	181	0,4	0,3
		6	Gojakovac	180	161	127	0,9	0,7
		7	Homolj	37	204	163	5,5	4,4
		8	Ivica	176	479	316	2,7	1,8
		9	Kuliješ	204	365	335	1,8	1,6
		10	Solakovići	95	305	205	3,2	2,2
		11	Tulica	149	280	261	1,9	1,8
		12	Zabrđe	201	331	268	1,6	1,3
		13	Žeželovo	295	357	302	1,2	1,0
Total Kiseljak		13		3.124	4.165	3.347	1,3	1,1
Settlements along the adopted route total		93		49.412	157.389	139.322	3,2	2,8

Urban area structure of the narrow impact area has been scattered. There is the highest number of urban areas with the surface within the 200-499 range, populated with 11.068 people, according to the 1991 register (Figure 4.1.1). The second numerous group of 31 urban areas, with the population of 500-1000, are inhabited with 22.075 people, that is 14% of the total urban area population. There was only one urban area with more than 5000 inhabitants, and the other with more than 10000 inhabitants in 1991, both of them holding up 64,5% of the total urban area population.

Table 4.1.1.5. Settlement structure by size in 1991 and 2004

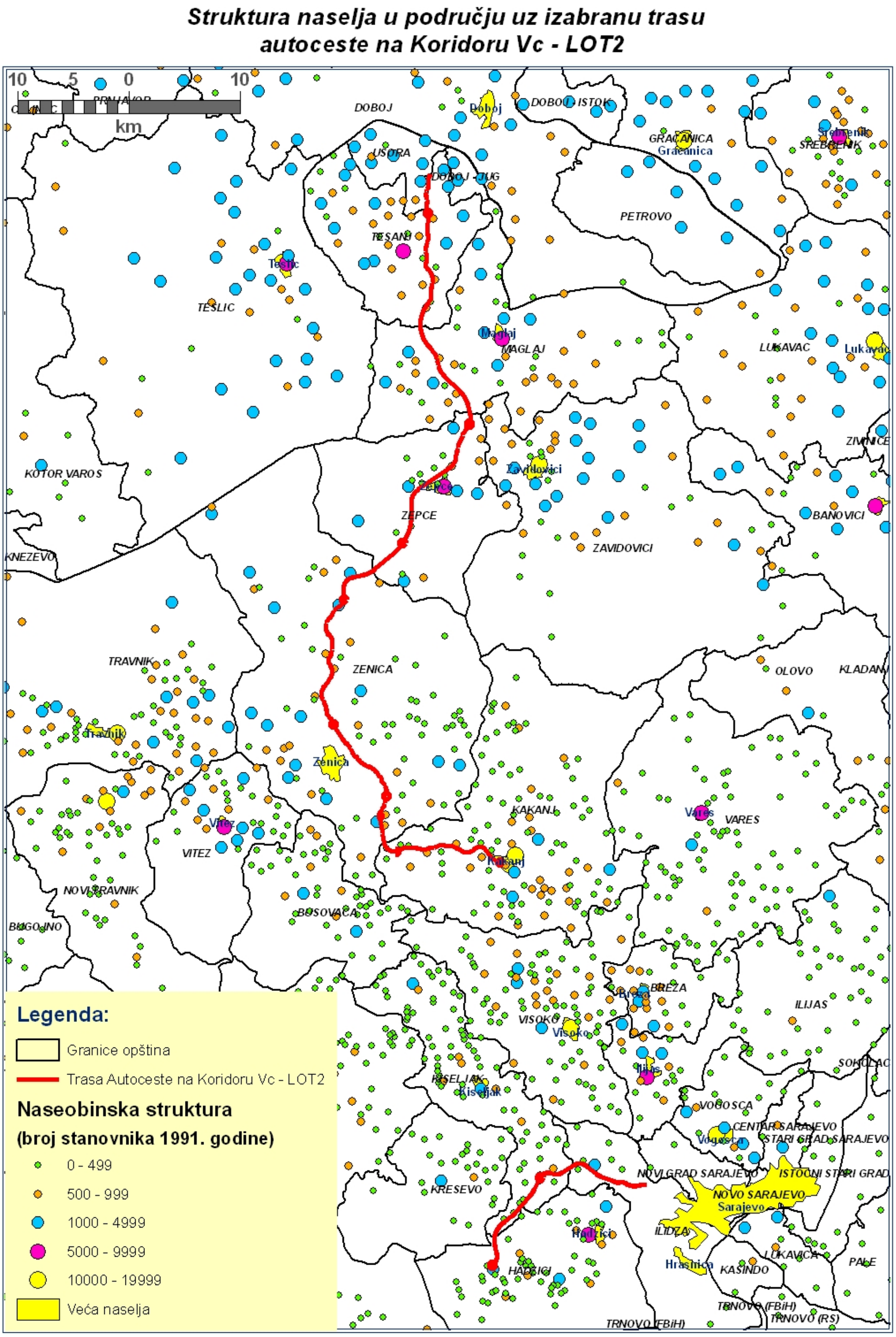
No	Population	Urban areas structure size 1991.				Urban areas structure size 2004.			
		Settlements		Population		Settlements		Population	
		num ber	%	number	u %	number	%	number	u %
1.	do 199	13	14,3	1.325	0,8	21	22,6	2.481	1,8
2.	200-499	32	35,2	11.068	7,0	30	32,3	9.922	7,1
3.	500-999	31	34,1	22.075	14,0	28	30,1	20.144	14,5
4.	1.000-1.999	11	12,1	14.434	9,2	10	10,8	13.316	9,6
5.	2.000-4.999	2	2,2	6.889	4,4	1	1,1	2.071	1,5
6.	5.000-10.000	1	1,1	5.571	3,5	2	2,2	13.398	9,6
7.	>10.000	1	1,1	96.027	61,0	1	1,1	77.990	56,0
Total:		91*	100,0	157.389	100,0	93	100,0	139.322	100,0

* Settlements Gladno Polje and Rogačići did not exist according to 1991 register.

The urban area fragmentation took place in 2004 due to population number decrease. There was an increase in number of urban areas with 200 inhabitants to 21, all of them populated with 1,8% of the total population of the area. The largest urban area is populated with 77.990 inhabitants, what is 56% of the total population of the area.

Spatial regulation and development plans are presented in document Backgrounds for planning documentation – LOT 2, which, together with this study creates comprehensive basis for further analysis of spatial-planning documentation.

Illustration 4.1.1. Settlements structure in area along the adopted route - LOT 2



4.1.3. Economic Indicators

B&H GDP, Analyzed Area GDP and GDP Structure
B&H GDP is calculated[16] according to productive approach using current prices (on the basis of added or new/created value). For now it is the only methodology, because resident statistics institutions are still not developed enough to use some other methodology for GDP calculation.

Table 4.1.3.1. GDP in Bosnia and Herzegovina – basic indicators

Indicator	1995.	1996.	1997.	1998.	1999.	2000.	2001.	2002.	2003.
GDP (millions of KM)	2.676	4.125	6.116	7.559	8.603	9.611	10.480	10.879	11.342
GDP p/c (US$)	491	721	901	1.136	1.231	1.189	1.259	1.376	-
Real GDP growth	20,8	86,0	37,0	15,6	9,6	5,6	4,5	3,8	3,5

Source: European Bank for Reconstruction and Development, Transition report 2003 - Integration and regional cooperation, London, 2003, page 127.

Indicators for nominal GDP and real GDP growth in B&H for period 1995.-2004 are presented in previous table. The Bosnia and Herzegovina GDP in 2003 was 11,3 billion KM and compared with 1995 is 4 times higher, when it was expressed at the level of 2,67 billion KM. The annual growth of the real GDP varies from 86,0% in 1996 to 3,5% in 2003. Rather high growth of the real GDP in 1996 was reduced almost 25 times in the next 7 years. The average annual growth in the stated period was 15,6%. The percentage growth of the real GDP was reduced to the level of 3,5% in 2003, which is rather low growth regarding the fact that the economy of Bosnia and Herzegovina inadequately uses its business capacities.

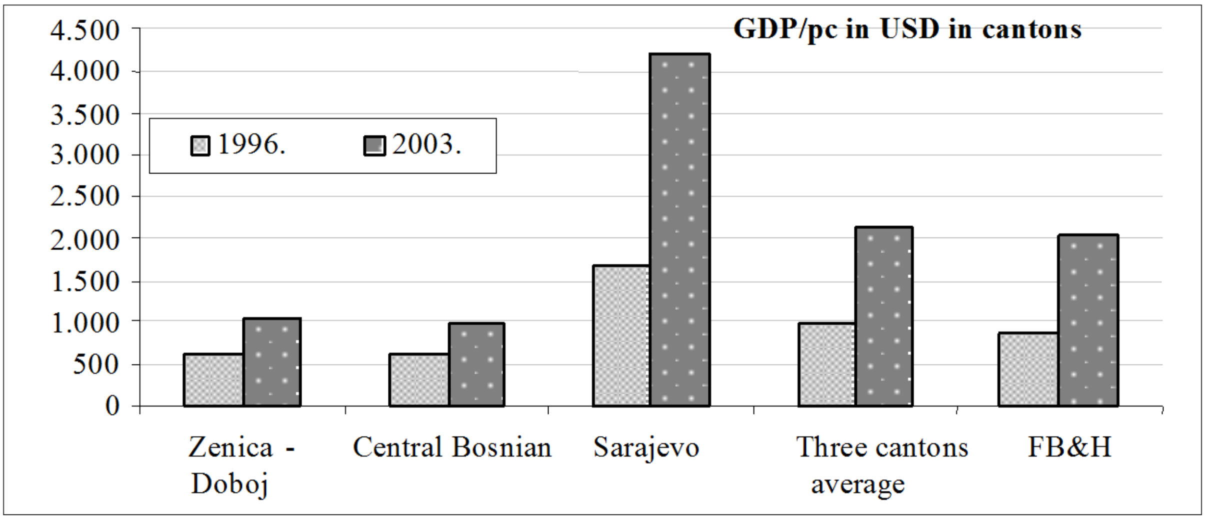
High growth rates in the first post-war years were supported by the foreign aid, donations and unilateral transfers. Lately, GDP growth decreasing and it become rather low comparing to previous. With the existing trend of GDP growth (for last 2-3 years), it will take a lot of time[17] to reach GDP level that Bosnia and Herzegovina had before the transition reforms.

Many analyses indicate that the revival of the economy and progress in the post-war period has been realized primarily due to the inflow of foreign money assistance risking creation of "aid driven GDP"[18]. High growth rates are mostly supported by foreign aid, donations and unilateral transfers and not with investments. The adopted route of the Corridor Vc Motorway - LOT 2 is passing through areas of Zenica-Doboj, Srednjebosanski and Sarajevo Canton with the largest concentration of economy effects: gross value of production and GDP as a „sovereign indicator of economic development".

Total value of goods and services that was made by producers from Zenica-Doboj Canton, Central Bosnian Canton and Canton Sarajevo in 2003, or gross value of production is 8.177 million KM, what represents around 57% of the whole production rate in the Federation of B&H[19].

[16] According to B&H Statistics..
[17] B&H will reach pre-war level of GDP in second decade of this century if its economic growth continue as it was in last two years,.
[18] GDP growth as a result of national economy monetary incoms through different forms of grants.
[19] In 2003, 63% of national GDP is generated in Federation of Bosnia and Herzegovina.

Illustration 4.1.3.1 GDP per capita - Cantons



The GDP structure, seen from the production standpoint on the basis of gross added value participation, is presented in the following Table.

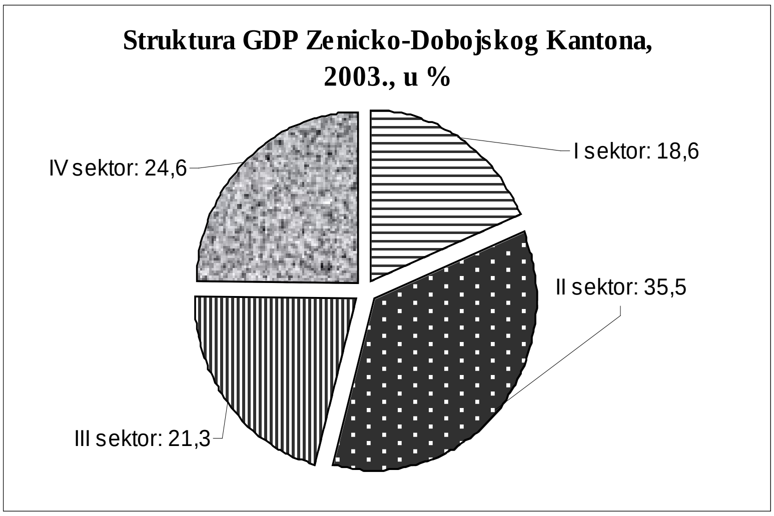
Table 4.1.3.2. Share in total GDP of BiH

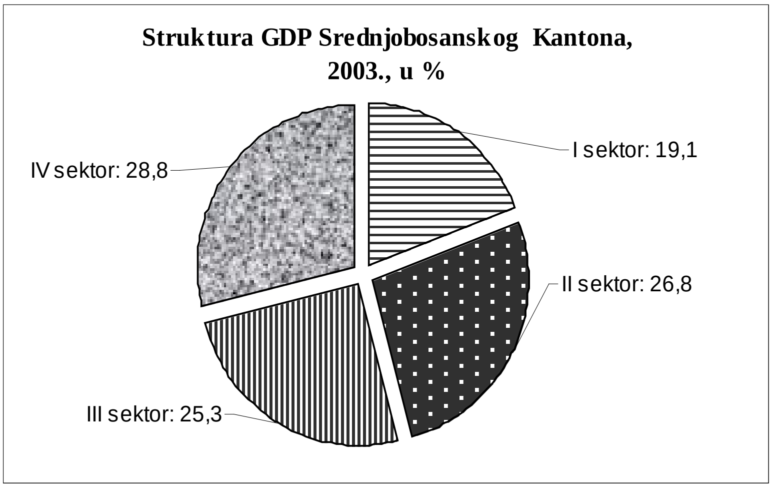
ACTIVITY	2001.	2002.	2003.
Agriculture, hunting and forestry	13,3	12,45	11,01
Processing industry	12,83	12,68	12,97
Construction	5,47	5,26	5,80
PRODUCTION ACTIVITIES IN TOTAL	41,96	39,29	39,68
Wholesale and retail sale; car repairs and goods for personnal use and households	11,90	13,36	13,75
Transport, warehousing and communication	11,33	11,40	11,90
Public administration and defense, mandatory social security	15,09	15,82	13,99
SERVICES IN TOTAL	60,87	63,73	63,70

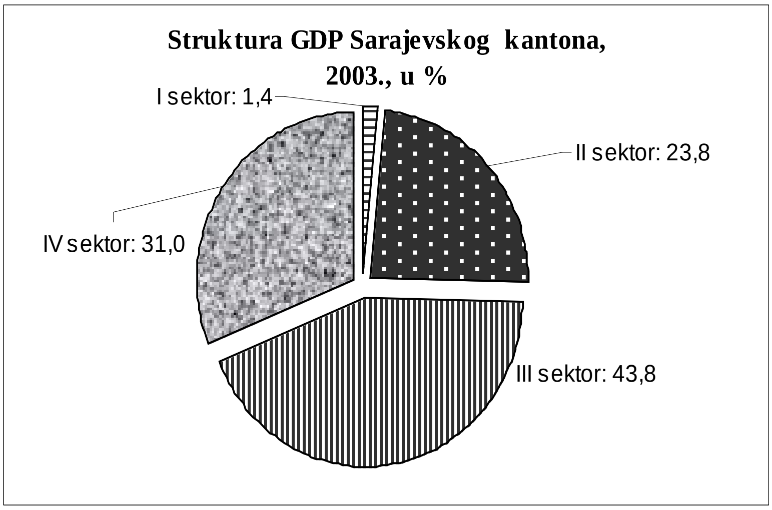
Source: Agency for Statistics of BiH, Statistics of National Accounts-statement, Sarajevo, July 30th 2004.

.

Illustration 4.1.3.2. Overview of BNP Structure in Zenica-Doboj, Srednjebosanski and Sarajevo Cantons







Overview of SAC activities

I sector

A Agriculture,hunting,
B Fishing
C Mining

II sector

D Manufacturing
E Electricity,gas and water supply
F Construction

III Sector

G Trade
H Catering
I Traffic,storring,connections
J Financial business
K Property business, renting, business services

IV Sector

L Public administration,socil and personal services
M Education
N Social protection
O Other public social and personal services.

Employment

Employment is economic as well as social category because it gives multidimensional indication of development. During 2004 in the three cantons there were 200.000 employed, which is more than 52% of work place concentration in FB&H. Canton Sarajevo has a quarter of all employees in FB&H.

Table 4.1.3.3. Employment per Cantons

No.	Canton	Average		Index 2004/ 2003	Structure %	
		2003	2004			
1	Zeničko-Dobojski	67.800	69.110	1,02	19,6	18,4
2	Srednjebosanski	35.273	36.172	1,03	10,2	9,6
3	Sarajevo	85.737	90.910	1,06	24,8	24,2
Total (1+2+3)		188.810	196.192	1,04	54,5	52,2
FBiH		346.381	375.871	1,09	100.0	100.0

Structure of employment according to SAC points out that in the area of the three cantons the highest employments rate is in industry-47.253 (53.3% participation in FB&H), then in trade 25.329, public administration and service activities 19.096, as well as in education 16.636. Traffic and connections provide 14.710 work places what represents around 53% employed in traffic in the area of the whole Federation of B&H.

General assessment implies the existence of economic activity concentration in the urban areas of Zenica-Doboj Canton, comprising 86,3% of the total area, populated with 95,5% of the population of the narrow impact area.

4.2. Climatic and Meteorological Characteristics

Area of section LOT 2, by it's the biggest part, passes through the zone of moderate continental climate, which impact comes from Pannonian plain. By its southern part only, at distance Hadžići-Tarčin, comes into the zone of moderate continental climate of mountainous type, due to height above sea level. The main characteristics of moderate continental climate are severe winters and warm summers, but in relation to mountainous zone, temperature ranges are smaller between winter and summer temperatures. The warmest areas are located at northeast, but mean temperature decreasing toward southwest, going through the valley of the Bosnia River toward the Sarajevo basin. Annual precipitation quantities are going from 780 l/m^2 to 1300 l/m^2. Quantity of snow is significant during the winter period, and amount of precipitation and number of days with snow blanket increases with increase of height above sea level (Map 5).

Data from ten meteorological stations have been used for the analysis of some climatic parameters of this area, for the period: 1961-1990.

Table 4.2.1.1. Coordinates of meteorological stations

Station	φ	λ	Hs (m)
Doboj	44°44'	18°06'	146
Maglaj	44°32'	18°07'	190
Zavidovići	44°27'	18°10'	210
Zenica	44°13'	17°54'	344
Kakanj	44°09'	18°05'	380
Visoko	44°00'	18°12'	439
Sarajevo-Bjelave	43°52'	18°26'	630
Butmir-Aerodrom	43°50'	18°21'	518
Hadžići	43°50'	18°13'	570
Tarčin	43°48'	18°06'	660

4.2.1. Air Temperature

Depending on the height above sea level, a middle annual temperature ranges between +8.6 and +10.6°C (Illustration 4.2.1.1). The lowest average monthly temperature in the registered period was –8.0°C (in January), whilst the highest average monthly temperature was +23.3°C (in July). The absolute minimum temperature was –32.2°C, and the absolute maximum temperature was +40.0°C.

Temperature changes with isotherms are shown at illustration 4.2.1.2.

Illustration 4.2.1.1. Average monthly air temperatures (°C)

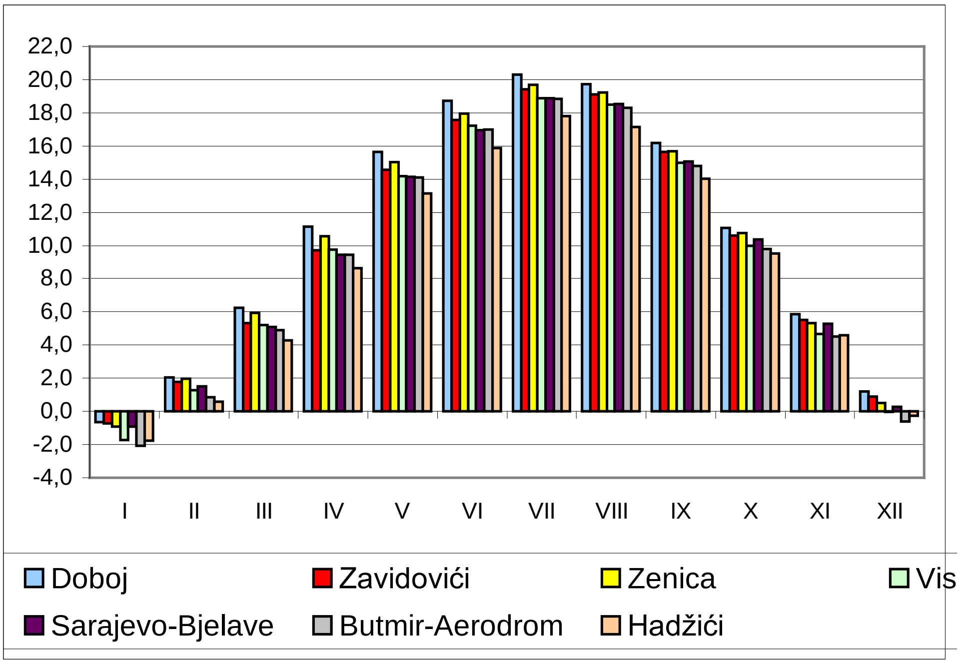
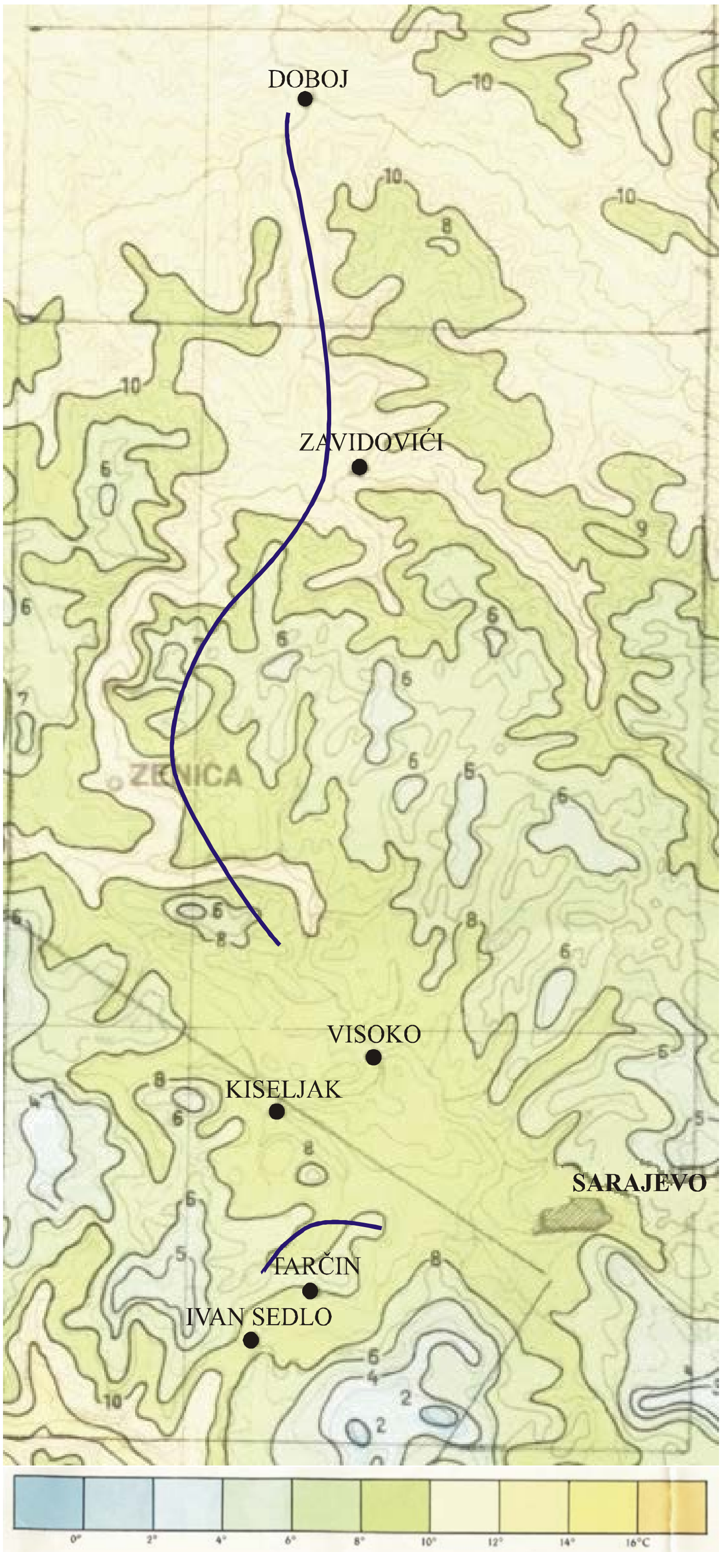


Illustration 4.2.1.2. Middle temperature of air for a year

MIDDLE AIR TEMPERATURE FOR A YEAR



Temperature ranges in the coldest and the warmest part of year are given at the Illustrations 4.2.1.3.-4.2.1.6. It is remarkable that maximal annual amplitude slightly decreases with height above sea level and it goes from 72°C (Doboj) to 62°C (Hadžići). Values on graphs are connected by linear trend that show average temperature change with change of height above sea level.

Illustration 4.2.1.3. Middle temperatures in January (°C)

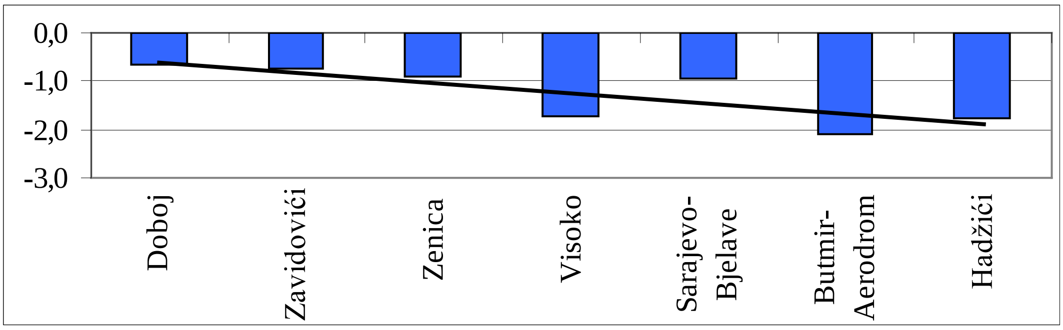


Illustration 4.2.1.4. Middle temperatures in July (°C)

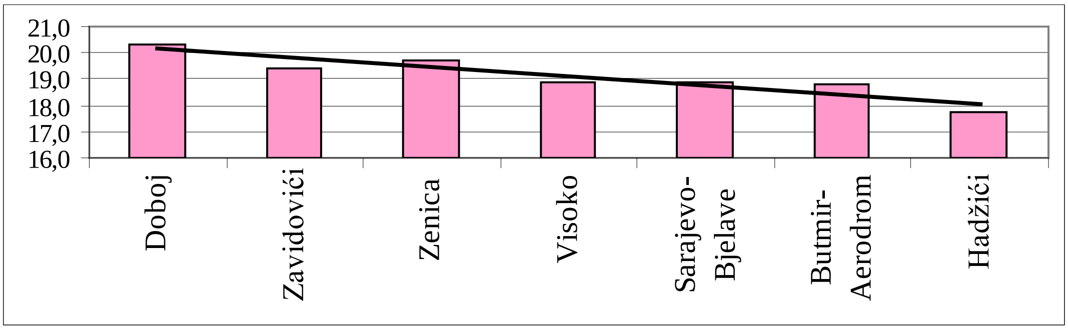


Illustration 4.2.1.5. Minimal temperatures in January (°C)

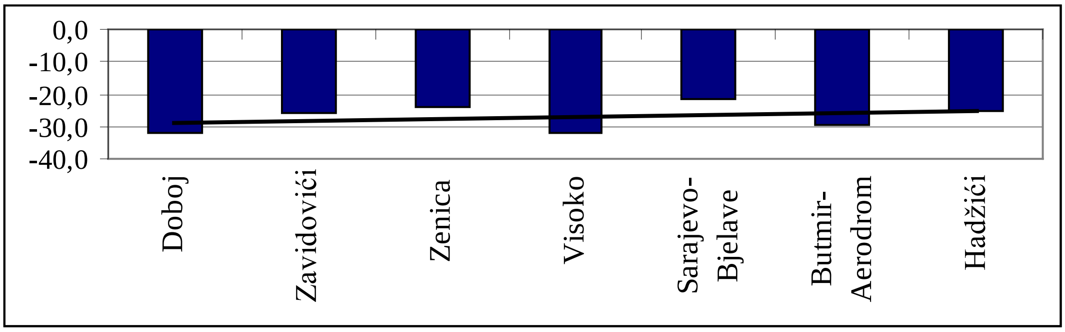


Illustration 4.2.1.6. Maximal temperature in July (°C)

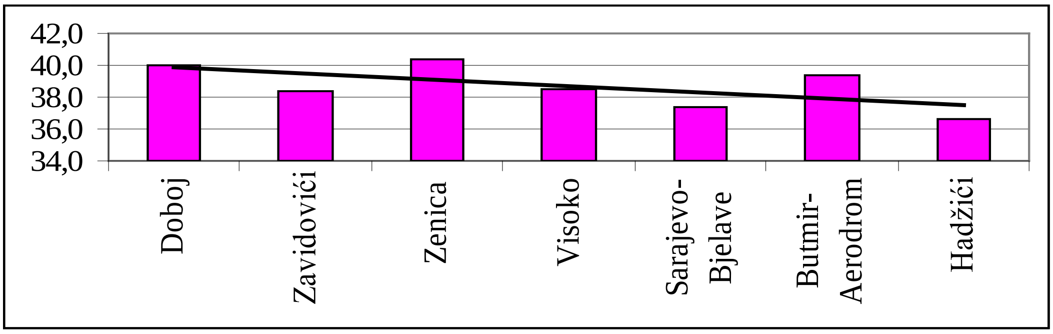
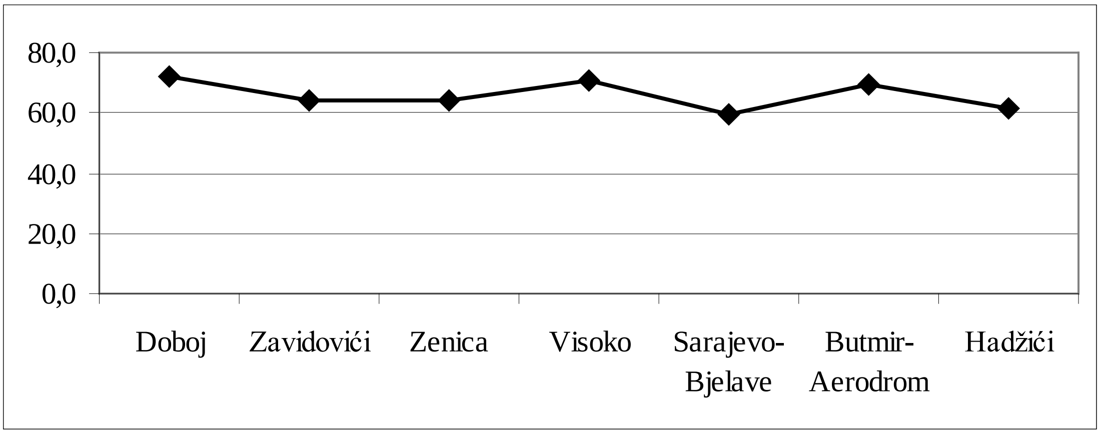


Illustration 4.2.1.7. Maximal yearly amplitudes (°C)



Total number of days with frost is going in range from 80 to 110 annually. In average, the first day with frost is 16th October, and the last is 25th April.

Table 4.2.1.2. The first and the last day with frost, in average

Meteorological station	The first day in average	The last day in average
Doboj	30. October	12. April
Zavidovići	25. October	17. April
Zenica	27. October	18. April
Visoko	29. October	20. April
Sarajevo-Bjelave	23. October	16. April
Butmir-Aerodrom	16. October	25. April
Hadžići	19. October	23. April

As it is obvious from the Table 4.2.1.2, frost is along whole motorway route possible in period from October to April, but in areas which gravitate to the zone of moderate continental climate of pre-mountainous climate (Hadžići), in average, the first day with frost appears in mid October, and the latest at the end of October, at the northern part of the route (Doboj). In average, the last day with frost appears in parts that gravitate to the zone of moderate continental climate of pre-mountainous type (Hadžići) at the end of April, but at the northern part of the route (Doboj) in mid April.

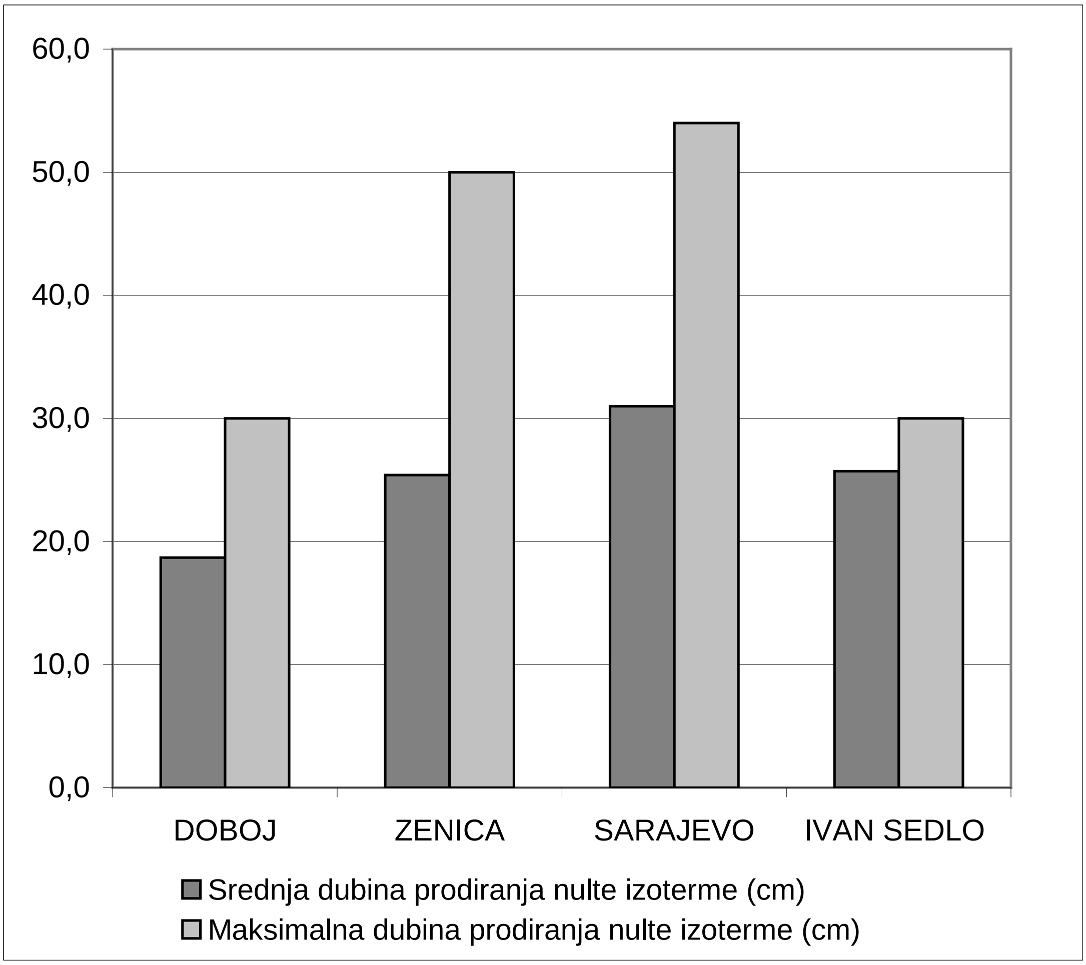
Big number of days with maximal temperature less than 0°C is one of characteristic of the route and that number is equalized on the whole route.

4.2.2. Temperature Regime of Soil

Based on results of the soil temperature measured at 2 cm to 50 cm deep in the ground during the period over several years (1981-1990), the mean and maximum depth of the zero isotherm penetration have been obtained. The depth of the zero isotherm penetration does not depend only on the sea level. The thickness of the snow cover and its duration at the beginning and at the end of winter is extremely important. Therefore, even at the lower heights above sea level, because of the thin snow cover, we have noticed the zero isotherm penetration at greater depths.

The deepest zero isotherm penetration in the observed period has been noticed in Sarajevo and it amounted to 54 cm (winter 1986/1987).The mean depth of the zero isotherm penetration for Doboj amounts to 18.7 cm, and for Sarajevo 31 cm.

Illustration 4.2.2.1. Depth of the Zero Isotherm Penetration (cm)



Ranges of middle soil temperatures and ranges of maximal and minimal soil temperatures are given at Illustrations 4.2.2.2. and 4.2.2.3.

It is noticeable that values decrease going from the north to southern part of the motorway route.

Illustration 4.2.2.2. Middle temperatures of soils (°C)

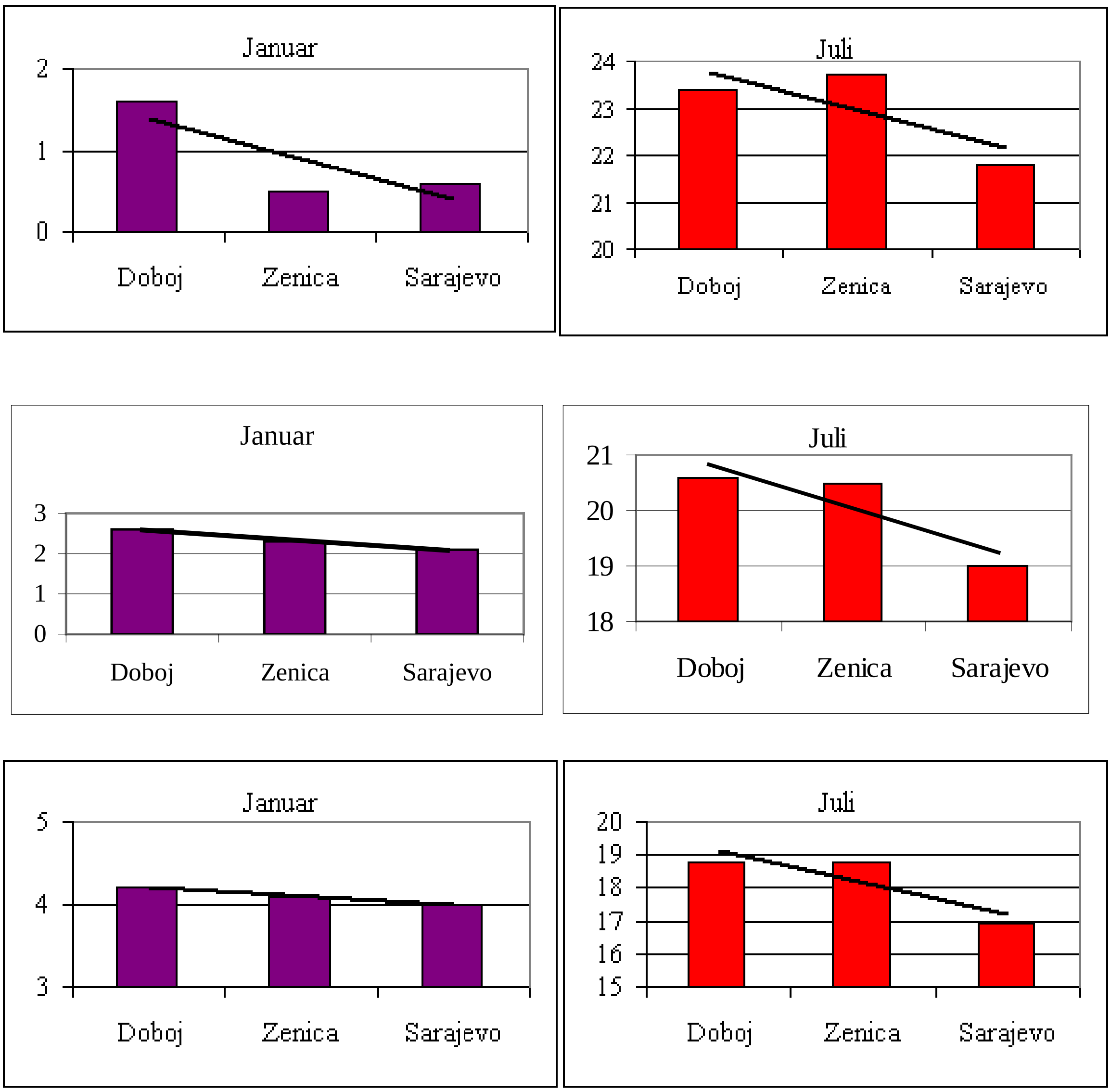
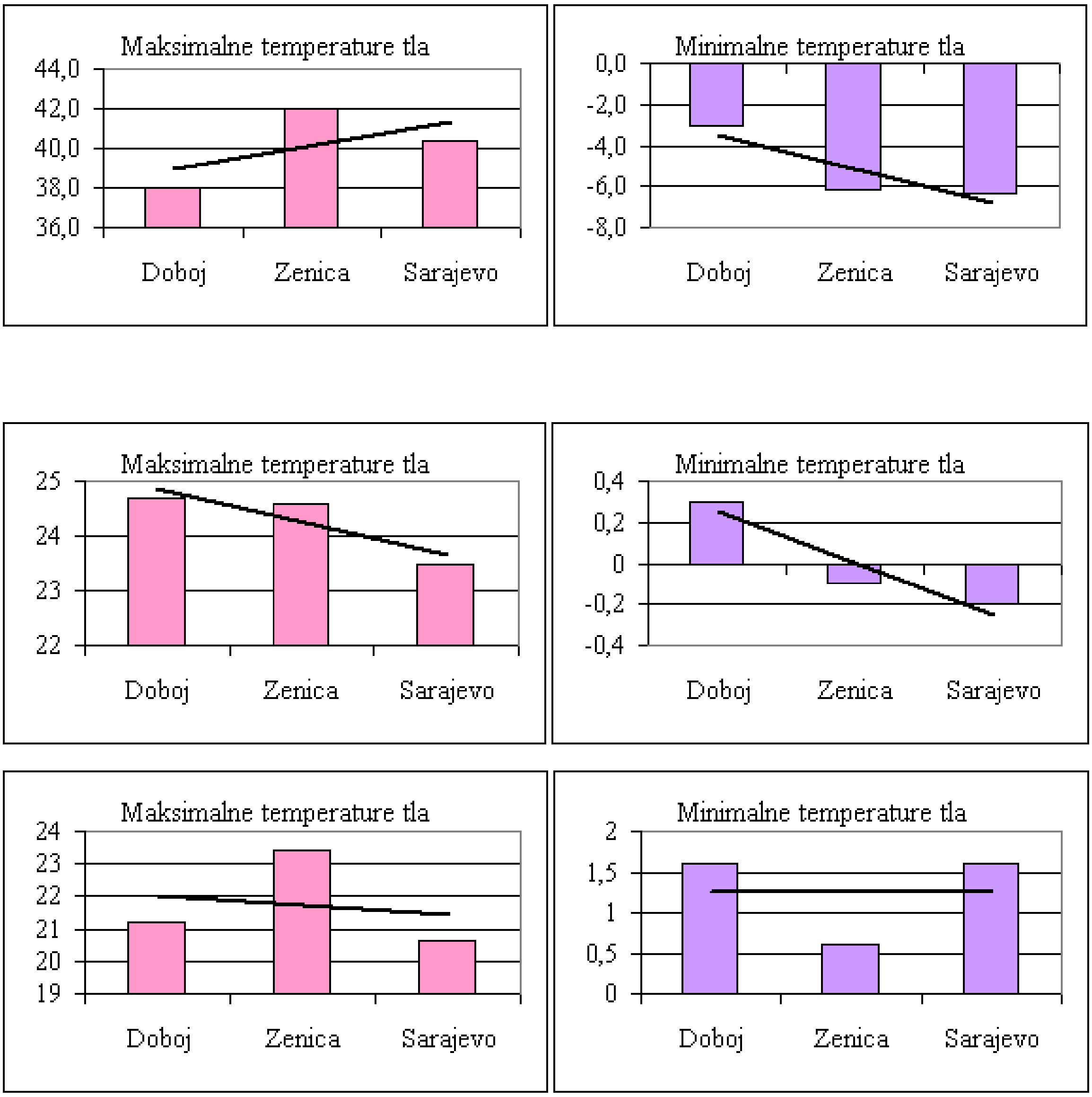


Illustration 4.2.2.3. Maximal and minimal soil temperatures (^oC)



4.2.3. Precipitations

It is noticeable from illustrations 4.2.3.1. and 4.2.3.2 that an average annual amount of precipitation goes in range from 780 l/m^2 (in Zenica) to 1340 l/m^2(in Tarčin). The annual precipitation variation (Graph 3.) is typical for a moderate continental climate. The main characteristic of this climate is the even distribution of precipitation during the whole year. However, in the graphical presentation below one can notice a springtime maximum (in June) and an autumn maximum (in November). In principle, the amount of precipitation rises with the rise of the sea level. Zenica Region is an exception which is characterized with the lowest annual amount of precipitation. Maximum daily precipitation ranges between 70 l/m^2 and 100 l/m^2 for the whole observed area.

Precipitation intensities are very law at this area, especially in area of Zenica valley. Exception makes only a short distance from Hadžići to Tarčin. This statement is related on annual number of weather storms. For example, valley of the Zenica town has average annual number of days with thunders between 20 and 30, northern and southern part of the route between 30 and 40, while part from Hadžići to Tarčin has average annual number of days with thunders between 40 and 50.

Illustration 4.2.3.1. Average Monthly Precipitation (l/m2)

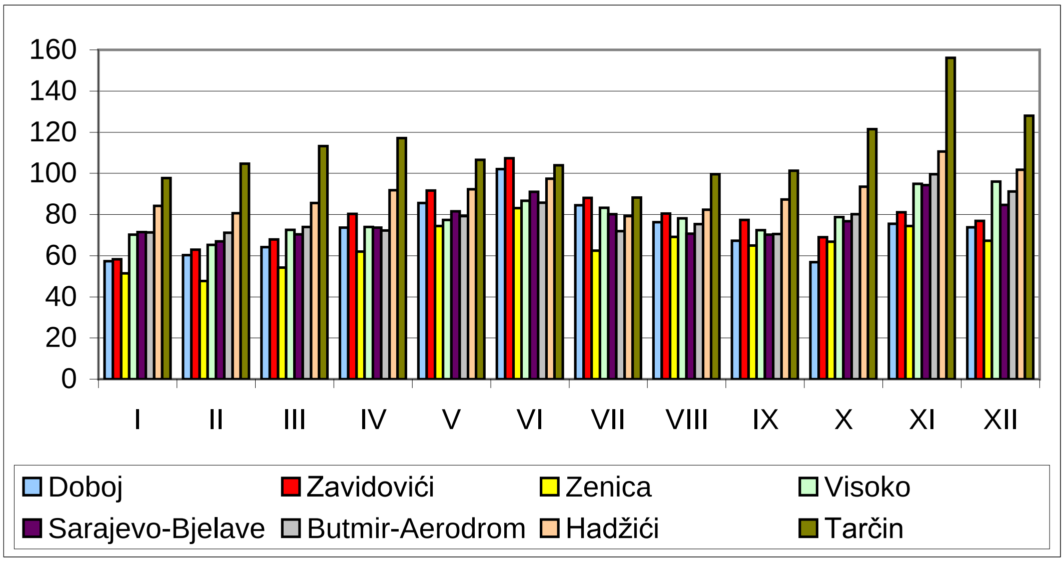
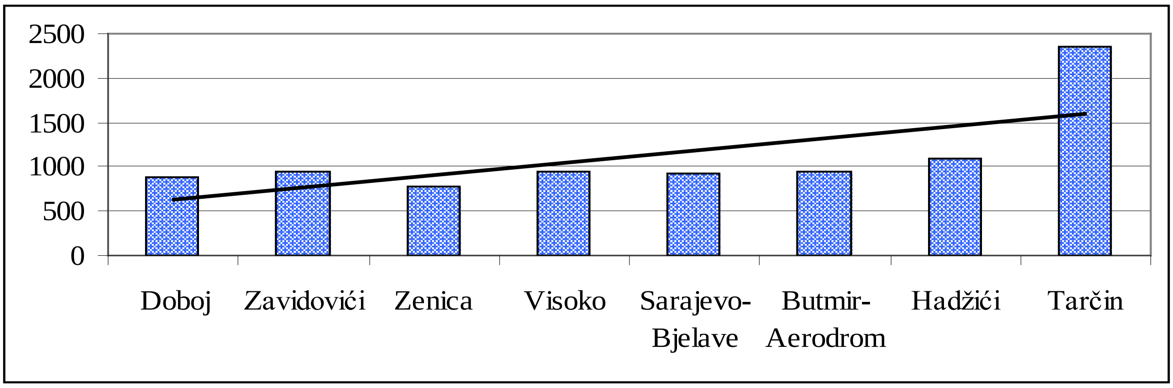


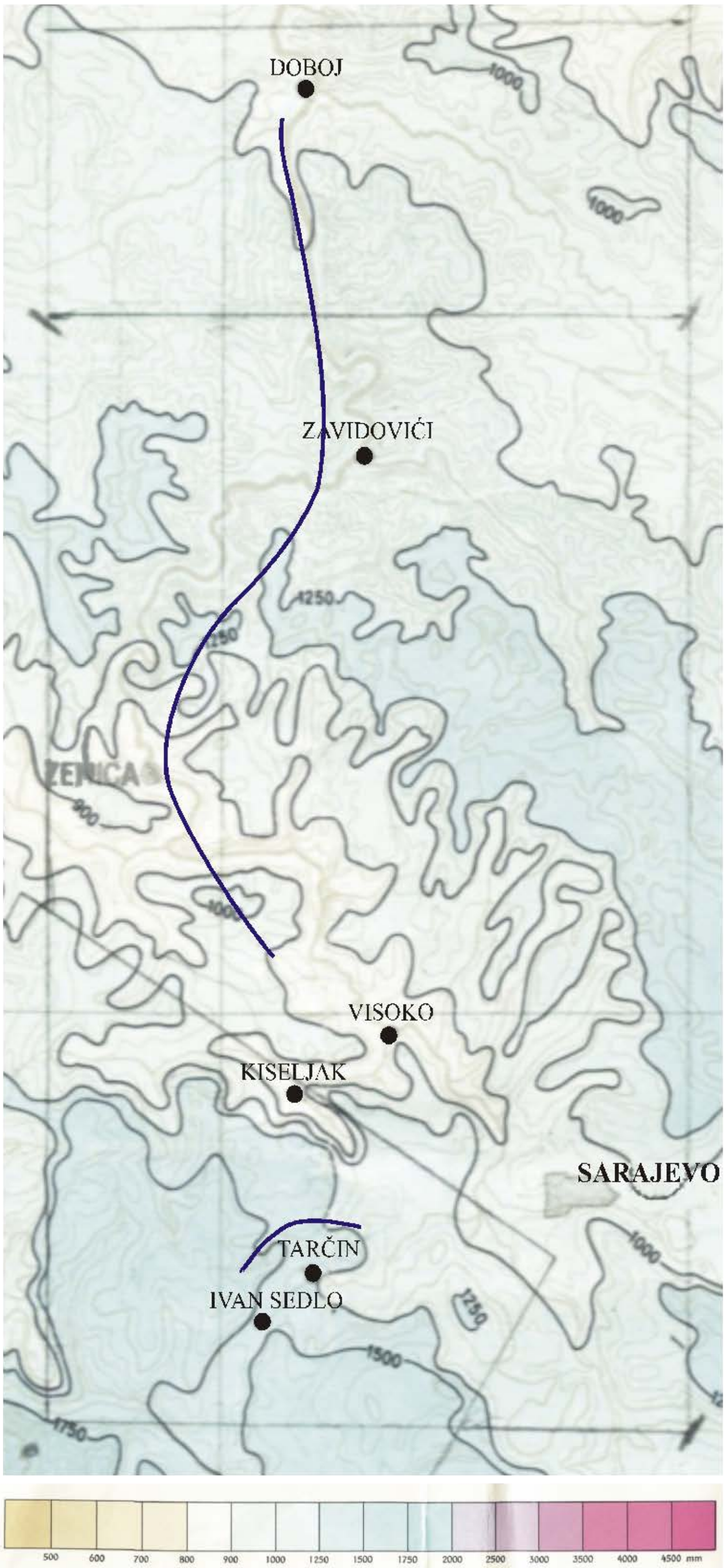
Illustration 4.2.3.2. Change of annual precipitation amounts along the route (l/m^2)



The days with snowfall occur most often in the winter period. There is no snow at all between June and September. The average annual number of days with approximately 10 cm snow cover rises with the increase of height above sea level and it is the lowest in Doboj 23 days and the highest in Butmir 33 days.

Illustration 4.2.3.3. Middle annual precipitation amount (l/m2)

SREDNJA KOLIČINA PADAVINA ZA GODINU (l/m^2)



Along the Zujevina River valley towards Tarčin, the number of days with approximately 10 cm snow cover gradually rises at every 100 meters for 8 days. Disposition of annual number of days with snow blanket bigger than 1 cm and 10 cm is given at illustrations 4.2.3.5 and 4.2.3.6.

Number of days with snow blanket ≥ 30 cm happens 2 times during 3 years, in average, while in Zenica region that frequency amounts 1 time in 3 years. Number of days with snow blanket ≥ 50 cm appears 1 time during 3 years, in average, while in Zenica region only 1 day in 30 years was recorded with such snow blanket. Maximal height of snow blanket was 72 cm in Doboj (February 1984), and 100 cm at Butmir (January 1967).

Illustration 4.2.3.4. Middle number of days with snaw blanket ≥ 10 cm

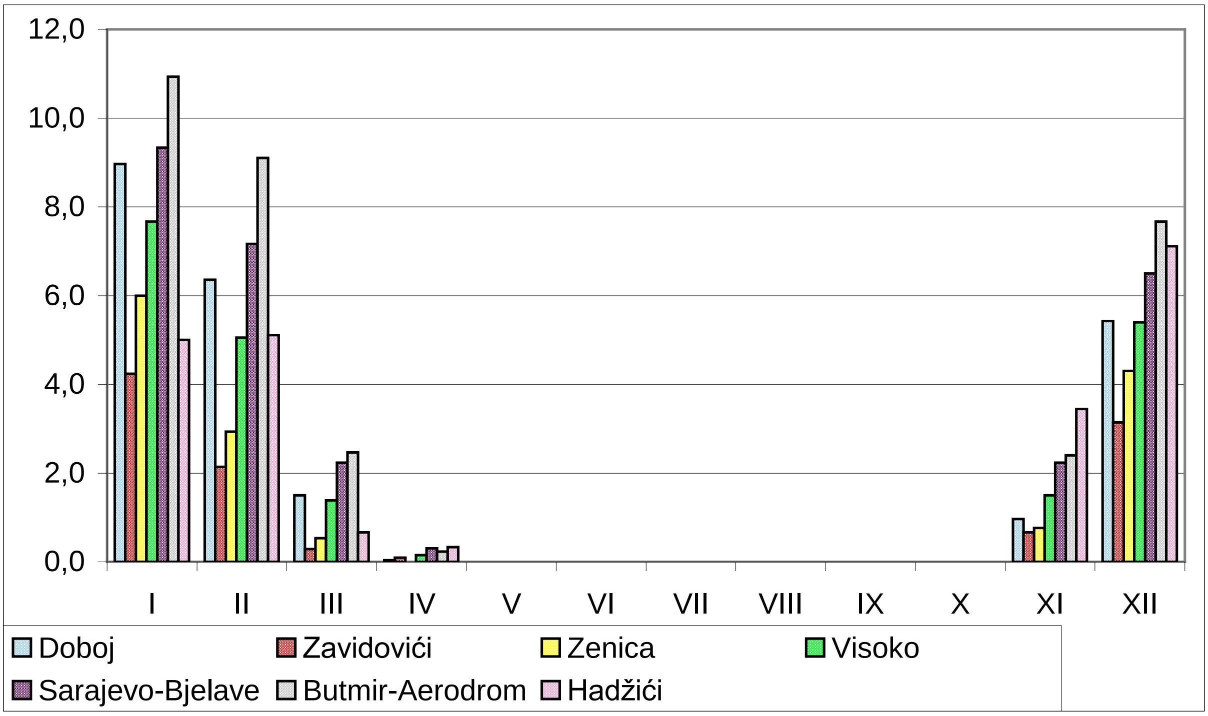


Illustration 4.2.3.5. Middle annual number of days with snow blanket >1cm

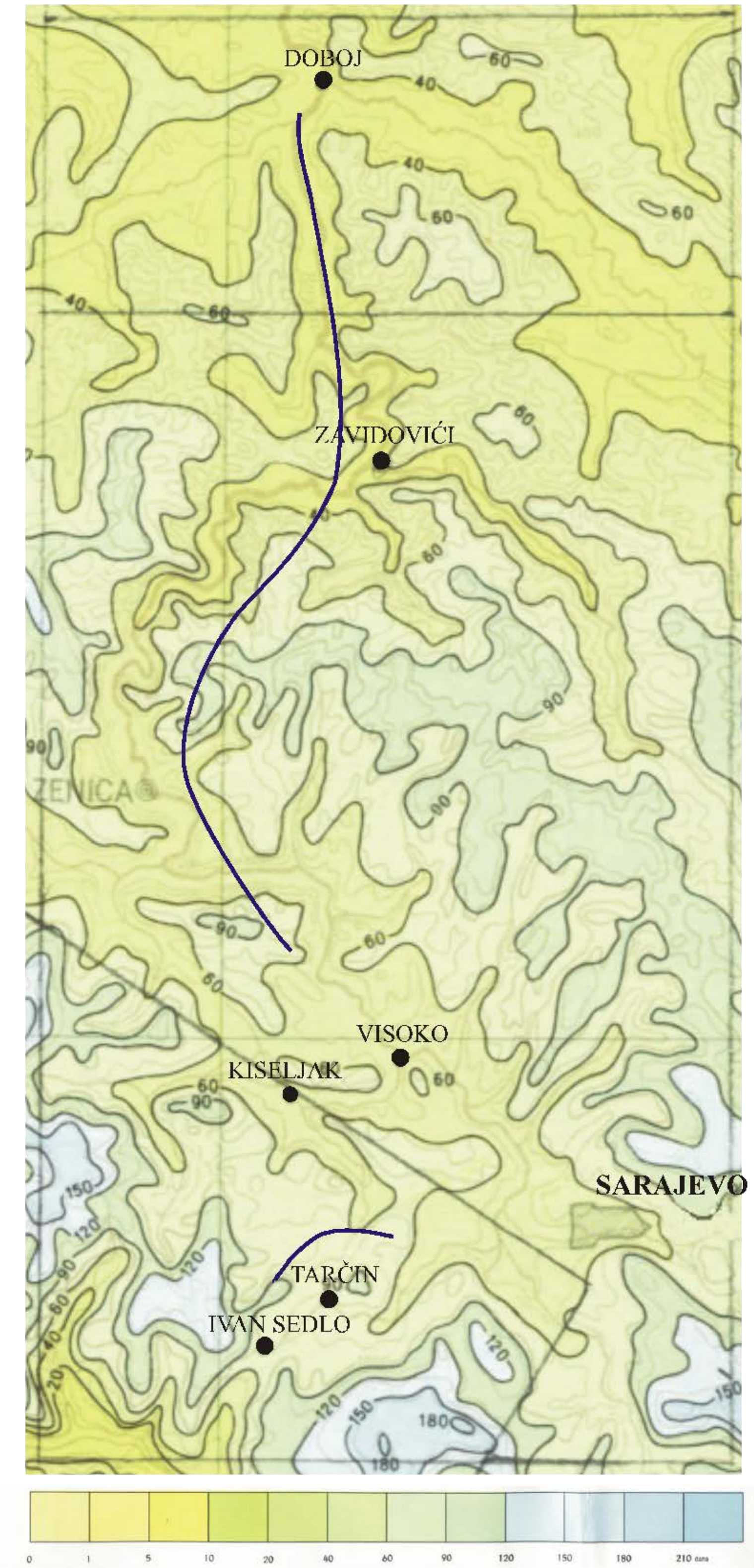


Illustration 4.2.3.6. Middle annual number of days with snow blanket>10cm

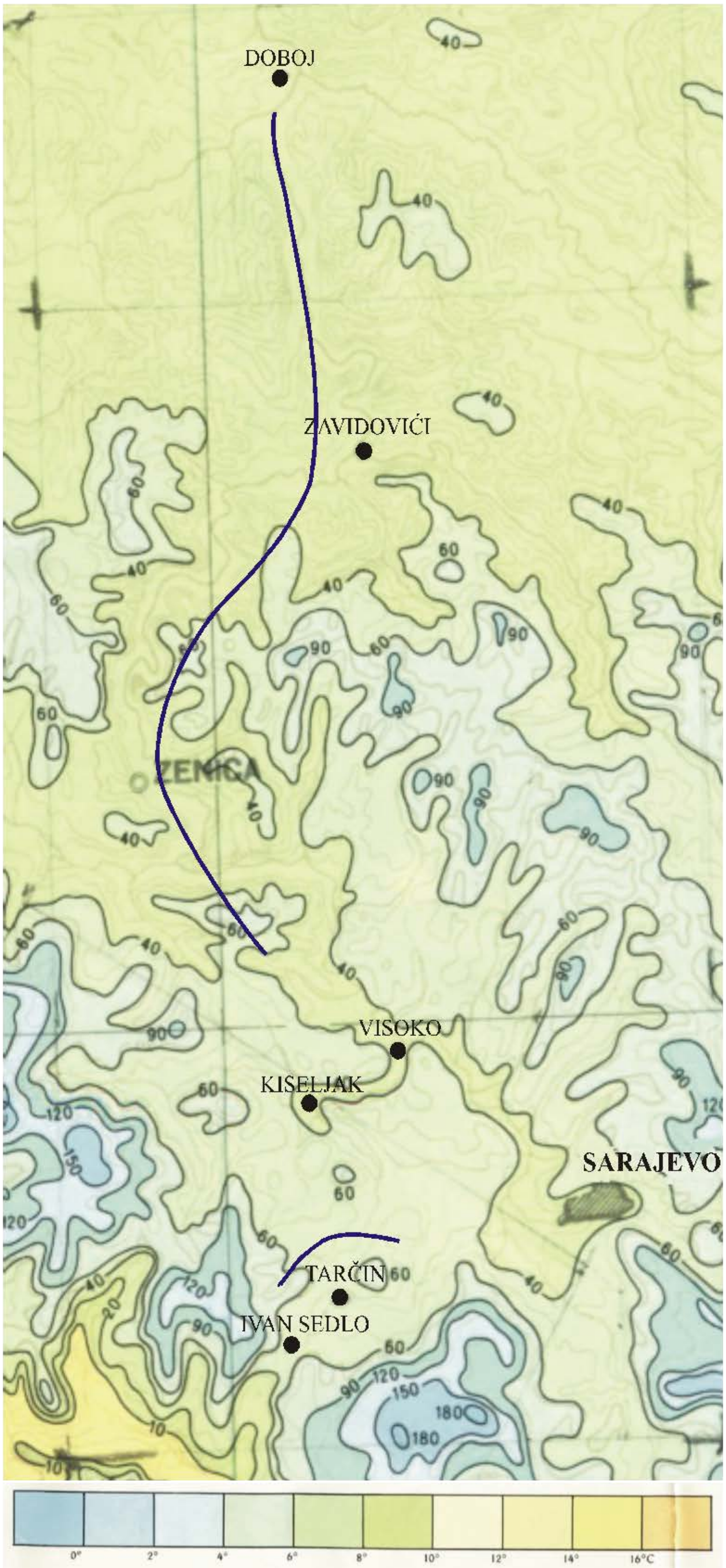


Illustration 4.2.3.7. Middle number of dayswith snow blanket ≥ 30 cm

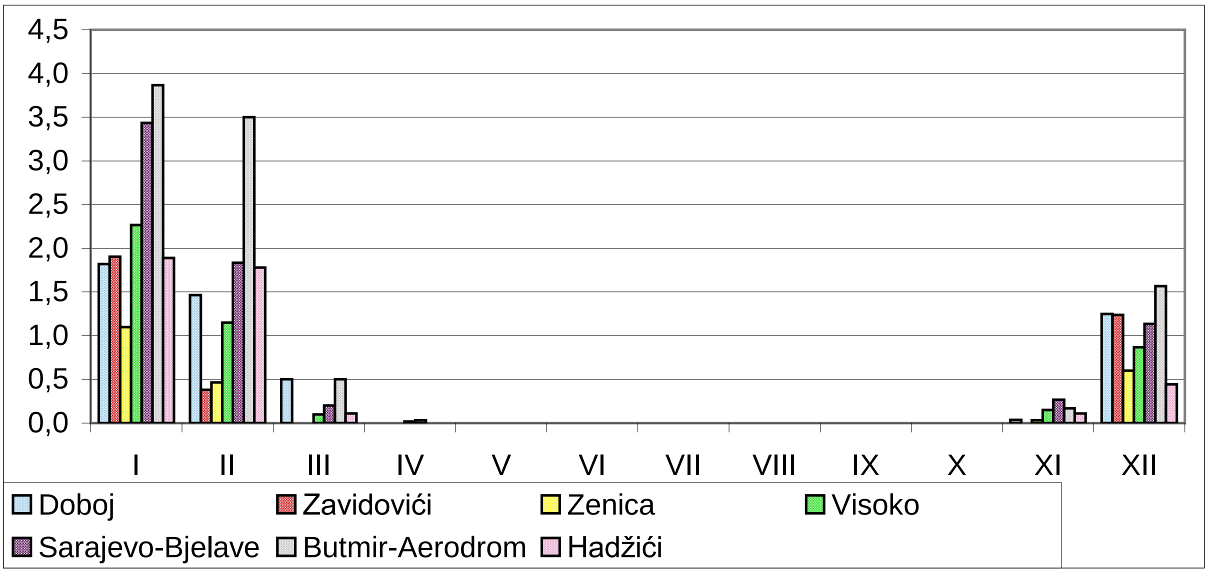
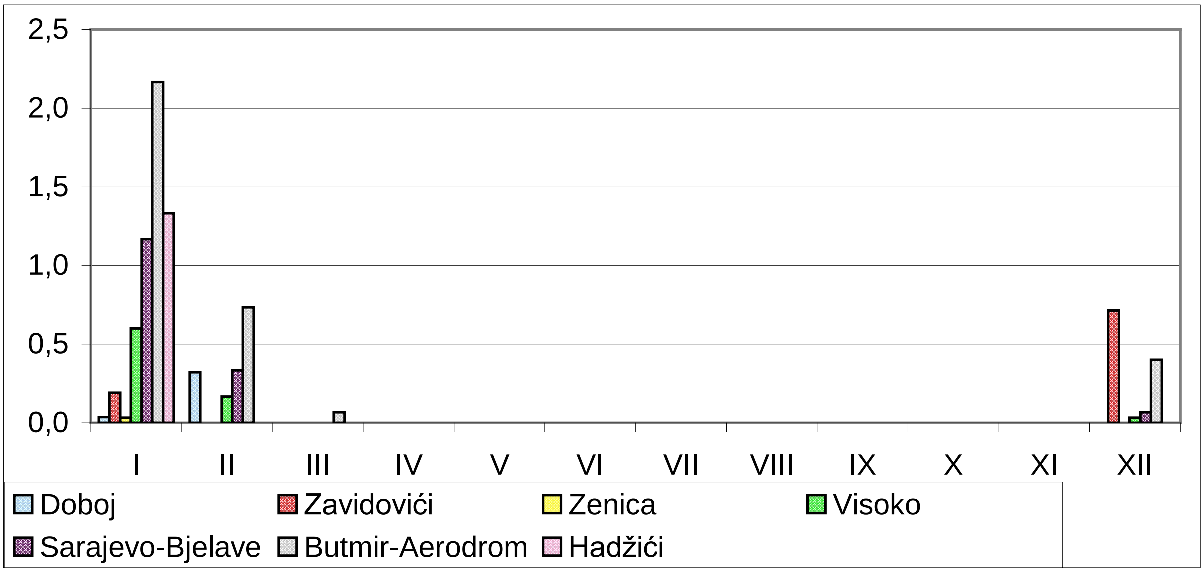


Illustration 4.2.3.8. Middle number of days with snow blanket ≥ 50 cm



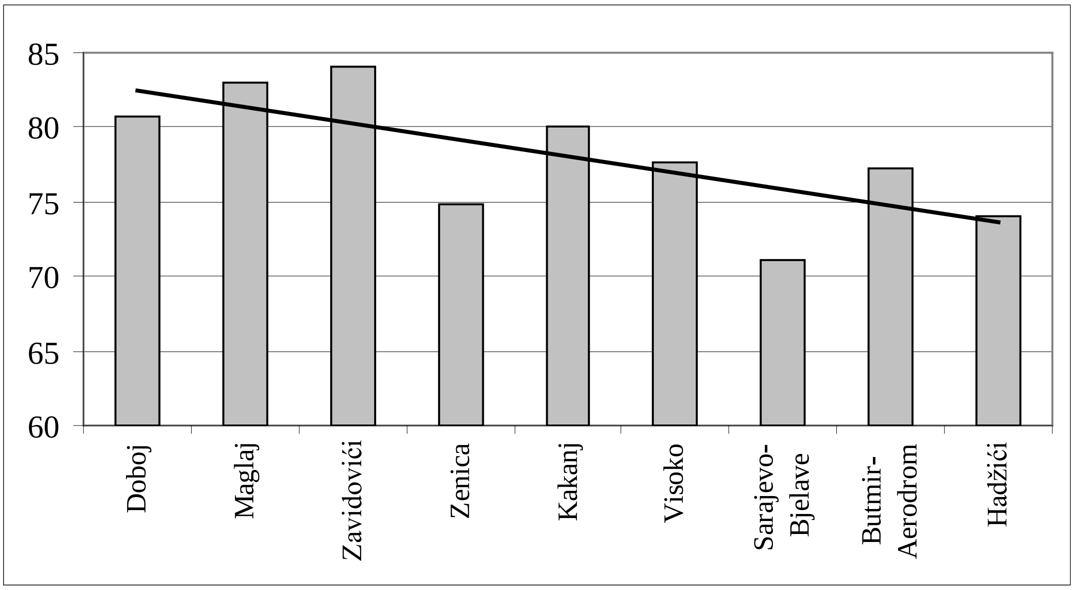
4.2.4. Freezing and Depositing of Snow

Icy film and sediment of solid precipitations at traffic surfaces reduce safety of traffic. These phenomenons appear the most often at temperature range from -1^{o}C to -10^{o}C. Partial freezing happens at the entrances of tunnels, on bridges and in cuts, as consequence of temperature differences and bigger air humidity. During the cold nights, at vehicles and traffic lines, the first of all on bridges and viaducts, frost appears, because cooling is the strongest at those places.

4.2.5. Air Humidity

Average annual air humidity ranges between 71% and 84%. The highest air humidity appears in the winter months, with mean monthly values ranging from 73% to 90%. The lowest air humidity appears in the springtime and summer months, with mean monthly values ranging from 63% to 80%. Disposition of air humidity along the route is given at the illustration 4.2.5.1, from where is noticeable that the biggest values belong to Zavidovići, and the smallest to Hadžići (in Sarajevo-Bjelave). This disposition is consequence of temperature inversion phenomenon in river valley.

Illustration 4.2.5.1. Middle annual values of relative air humidity (%)



4.2.6. Fog and Visibility

Fog appears in the Valley of Bosna River very often and it is a consequence of a temperature inversion, which in the river valley creates a layer of air that is colder that the air layer on the surrounding mountains. This phenomenon appears during whole year, but more often in its colder part (Illustration 4.2.6.1). The biggest number of days with fog is recorded in area of Visoko (150). The smallest annual number of foggy days is reported in the area of Zenica valley (48). As far as annual distribution of fog is concerned, a fog is the most common in the winter months. It is noticeable from Illustration 4.2.6.2. that annual values are rather unequal, what is consequence of surrounding relief impact, depending on area through which the route passes.

Extremely high number of days with fog is recorded in canyons (at distance **Maglaj-Tunnel Vranduk** and widen area of the mouth of **Lašva river into Bosna-Visoko**). There is high possibility of fog appearance during the whole year at these sections, heedlessly on season.
This fog is of radiation origin and under certain weather conditions can be of big intensity, so **visibility can be less than 100 meters**.

On visibility influence, besides fog, very often, especially in winter months when the sun is low on horizon, direction of the motorway and disposition of structures at the motorway, because the fact that the sunrays can blind drivers temporarily.

Illustration 4.2.6.1. Middle number of days with fog

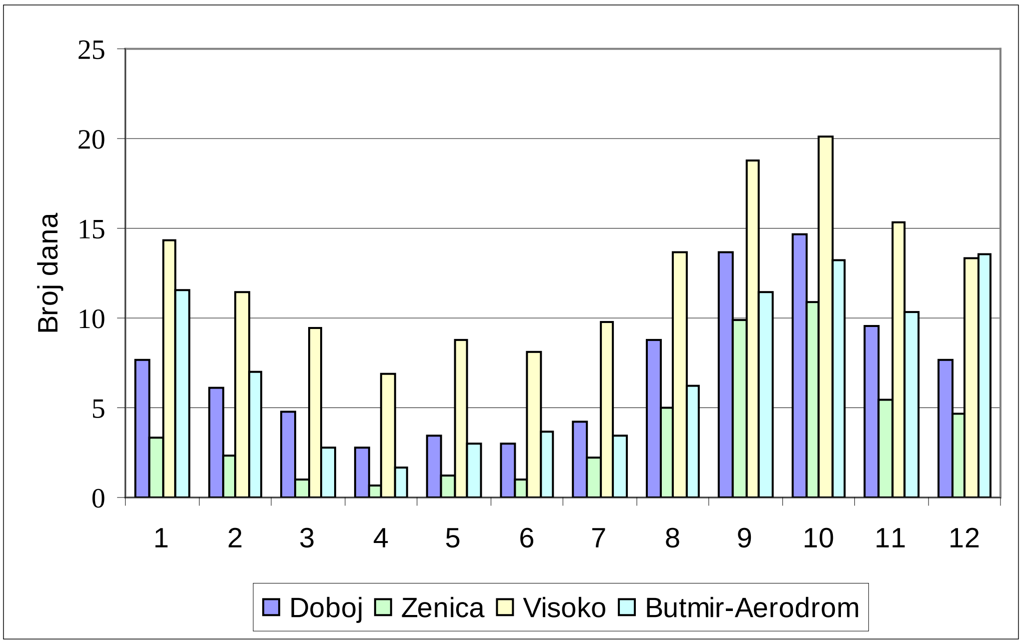
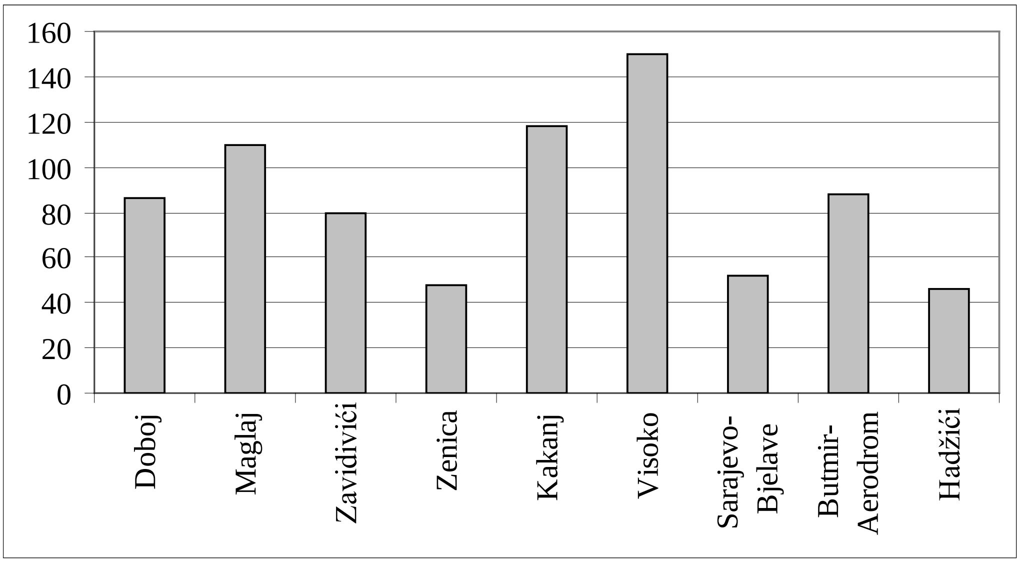


Illustration 4.2.6.2. Change of annual number of days with fog along the route



4.2.7. Wind

Disposition of frequencies and middle speeds of wind per sections (roses of wind) mostly depend on the local topography of the terrain. As it can be observed from the graphical presentations obtained from Doboj, Zavidovići, Zenica and Butmir-Airport meteorological stations, the shape of the 'wind rose' is mostly determined by the direction of the expanse of the Bosna River valley. We can notice that the prevailing wind directions are from the North, the North-East and from the South.

From the indicated mean value of the wind speed, it can be observed that the valley of the Bosnia River is not very often exposed to winds, because it is protected by the surrounding mountains. However, the strongest winds are recorded in the Doboj valley and in the Sarajevsko polje.

As can be observed from Illustration 4.2.7.1, the highest monthly maximum wind speeds at Butmir-Airport reach 45 m/s and occur mainly in November and December. Gale winds are possible in all seasons, but as can be observed from Illustration 4.2.7.2. they occur most often in springtime, and during November and December.

In the Zenica valley gale winds are very rare, and their probability is maybe less than once a year. The monthly maximum wind speeds are around 20 m/s and occur mostly in January, April and November. (Illustration 4.2.7.3).

In regard to the parts of the route between stations mentioned above, winds mainly go through canyons of Bosna river and wind direction is defined by direction of canyon (mostly north-south), but, in regard to maximal wind speeds, they are significantly smaller, because of impact of surrounding terrain.

Appearance of local turbulence is possible. It appears because of air flows around the hill, above it, or above complex of structures. Whirlpools on sides of the hill, which are not exposed to wind, can be very strong and make impact on vehicles in traffic. After passing of large vehicles, turbulence is created and unfavorably influence on smaller vehicles, and also between two driving lanes with traffic in opposite directions.

Illustration 4.2.7.1. Meteorological station Butmir-Airport Annual disposition of maximal wind speeds

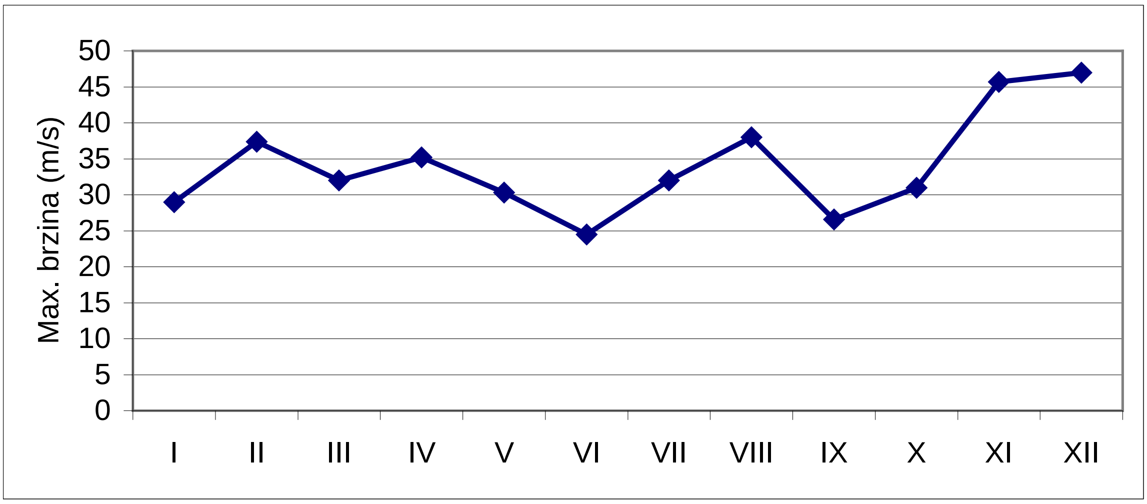


Illustration 4.2.7.2. Meteorological station Butmir-Airport Average number of days with gale wind per months

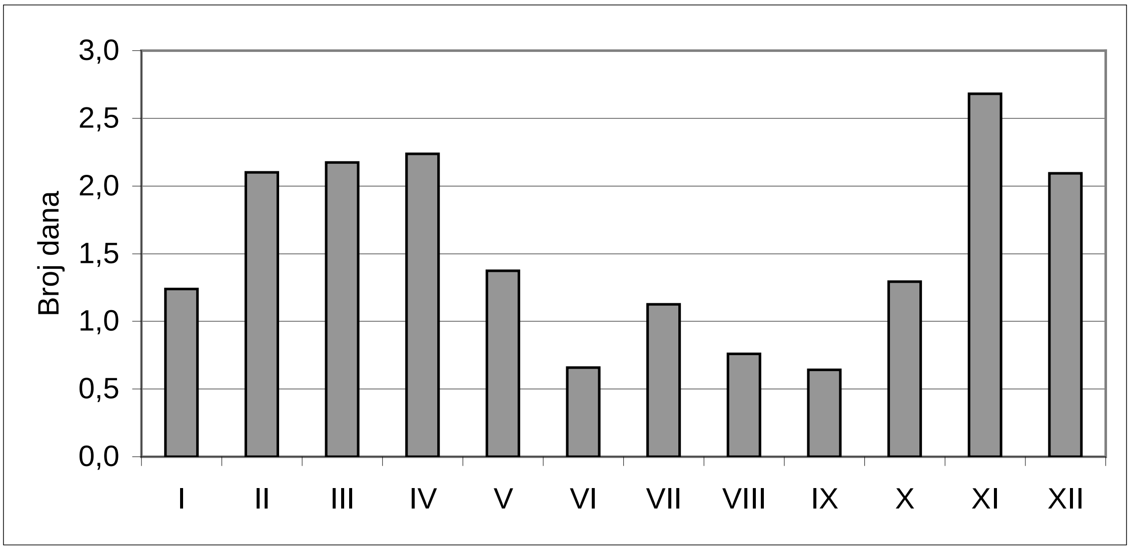


Illustration 4.2.7.3. Meteorological station Zenica Annual disposition of maximal wind speeds

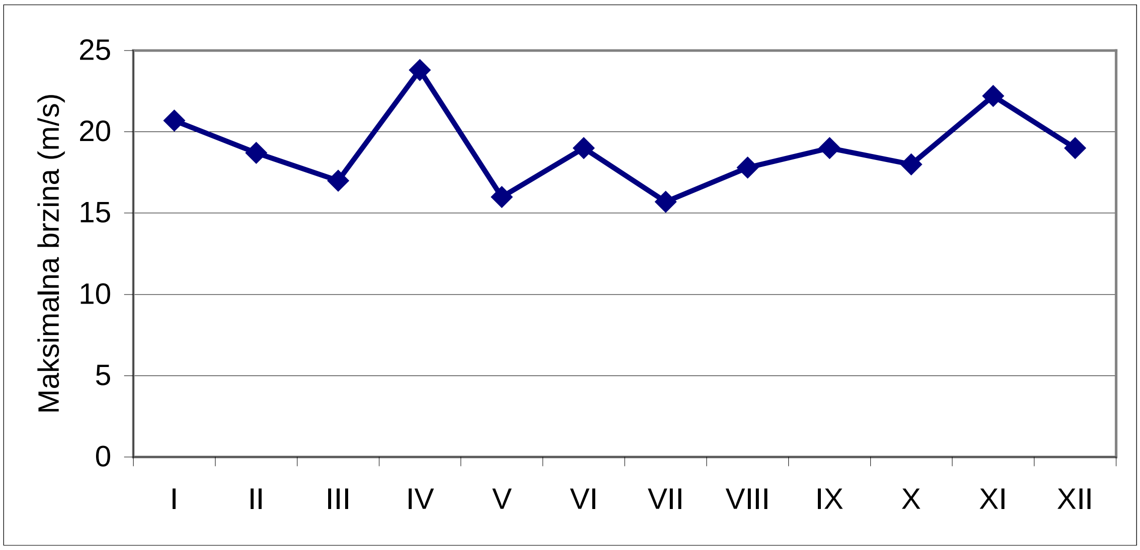
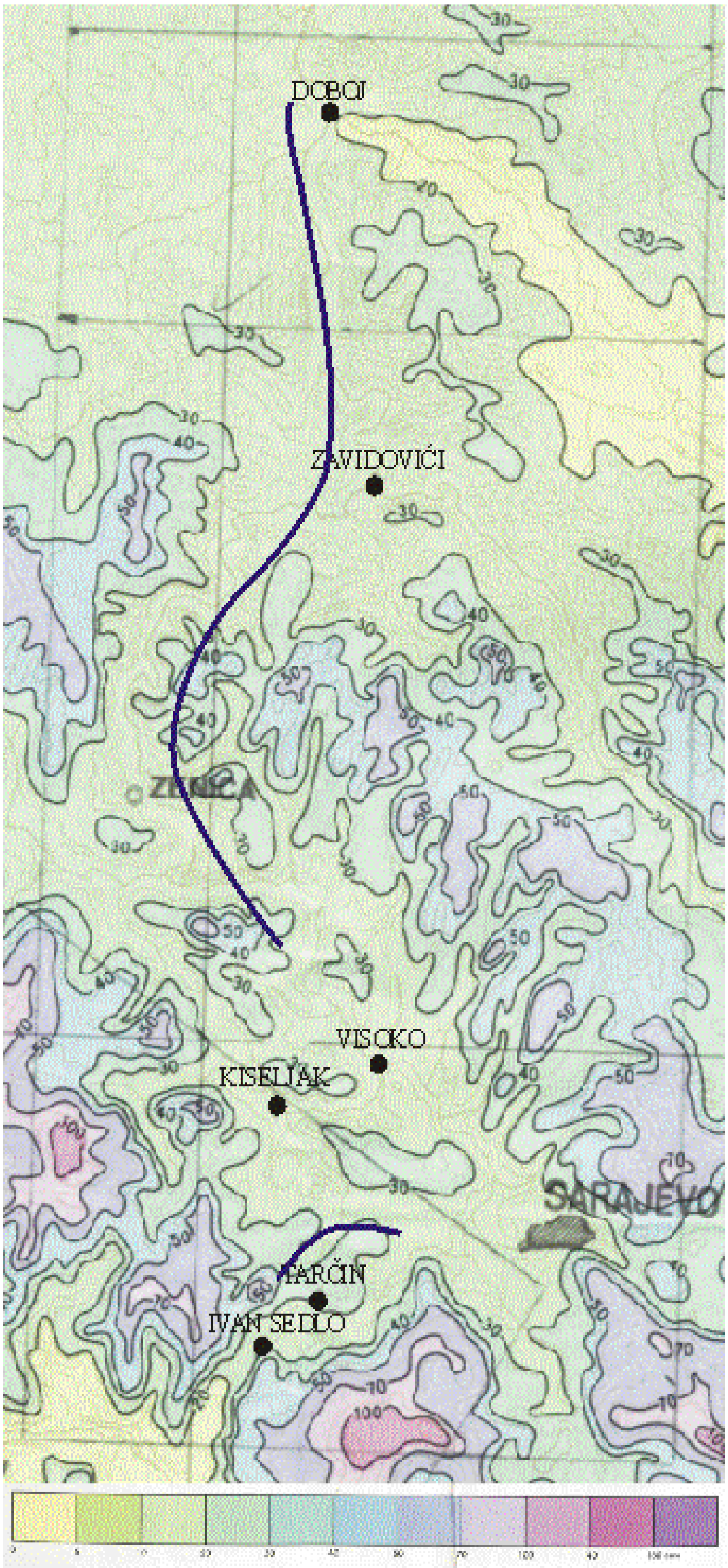


Illustration 4.2.7.4. Middle annual number of icy days (days with maximal temperature of air <0 oC)



4.3. Geomorphological Characteristics

In geomorphologic terms, relief between Doboj and Tarčin is very various and morphometrically uneven. It is caused by changeable lithofacial composition, complex tectonic relations, neotectonic activities and various behaviors of rock masses in the surface zone of decaying under the influence of exogenous agents Terrain belongs to Dinarides mountain system as one of the geomorphologic units of BH with hilly-mountain relief. Almost 80 % of the terrain is at altitudes of over 500 m, except the valley of river Bosnia at altitudes of up to 500 m a.s.l.

Deep river valleys and canyons give general marks to the relief, as well as mountain chains at altitudes of over 1000 and more meters. Between mountains, there are several paleo-depressions filled with lake sediments of the Neogene and Quaternary. The most important once are Tešanj, Šeher-Žepče and Sarajevo-Zenica paleo-depression. Besides above mentioned, along the corridor Vc, in part Doboj - Tarčin, different genetic types of relief are changing and they can be selected in the following categories.

4.4. Geological, Geological-engineering and Geotechnical Characteristics

In geological composition of terrain represented is geological column, from the Paleozoic to Quaternary.

- **Paleozoic creations** are composed of phyllite and phyllitoide (^{2}PZ), quartz – sericite shale with lenses of lydite and quartzite (^{3}Pz), quartz-porphyrite (πq), dolomite, limestone and marble of Devonian (D), and Permian conglomerate, sandstone and slate (P).
- **Permian Triassic (P,T)** is composed of shaly marly limestone.
- **Mesozoic sediments** create most part of the terrain. They are completely developed and characterized with great facial variety.

  Lower Triassic (T_1) is developed within the Seis sediments and undivided lower Triassic (T_1). Seis sediments are represented with sandstone, slate and marl, and undivided formations of lower Triassic are composed of quartz – mica sandstone, slate, marl and limestone.

  Middle Triassic (T_2) is developed in the Anisian and Ladinian stage. The Anisian sediments (T_2^1) are represented with different types of limestone and dolomite, while Ladinian sediments uneven composition, represented with chert and igneous-sedimentary formation (tuff, sandstone, siliceous slate, chert, limestone and dolomite).

  Transitional horizon of middle and upper Triassic (T_{2+3}) is of limestone development. Massive limestone is represented.

  Upper Triassic (T_3) is represented with massive microsparite.

  Transitional creations of Triassic and Jurassic (^{2}T,J) are represented with chert, subordinating slate and marly micrite and siliceous micrite.

  Jurassic (J) has significant spreading, from Doboj to Nemila. It is represented mainly with volcanogenic-sediment (diabase-chert) formation ($J_{2,3}$) composed of sandstone, breccia, slate, graywacke sandstone, chert, marly limestone, marl and different igneous rocks: peridotite, serpentine, granite, gabbro-peridotite, spilite, dolerite and gabbro of different varieties.

  Transitional horizons of Jurassic and Cretaceous (J,K) are represented with flysch creations. Within flysch sediments, separated are: Nemila (^{1}J,K) and Vranduk series (^{2}J,K).

The Nemila series is created of siliceous slate, sandy siliceous calcarenite and limestone, and Vranduk series is composed of marly limestone, calcarenite and marl.

Besides flysch sediments, as Jurassic-Cretaceous transitional member, separated is also a series of conglomerate, big-grained sandstone, breccia, marl and massive limestone. Those sediments are of limited occurrence.

Upper Cretaceous (K_2) has variable development of facies. In the lower part, there is thin stratified marl, sandy marl, sandstones, breccia and limestone are represented. Special facie within upper Cretaceous flysch represents "carbonate flysch", composed of massive limestone and limestone breccia, and subordinating pelite-alevrolite and marl.

- **Cenozoic (Kz)** is represented with sediments of Paleogene, Neogene and Quaternary.

As ***Paleogene*** sediments, separated are massive to thick-bedded limestone, alevrolite, slate and at some parts limestone of the ***Paleocene-Eocene*** (***Pc,E)***.

Oligo-Miocene sediments, as transitional between Paleogene and Neogene, are separated within five series:

- Ol,M - "red series" of Šeher-Žepče basin: conglomerate, sandstone and marl;
- ^{1}Ol,M - basal zone: conglomerate, sandstone and clay with occurrences of coal;
- ^{1,2}Ol,M – gypsum limestone, conglomerate and sandstone;
- ^{2}Ol,M - gypsum limestone, and
- ^{3}Ol,M - "multicolored" series: conglomerate, sandstone, marl and clay.

Neogene (N) is represented with sediments of Miocene and Pliocene. **Older Miocene complex ($M_{1,2}$)** is characterized with great facial variations with economically interesting occurrences of coal in Sarajevo-Zenica and Šeher-Žepče basins. Besides coal seams, within this complex, there are conglomerate, sandstone, clay, marl, and limestone.

Middle Miocene (M_2) is represented with "roof limestone zone" (sandy limestone with coal seam in roof) and "transitional zone" (thin stratified marl and sandstone) within Sarajevo-Zenica basin.

As transitional creations between middle and upper (younger) Miocene complex, selected is series of conglomerate, sandstone and marls, which is called "Lašva series" in Sarajevo-Zenica basin.

Younger Miocene complex (M_3) is represented with "Koševo series" composed mainly of clay, marl and coal.

Pliocene and Plio-Quaternary creations (Pl_1; Pl,Q) are composed of sand, gravel and clay, and there is also coal in Pliocene sediments.

Quaternary (Q) has significant wide spreading. Quaternary creations are represented with various genetic types and they are:

Lake sediments **(j),** in wider area of Tarčin, are represented with tufaceous breccia limestone, conglomerate and sand.

Diluvia creations (**d**) take significant surface widespread but they are especially separated in area of Zenica. They are composed of clayey debris of different grain size distribution.

In the river valleys, separated are two levels of river terraces composed of gravel and sand.

Alluvial creations of riverbeds are also composed of gravel and sand, while facie of flooding area is composed of fine-grained sand dust and clay.

4.4.1. Seizmic-Tectonic Characteristics

The most important and the most active epicenter area in territory of BH are: Treskavica - Sarajevo; Foča; Zenica - Travnik; Jajce - Bugojno; Banja Luka; Tuzla; Žepče; Sokolac; Livno; Drinovci; Ljubuški; Mostar; Dokanovići; Stolac; Ljubinje; Dabarsko polje; Nevesinje and Drežnica. In framework of Basic neotectonic map of SFR Yugoslavia (Scale 1: 500.000), the territory of B&H from southwest toward northeast is divided in three tectonic areas: (i) fault zone; (ii) fold-fault zone i (iii) fold zone. Here is given only review of those seismic zones that cover wider area of reviewed corridor.

Fold-fault zone:
Inside of this zone the main causes of neotectonic, and contemporary tectonic manifestations can be linked to megablocks activities on regional (epidermal) longitudinal faults. Special characteristic of this zone is that labile parts are not obviously limited by faults; they are tectonic trenches and horsts with fault zones crossed in shape of stairs. The area of Žepče - Teslić, Sarajevo-Zenica basin and area of Treskavica – Kalinovik belong to this zone.

Area Žepče – Teslić
This area is located between the Bosna river and fault Žepče - Pribinić. It is recognized as labile, seismically active. Significant longitudinal fault that goes from Žepče toward Teslić extends toward northwest. But, inside of limited space in middle of this area, in the valley of Usora river, extends a transversal fault Doboj - Teslić. Occurrence of earthquake, thermal and mineral water indicate that those faults are deep. Labile area belongs into 7^{o} MCS-a and it takes area of Žepče – Zavidovići - Novi Šeher – Lugovi - Papratnica. Five earthquakes have been recorded in this area out of which two were 7^{o} MCS-a. But, along river Bosna, from Papratnica and Žepče to Dubravica, moderate frequency of occurrences of earthquakes should be expected.

Sarajevo-Zenica basin
Sarajevo-Zenica basin represents the most labile zone of the terrain along the highway. Noticeable structure is deep tectonic trench, formed along Busovača fault. Busovača fault was active before and after the Neogene and during younger periods, Falling of northeast block along this fault during the Neogene caused settlement of the thick Miocene sediments in southwest part of the basin. Fault is active at present and that was through geological history (from Mesozoic to Quaternary).

On the huge depth of this geological fracture, besides to stratigraphic facts numerous occurrences of thermal, thermo-mineral and mineral water also indicate. Besides to vertical movements of Sarajevo block, there are also horizontal movements. That results in compression of rock masses, to which whole Dinarides are exposed, especially during the Neogene. Directed pressure at consolidated blocks causes occurrence of “joints”. "Joints" cause diagonal placement of folds in relation to direction of faults.

Along Busovača fault, the line of epicenter is visible, on the line Sarajevo-Zenica- Travnik - Jajce- Mrkonjić Grad. From seismic-tectonic point of view, that is active fault with periodical sudden tension equalization what results as earthquakes. For example, in the area of city Zenica it was recorded 14 earthquakes that had intensities of up to 7^{o} MCS. Because of that during definition of micro regions for certain facilities, geophysical researches should be done and attention should be given to correction of soil seismic, especially because of presence of landslides as possibility of occurrence of “new” instable slopes.

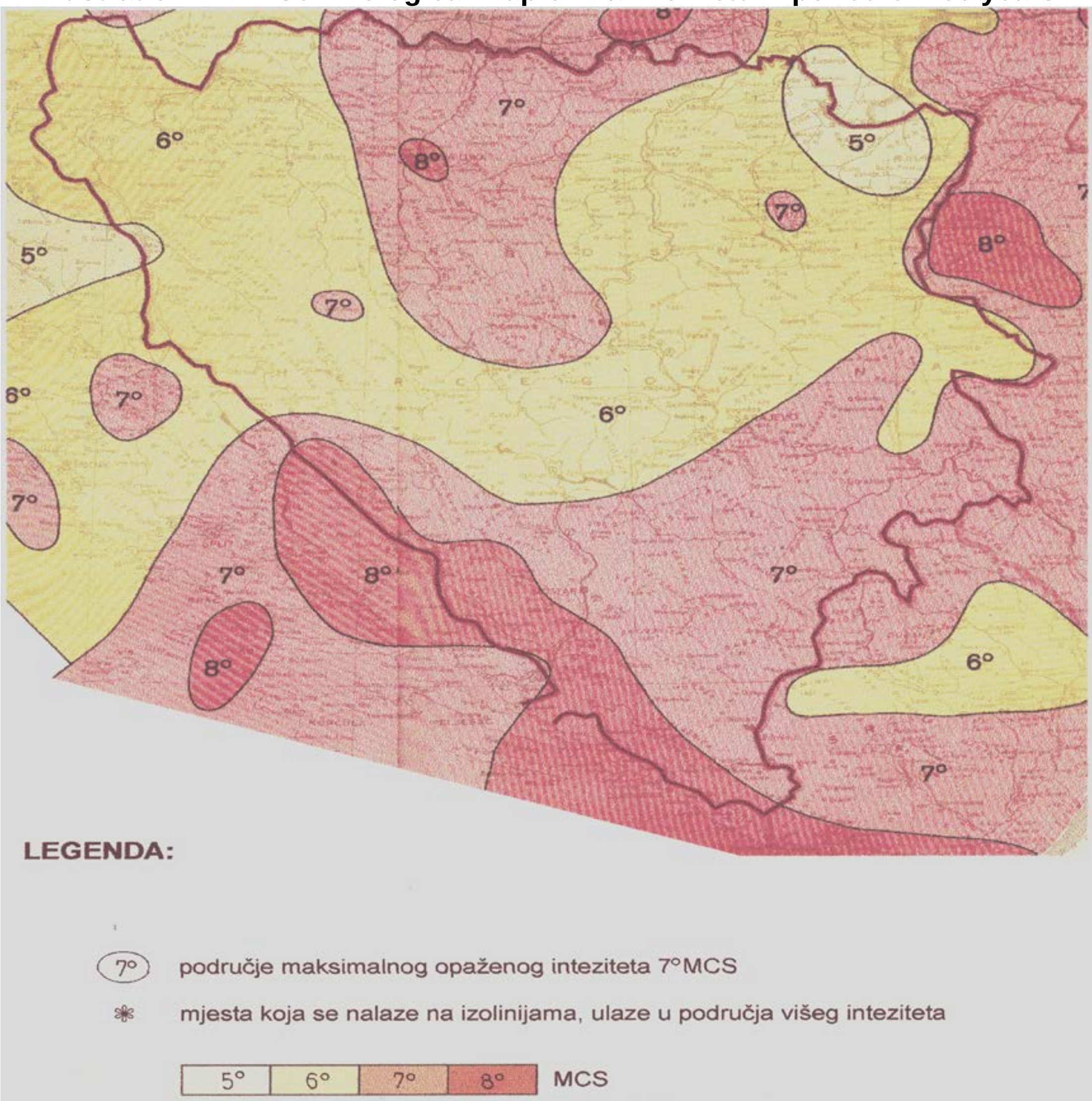
Area of Treskavica - Kalinovik

Seismic activities of the zone Treskavica-Kalinovik are connected to Durmitor reverse fault confirmed with gravimetric measuring. This instable area raise seismic ability of Sarajevo and surrounding area, and it is known that area of the city belongs to the area with 7° MCS and it is connected to epicenter area of Treskavica. In the area of Treskavica, zone with 8° MCS is separated. It is placed in the north of Kalinovik and includes mountain Treskavica. Isoline 8° MCS has a shape of extended ellipse and approximate direction of strike NNW-SSE. In the north from this area, there is also another zone of 8° MCS, to Vogošća and Semizovac. Part of this area overlaps with Sarajevo-Zenica basin, and it "initiates" with its own impacts.

In the area of Sarajevo, registered are 32 earthquakes even that earthquakes of Treskavica towards city are slightly absorbed. According to available data, region of Sarajevo have earthquakes more that one in 25 years, while area of Ilidža has more rare occurrence of earthquakes – one in 15-50 years, intensity to 7° MCS.

Instead conclusion, it should be said that for defining of seismic characteristic of some locality, it is necessary to carry out adequate investigations, and that is an obligation contained in next phases of the project documentation preparation process.

Illustration 4.4.1. Seizmological map of B&H for return period of 100 years



4.5 Hydrogeological and Hydrographic Characteristics and Their Hydrological Features

4.5.1. Hydrogeological Characteristics

Following the accepted route of motorway of the Corridor Vc at the range of area LOT 2, it is possible to conclude that the area is mainly characterized by hilly-mountains relief. Bosna River is the dominant watercourse of that large area with many bigger or smaller tributaries, which inclines to the mentioned catchment's area. At the Karuše location, situated nearby mouth of Usora River into Bosna River there is ending of the section LOT 1 of the Corridor Vc. Bosna River crosses this tributary in several locations and then the Section LOT 2 of the same Corridor begins.

With respect to the size of concerned line structure, we can't observe the explored area as a unique aquitard, but as the association of rocks of different hydrogeological characteristics, which are rotating within the geological plan and profile. In accordance with certain lithological types with changeable and uneven physical and chemical properties, the characteristics of water permeability are more or less stressed within the concerned rock material, i.e. in the lithological complex of fissure, fissure – cavity or intergranular porosity.

According to hydrogeological characteristics of rock material, the route of motorway at the section LOT 2 crosses over or touches the aquifer environment of fissure, fissure – cavity and intergranular porosity, where the aquitards with the free level are generally established, but also the aquitards under pressure with different level of yield, i.e. water redundance. According to the data of hydrogeological researches and exploitation pumping of water intake structures previously carried out, it has been concluded that Quaternary (Q), alluvial aquifers (rocks of intergranular porosity), exist as a most dominant aquifer environment, respecting the exceptions of saturated carbonate formations at the particular sections of LOT 2. The other rock complexes in the area exist as complexes of secondary aquifer witch are usually used for water supply of a less number of individual residential structures.

Respected the previously presented, we want to stress the critical areas in the map of limitations related to water resources (N° 12.3.5), according to the sensitivity and vulnerability of aquifers i.e., ground water in the concerned area. The orange hatch marks an aquifer area where the motorway can pass but with taking all necessary measures of prevention and minimization of negative impacts on the ground water, in order to prevent them or to fully annul them. That means that for the suggested route it is the absolute priority to find such project solutions, as well as to design the system of internal and external drainage that would maximally take care of the way and level of aquifer protection in the concerned area.

This especially applies to the area where:

- The route passes in the vicinity of the protected zone of water source Tešanjka (Section Karuše – Medakovo)
- The part from the chainage km 12+000 to km 18+000, route passes between the water protection zone of Bistrica River and water protection zone Crni Vrh (do not cross these water protection zones, but is laid down immediately between them in the zone of approximately 300 m of width)
- At the chainage from km 77+225 to km 77+850, the route passes along the edge of the areas of thermal, mineral and thermomineral water sources Tičići

In the case of possible accident situations, as well as inadequate and incomplete level of activities taken for the protection, the aquifer area, which is of the strategic interest can be lost or be damaged very hard.
In relation with the previously said, all characteristic critical places along the sections of LOT 2 are marked in the exploring area with 33 orange spatial positions.

Demonstration of hydrogeological characteristics in the exploring area from the chainage to the chainage along the route of the Corridor (LOT 2), has aim to turn the attention to the critical characteristic locations in witch close or wider environment, the motorway as a line structure can cause certain negative impacts on ground water in the future.
That is the reason for necessary prevention action with which the noticed adversities would be avoided, limited or fully eliminated in the phase of the conceptual design. The special attention, respecting the hydrogeological aspect, i.e. the aspect of endangerment of the aquifer environment, is given to the water resources protection as existing and potential sources with the aim of water supply for the population. After finishing the exploration works, it is necessary to prepare a detailed hydrogeological map of the close zone around the motorway route in the scale 1: 5000.

Section 1. Karuše – Medakovo (the chainage km 0+000 to km 4+000)

At this section of LOT 2, the route is marked with two (2), characteristic-critical, spatial positions. At the chainage from km 0+000 to km 1+300, the route passes through massive and banked limestones (sediments of Pc, E), as potential aquifer area. At the chainage from km 2+100 to km 2+600, the route also passes through the Pc, E sediments (from massive parts to banked limestones), which are defined as potential aquifer area.

Section 2. Medakovo - Ozimica (the chainage from km 4+000 to km 24+876.440)

At this section of the motorway, three characteristic critical locations have been registered. In the part from the chainage km 6+500 to km 7+000, the motorway route passes along the edge of Pc,E sediments which are distributed very limited, inside of water impermeable Miocene (M2,3) conglomerates, sandstones and marlstones with limestones. The motorway route at the chainage km 9+500 to km 9+700, passes along the short aquitard zone of Pc, E limestones, located inside the water impermeable spilites (ββab), which mark the volcanism from the Jurassic (J2,3), period.
The motorway route from the chainage km 22+800 to km 23+200, passes along the upper flow of Lješnica River and in the same time crosses its alluvion as an aquifer area.

Section 3. Ozimica – Poprikuše (the chainage km 24+876.440 to km 38+617,434)

The section 3 has five characteristic critical positions inside of its area. The part of motorway route from the point km 31+600 to km 32+900 crosses the alluvion of Bosna River as an aquifer zone and also the open watercourse of the concerned river. The motorway route from the chainage km 33+600 to km 34+000, also crosses the alluvion of Bosna River and the River itself as an open watercourse. From the chainage km 34+900 to km 35+400, the motorway route crosses the alluvial aquifer area and also the open watercourse of Bosna River within the concerned alluvion. From the chainage km 35+800 to 36+750, the motorway route crosses the immediate vicinity of the group of water sources of unmeasured capacity. From the chainage km 37+150 to km 37+400, the motorway route crosses the alluvion of Bosna River and Bosna River itself as an open watercourse.

Section 4. Poprikuše–Nemila (the chainage km 38+617.434 to km 46+388.80)

The section 4 includes two characteristic critical locations. The motorway route crosses the alluvion of Bosna River as well as the open watercourse of the concerned river from the point km 41+300 to km 41+700. But from the chainage km 41+700 to km 46+289 (end of section IV), the entire motorway route crosses right through the open flow of Bosna River.

Section 5. Nemila – Donja Gračanica (the chainage km 46+388,80 to km 58+434.599)

Section 5 includes three characteristic critical positions. From the chainage km 46+289 to km 49+000, the motorway route presents continuation of the development along the watercourse of Bosna River. From chainage km 49+000 to km 52+500, the motorway route crosses the open flow of Bosna River at four positions, going away at the safe distance from the river at the chainage km 52+500. The motorway route passes relatively close to Bosna River at the chainage marked as km 55+000 to km 56+000.

Section 6. Donja Gračanica – Drivuša (the chainage km 58+434.599 to km 66+959.592)

Section 6 consists of five characteristic critical positions. From the chainage km 58+650 to km 59+550, the motorway route crosses the aquifer calcareous sinter limestones of Oligomiocene (2Ol,M) and a short part of also aquifer massive and layer limestones with breccias of Upper Cretaceous (1K23). At the length of approximately 500 m (from the chainage km 60+550 to km 61+000), the motorway route passes the edge area of layer to massive limestones of Upper Cretaceous (1K23). From the chainage km 61+450 to km 64+400, the motorway route passes through the edge area of deluvial sediments (elements of aquifer area), where at the contact and in its immediate basement, aquifer massive crateceous limestones (1K23) are located. From the chainage km 64+400 to km 65+360, the motorway route crosses through the deluvial sediments of Quaternary, which are in the immediate contact with very watered alluvial deposits of Bosna River. From the chainage km 66+000 to km 66+959.592 (end of section), along the part of about 1 km in length, the motorway route crosses over the Quaternary (Q) alluvial deposits of Bosna River, closely touching or, crossing this significant open watercourse in two locations.

Section 7. Drivuša – Kakanj (the chainage km 66+959.59 to km 82+595.0)

Section 7 includes two characteristic critical locations. From the chainage km 66+959 to km 68+500, the motorway route presents the continuity of the previous part of the route. As in the previous case, the route crosses through the alluvial deposits of Bosna River along the entire marked area, where this watercourse have been crossed at two locations and actually closely touched. From the chainage km 72+000 to km 82+595 (end of section), the motorway route crosses over Bosna River at several locations, closely touches it, or passes directly along the watercourse. At the same time (from the chainage km 77+225 to km 77+850), the motorway route crosses through the edge part of the zone of thermal, mineral and thermomineral water sources «Tičići».

Section 8. Blažuj – Tarčin (the chainage km 0+000 to km 19+100)

Section 8 includes eight characteristic critical positions. From the chainage km 0+000 to km 0+050, the motorway route, within the area of left tributary Rakovica River to the marked point, crosses through the alluvial deposits of the concerned watercourse. From the chainage km 1+650 to km 1+850, the route crosses through the alluvial deposits of Rakovica River, crossing the next (upper) left tributary of this watercourse. From the chainage km 2+600 to km 2+800, the route touches the alluvial deposits of Rakovica River. From the point km 3+850 to km

4+200, the route crosses over the alluvial deposits of Rakovica River. Along the part (the chainage km 4+750 to km 5+850), the motorway route crosses over the alluvial deposits of the right tributary of Rakovica River. From the point km 6+075 to km 6+650, the route crosses through a very watered Anisian limestones and dolomites (T21). From the point km 7+250 to km 7+950, the route of motorway crosses over the alluvial area of the right tributary of Lepenica River- the third river terrace (t3). Along the part of motorway (from the chainage km 8+650 to km 10+000), the route crosses over alluvial area of Lepenica River.
From the point km 10+000 to km 13+800, the route crosses over the alluvial area of Lepenica River. Along the part of motorway (from the point km 13+800 to km 16+300), the route crosses over the aquifer dolomites, limestones and marbles of Devon or it closely touches them. At the final part of this section, which is at the same time the end of LOT 2, (the point km 18+450 to km 19+100), the motorway route is located in the Tarčin area and passes along the alluvial deposits of several surface watercourses (Kalašnica, Korča, Bjelašnica and Mlavica).

The groundwater sources for water supply

During Environmental Impact Study preparation for LOT 2, the Consultants for the water resources aspect contacted the representatives of all eight municipalities, through which area the concerned section passes, as well as the water utility companies in those municipalities. With their assistance, the detailed data on sources used in the public water supply system of cities and suburban settlements have been collected and presented in the Study, as well as data on the sources of local nature. In most cases, both municipalities and utility companies did not have data on local sources, so that they had been collected in local communities.
The significant information in relation with the sources for water supply, as well as the assistance in planning of water resources monitoring along the LOT 2 for motorway construction and exploitation phases were obtained from Public Company for Watershed Areas of Sava River catchments in Sarajevo. For consideration and overall view of water resources aspect along the route, and for the needs of Study preparation, all available sources have also been used, which list is given in the reference list of the used literature and documentation.

In final lay down of the route, the designers took into account that the sources of the public water supply system of the cities and settlements along the section of LOT 2, as well as their accessory water protection zones are avoided.
In the wider area, along the route of LOT 2 of the Corridor Vc, there are stationary public systems for water supply of the cities and suburban settlements of municipalities Doboj-South, Tešanj, Maglaj, Žepče, Zenica, Kakanj, Hadžići and Kiseljak. At the map of limitations for water resources (Annex 12.3.5), the water protection zones of the sources from the public system of water supply are shown, and which are in the immediate vicinity of the research zone. In relation with that context, the following has been showed:

- Water protection zones of the local waterworks Tešanjka (Section Karuše– Medakovo).
- Water protection zones of drinking water source in Bistrica River catchments (Section Karuše-Medakovo).

The following has been showed as well:

- Water protection zone of mineral water sources «Tešanjska vrela» and «Oaza» in the area of Tešanj municipality (Section Karuše – Medakovo).

During placing the route of the Corridor Vc, it has been taken into consideration that sources of public system for water supply of above mentioned cities and settlements along the section LOT 2, as well as its related water protection zones be avoided in total. This applies to:

- Drinking water source on «Mekiš potok» and «Trebačka rijeka» – Waterworks in Tešanj.
- Drinking water supply in the catchment area of Bistrica River – Waterworks in Maglaj.
- Drinking water supply «Ravna rijeka», «Mala rijeka», «Rijeka Ograjina», «Bukovik», «Jakovac» and «Vrelo III» - Waterworks in Žepče.
- Sources of public water supply system of Zenica city («Babina rijeka», «Strmešnjak» and «Zmajevac»).
- Sources of public water supply system of Kakanj city («Bukovica», «Ilidža», «Pitka voda» and «Stog»), from which the part of population at the areas of communities Slijevnice, Banjevac, Zmajevac, Dumanac, Karaula and Doboj is being supplied.
- Sources of public water supply system of Kiseljak City, from which one part of the population in the area of Lepenica settlement, where the motorway passes, is being supplied.

The exception is a source «Klopče», which is in the system of public water supply of Zenica city, and is situated in the concerned area of our research.
The water source Klopče, located in the public water supply system of Zenica City, is the only source located in the area of the scope of our consideration. This source is located in section 6: Donja Gračanica – Drivuša (chainage km 58+434.599 to 66+959.592), i.e. between the chainages km 60+000 - 62+000.

The water source Klopče hasn`t established sanitary protected zones assigned with "Rulebook on conditions for determining of sanitary protection zones and protection measures for water sources that are used or are planned to be used for drinking water supply" (Off. gazette nr. 51/02).

The water intake of this source is being charted in the map of limitations for water resources (Annex 12.3.5).

Moreover, it is very important to point out that in the research area, there are a great number of local sources that are not included in the public water supply system of municipalities on which territories they are located. These local sources are used for public water supply in the settlements where the motorway is passing through or is located in its immediate vicinity. In that sense, the data have been collected from the municipalities about the local sources, which will be presented in the next part of the project per sections (along the whole route of the Corridor) and they are charted in the map of the limitations for water resources (Annex 12.3.5).

Section 1. Karuše – Medakovo (the chainage km 0+000 to km 4+000)

Sources in Tešanj municipality:

Tešanjka – the local waterworks Tešanjka. At this source, there are two water intakes in the form of well with capacity of Q = 1 l/s each. This local source has been registered, and water quality monitoring is made periodically. The data on water quality of this source are given in Annex 12.2.

Sources in Doboj-jug municipality:
«Kilavi dolovi» (capacity of 0,8 l/s), «Šume» (capacity of 0,8 l/s), «Grab» (capacity of 0,7 l/s), «Čatrlja» (capacity of 0,2 l/s), «Bukvik» (capacity of 0,8 l/s). Besides the mentioned sources in the area of Doboj-jug municipality, there are also a few local sources such as «Breza» (capacity of 0,3 l/s), «Šumska voda» (capacity of 0,8 l/s), «Sječa» (capacity of 0,3 l/s), «Vis» (capacity of 0,5 l/s), «Peraslika» (capacity of 0,2 l/s), «Jakitovac» (capacity of 1 l/s), and «Otavica» (capacity of 0,7 l/), which are situated in the area of Section LOT 1 of motorway.

Section 2. Medakovo - Ozimica (the chainage km 4+000 to km 24+901.587)

Sources in the area of Tešanj municipality

Oaza, Crni vrh, Tešanjska vrela, Alispahići 1, Bahtić, Alispahići 2, Begunić, Lipe, Selo, Bobov Dol, Bijele vode, Kadušići. According to data obtained from Tešanj municipality, the sources «Tešanjska vrela» and «Oaza" are the only registered sources of all mentioned sources and there are official data on water quality for them that are added in Annex of obtained data from the municipalities. The other sources are used for water supply of 5 households («Alispahići» source) up to 120 households («Lipe» source), but they are not registered and there are no obtained information on water quality.

Sources in the area of Maglaj municipality

Maglaj municipality provided the map where local sources have been charted that are not included in the public water supply system and are used for water supply of a certain number of households in local communities. Those are the following sources: «Stube», «Jezero», «Vjerača», «Stub», «Tovarnice», «Strupina», «Lijepa voda», «Ključ», «Maleševa voda», a group of sources in the bottom of hill Šiljato Brdo, «Studenac» and source in the bottom of Kraljevo brdo. All mentioned sources are tapped. At the map that was obtained from Maglaj municipality, the sources without names have been charted and with the aim of as better identification as possible the listed sources have been identified on the basis of closer toponym. In accordance with that, these sources have been charted in the map of limitations for water resources and considering that their names have not been given, the sources are being described as a group of water intakes in the area of Maglaj municipality. In the area of Maglaj municipality, in the area of research, also there are sources at the location Bezica, Mejvine, Tovarnica and Palučci. Those sources are wells with booster pumps and the capacities of all local sources that are being charted in the Maglaj Municipality are unknown. The municipality has not given the data on water quality from these local sources. According to data obtained from Local Community Novi Šeher, which belongs to Maglaj municipality, the registered source «Stubo" of unknown capacity is located in the range of scope of motorway route. This source is a tapped water intake, which supplies a part of Novi Šeher Community. In the urban part area of Novi Šeher, there are both sources and private wells of unknown capacity and which are not registered.

Section 3. Ozimica – Poprikuše (the chainage km 24+876.440 to km 38+617.434)

Sources in Žepče municipality

«Jezera», «Studenac», «Trnčić», «Orašje III», «Orašje II», «Sojtovača», «Ivićeva voda», «Hasanbegova voda», «Jurićka kruška» and «karst», «Skakavac», «Grab», «Markova voda», «Matina voda», «Maline», «Krmare», «Torovi», «Vučijak», «Jurjevac I», «Jurjevac II», «Brezik», «Dolina» and «Šuma».

All the mentioned sources are tapped water intakes and are registered and legalized, but the water quality on them is not being tested. The water quality is regularly being tested only for water supply system in Žepče City. The capacities of the following sources are known: «Trnčić» 12 l/s, «Ivićeva voda» 11 l/min, «Skakavac» 1,5 l/min, «Markova voda» 1,0 l/min, «Dolina» 1,5 l/min, «Jurjevac I and II» 2,2 l/s. There are no results on capacity for other sources within the cadastre. Žepče Municipality has tapped sources with basins of average capacity from 5 to 20 m3 that serve for water supply of one to twenty households. Žepče municipality has not data on these sources with their exact locations.

Section 4. Poprikuše – Nemila (the chainage km 38+617.434 to km 46+388.80)

The sources in Zenica municipality

Topčić polje («Skoči voda», «Studena voda»), Kovanići, Doca, Nemila («Čerinac», «Gračun», «S. Nemila-Borak»)

Section 5. Nemila – Donja Gračanica (the chainage km 46+388.80 to km 58+434.599)

The sources in Zenica municipality

Vranduk («Ljubetovo-Draganovac», «Vranduk-Stragačevica», «Varošište-Sedrenik», Višegrad-Ahmetovac, Koprivna («Gladovići-Vrtača», «Koprivna-Sedra», «Ponirak», «Zabrće-Sedrenik»)

Section 6. Donja Gračanica – Drivuša (the chainage km 58+434.599 to km 66+959.592)

The sources in Zenica municipality

Gornje Crkvice («Novo Selo»), Ričice («Sviće-Selište», «Suha»), Donja Vraca («D. Vraca-Muratovka», «Dobra voda», «Banjić Sofa»)

Section 7. Drivuša – Kakanj (the chainage km 66+959.59 to km 82+595.000)

The sources in Zenica municipality
Lašva («Dolipolje»), Janjići («Gromiljak»), Dolača («Putovići-Liska», «Tišina-Grohovac», «Gorica-Bara», «P.Polje-Cvrkalj I and II», «Gornja Vraca-Lanište» and «Klopče-Stržanj»)

All listed sources in Zenica Municipality are tapped water intakes and no one of them has water management authorizations. There is no data on source capacities within the given data on local sources in Zenica Municipality and the water quality has been tested on the following sources: Dolača («Liska», «Grohovac», «Gorica-Bara», «P.Polje-Cvrkalj I and II», «Tišina-Grohovac»), Klopče-Stražanj. Water quality data for these sources are given in the Annex of the list of local waterworks, obtained from Zenica Municipality and are added in Annex 12.2.

The sources in Kakanj municipality

The water intakes in the form of well in the area of local community Doboj 3, D.Papratnica, TPP Kakanj, Tičići 1 and Slijevnice Bara, have a capacity of 5-15 l/min. Kakanj municipality gave data for the concerned area of research where there are also sources «Mačuh», «Ćamilova česma», «Lokvač», «Crvena voda», «Kameni dvorac» and «Rozi», for which there is no any data on type of water intake and its capacity. The sources have not been registered and the data have been collected during the research in the field.

Section 8. Blažuj – Tarčin (the chainage km 0+000 to km 19+100)

The sources in the area of Kiseljak municipality
«Barešići», «Glasinac», «Studenac», «Kruščanje», «Natuč» and «Tuk».
The capacities of these resources are:

- The source «Barešići» 0,5 l/s, supplies with water 10 individual houses
- The source «Glasinac» 0,1 l/s, supplies with water 8 individual houses
- The source «Studenac, which capacity is unknown, supplies with water 20 individual houses
- The source «Kruščanje» 0,35 l/s, supplies with water 50 individual houses

- The source «Natuč» 0,4 l/s, supplies with water 25 individual houses
- The source «Tuk», which capacity is unknown, supplies with water 2-4 individual houses.

The water sources are tapped and water quality has not been tested.

The sources in the area of Kiseljak municipality
«Laze», «Gaj», «Dobra voda», «Kruščanje I and II", «Vukuše», «Krečane», «unnamed sources» on slopes of Volujak, «Gostila» and «Penavina voda».
Source capacities are:

- The source «Laze», 0,1 l/s, supplies with water 4 individual houses
- The source «Gaj», 0,2 l/s, supplies with water 15 individual houses
- The source «Dobra voda», «Kruščanje I and II», supplies with water 35 individual houses
- The source «Krečane», unknown capacity, supplies with water 8 individual houses
- The source «Vukuše», unknown capacity, supplies with water 80 individual houses
- The source «Gostila», with capacity of 3 l/s, supplies with water 28 individual houses
- The source «Penavina voda», with capacity of 8 l/s, the number of households that supplies is unknown.

The water sources are tapped but all listed sources have not been registered. The exceptions are the sources «Natuč» and «Kruščanje", which are in the procedure of legalization, i.e. harmonization with the regulations of current Water Law. Municipality does not have data on water quality for these local sources.

The water sources in the area of Ilidža municipality

The route of the Corridor Vc goes accros Minicipality Ilidža area, more acurrate goes accros Blažuj and Rakovica local community. The Blažuj local community representatives visited the route area in this section. They affirmed, there are not a local drinking water sources in this area. (Annex 12.2.). The Rakovica local community representatives visited the route area. They affirmed, there are a local drinking water sources in this area (Annex 12.2.): Košelji, capacity 4-6 l/s, Rukodol capacity 2,1 l/s and Kakrinje capacity 2,0 l/s. These sources supply settlements: Rukodol, Kobiljača, Kakrinje i Vrela.

Type of water intake at all listed local water sources is capture. These water sources are not registered. The water sources Natuč and Kruščanje are an exceptions. For these water sources, the legalization procedure implementation is underway (the harmonization with requirments of The law on water).

The sources in the area of Hadžići municipality:
«Smucka»
According to data obtained from Hadžići municipality, the source «Smucka" is the only source in the area of the motorway route. This source supplies with water the following settlements: «Smucka», «Raštelica», «Vrbanja», «Mokrine», «Vukovići» and «Do». The source has been tapped and the data on water quality and capacity of this source have not been delivered in the questionnaire through which the data have been collected.

Thermal, thermo mineral and mineral water sources

In Section 7 (Drivuša – Kakanj) from the chainage km 77+850 to km 79+300, in the research area, there are thermal, thermo mineral and mineral water sources «Tičići». In November 2004, the Institute for Geology of Civil Engineering Faculty in Sarajevo has prepared the study on research of thermal, thermo mineral and mineral waters in the area of Kakanj municipality. The main aim of the study was to define the area of potential source for use for the purpose of sport, recreation and health care, considering its qualitative and quantitative characteristics, protection aspects as well as spatial and economic indicators. In that context, recognition and prospecting of all phenomena of thermal, thermo mineral and mineral waters have been done in the area of Kakanj municipality. The prospection included thermal water sources in Ribnica and Kraljeva Sutjeska, the mineral waters in the region of Bičer and Papratnica, and thermo mineral waters in the area of Tičići. During these researches, information have been collected about dispositions of manifestation, type and mechanism of discharge, water quality, water protection of sources, current use, purpose for future and directions of future researches. By analysis of data obtained by recognition, and especially of qualitative and qualitative characteristics, current use, and purpose of thermal, thermo mineral and mineral water, it was concluded that the future research, exploitation and use should be directed toward the thermo mineral waters in the wider area of Tičići. In that sense, the limitations have been taken into consideration for building of spa or sport and recreation center in Tičići region, and first of all the disposition of motorway has been taken into consideration in the Corridor VC, as well as the position of hydro-engineering tunnel PK Vrtlište and landslides.

4.5.2. Hydrographic Characteristics

River Bosna is the main watercourse of the Section LOT 2 of the motorway with its bigger and smaller tributaries. From bigger tributaries, it is necessary to point out the Lašva River and from smaller tributaries the following rivers: Tešanjka, Liješnica, Strupinska River, Kardaglijska River, Ozimica, Trebačka River, Gračanička River, Nemilska River and Lepenica .

In relation with the existing level of researched characteristics of certain watercourses, the most data exists for Bosna River, which is the main watercourse in the analyzed region. The used data presented in this Study were taken from the Study " Motorway on the corridor Vc – Technical study, February 2005 and Conceptual Design, Book IV – Textual part , October 2005., „Framework water management plan of B&H", 1994., and „Preliminary hydrologic basis for the project " Motorway on the corridor Vc ", February 2005.

The Bosna River is the right tributary of Sava River in the territory of Bosnia and Herzegovina and belongs to the Sava River catchment area. The source of river Bosna is strong karst exurgence located in the bottom of Igman mountain near the city of Sarajevo. The Bosna River catchment has an area about 10.460 km^2, and encompasses the central part of Bosnia and represents one fifth of B&H total area. It neighbors with the river basins of Vrbas River on west, of Drina River on east, of Neretva River on south and of Sava River on north. The natural length of Bosna River flow amounts to 275.5 km. The mean altitude of the flow amounts to 640 meters above sea level, the sources of Bosna River are on 491.67 meters above sea level, and the delta is on 77.73 meters above sea level. The total difference in height of the flow amounts to 413.94 m, while the mean longitudinal head amounts 0.0015. The water regime of Bosna River is pluvial-snow with high waters in the spring due to the snow melting and with some lower autumn discharges due to the intensive precipitations.

The natural length of Bosna River on the concerned section of the motorway, from the chainage of Kakanj City to Doboj-jug City, amounts to about 100 km. The mean discharge on this section increases from Q_{sr}= 53 m^3/s (upstream of Kakanj) to Q_{sr}= 139 m^3/s (the mouth of Usora River into the Bosna River).

The biggest tributaries of Bosna River in the concerned motorway section are:

- Usora River with the basin area at the mouth of 470 km^2 and with the mean discharge of Q_{sr}= 10,5 m^3/s

- Lašva River with the basin area at the mouth of 981 km^2 and with the mean discharge of Q_{sr}= 18,5 m^3/s.

The motorway section LOT-2 crosses also the bigger number of smaller and bigger streams with a basin area of 1 to 30 km^2. The density of the river network, presented as relation of the length of all watercourses and area where they occur, for the basin of Bosna is about 0.35 km/km^2 in total. The mentioned data indicates the existence of the developed watercourse network in the zone of motorway passage within this section.

The list of watercourses which motorway crosses

With the purpose of defining the possible negative impacts of the motorway on surface waters, i.e. on its flow regime and quality, watercourses which are the part of hydrographic network and which are located in the zone of motorway route passage are being presented here. The list of the watercourses is given per sections on LOT 2.

Taking into the consideration that the Consultant did not have Final solutions available on the level of the Preliminary Designs of the bridges, a well as of the external and internal motorway drainage, the below-given data refer to the evaluation in accordance with the working version of the Preliminary Design. The pictures of the watercourse, which the motorway route crosses or is in their immediate vicinity, are presented in the Annex 12.2. of the Study. By reduction of the large number of various solutions into the proposed one in the preliminary Design, it was possible to observe the hydro engineering problems in more efficient way along the adopted motorway route.

It should be mentioned that for all sections of LOT 2, the elevations of flooding of relevant high waters of Bosna River and its tributaries along the motorway of the Corridor Vc, i.e. the sections with more risks for floods are defined in details in Books "Preliminary Design – group of designs I and D – Hydrology and Hydro Engineering and Construction Design of river training of the watercourse".

Defining of the high waters of 100-year of phenomena rank on Bosna River, as well as on watercourses that the motorway route crosses included the analysis of the available historical data collected in that area in the earlier period. Knowing the discharges and elevation of the water level of 100-year high water, the necessary conditions are provided for observations of the relations of motorway route and flooding elevation of the coastal area with high waters of Bosna, Usora, Lašva, Lepenica rivers and other smaller watercourses, torrents and gullies.

On the basis of the elevations of high waters and the discharges which are equivalent to them, as well as of the geometry of the riverbeds, the spatial relations of the flooding zones and motorway route position have been observed using the appropriate mathematical method at the level of elaboration of the Preliminary Design. Besides the main watercourses, the basic hydrological and hydro engineering parameters for designing have also been defined.

Finally, at the parts where the motorway route goes into the area of the existing watercourses, the environmentally acceptable solutions of the river training of those watercourses have been given at the necessary length.
In the same books, the longitudinal profiles of the natural and trained riverbed of those watercourses, which are being trained, are given, so that those data are not shown in details in this Study. Data on lengths of the watercourse river trainings, as well as the locations of crossing of the watercourse via bridge constructions along the LOT 2, and also expected adverse impacts and prevention and minimization measures of the same in the motorway construction phase are given in the non-technical resume.

It should be pointed out that the relevant Ministry of water management, forestry and agriculture of Federation of B&H, on the basis of the existing Law on Waters, has issued the water management conditions for the preparation of the investment and technical documentation for the "Motorway on the Corridor Vc – LOT 2". The designing of the bridge construction is requested in the same documents with the condition that the bridge openings enable the discharges of the high waters of the phenomena rank of 1/100 with the height difference of 1.20m. Analyzing the Preliminary Design for the motorway on the Corridor Vc – LOT 2 per sections (Group of designs I and D), it is confirmed that these conditions have been satisfied as well as the conditions for discharges of the high waters of phenomena rank of 1/500, and which the documentation auditor has requested. In dimensioning the culverts, the European practice have been taken into account according to the guidelines of the auditors, so that they are designed and dimensioned on the water of the return period of 1/500.

The designers of the Preliminary Design of the trainings have satisfied the conditions of the protection of the coastal area from the flooding with the one hundred and five hundred high waters, and all detailed calculations, analysis and height relations of the level of the motorway route and the elevations of the high waters are shown in the graphic presentations of the "Preliminary Design – design group I and D- Hydrology and Hydro engineering and Construction Design of the river training of the watercourse".

Bearing in mind that the final solutions on the level of preliminary design about the watercourse regulation have not been available to the EIS Consultant as well as solutions on the structures of the motorway route, the below-mentioned data are related to the evaluation in accordance with the working version of the preliminary design. The photos of watercourses which the motorway intersects or is in their direct proximity are presented in Annex 12.2.

Section 1. Karuše – Medakovo (from chainage km 0+000 to 4+000)

The route of motorway is almost on the whole length of this section situated alongside with Tešanjka river bed which flows into Usora River, upstream of the foreseen interchange Karuše. The section length amounts to 4km. It is estimated to have 6 bridges on the locations where the motorway intersects Tešanjka River. The total length of bridges amounts to 260 m. The Tešanjka river-bed needs to be regulated on 5 locations in the total length about L=1,680 m.

Section 2. Medakovo - Ozimica (from chainage km 4+000 to 24+901,587)

In the section 2, the motorway route is situated alongside with the Trebačka`River from the chainage km 4+000 to 11+843.051. The motorway route intersects Trebačka River on 11 locations where the bridges will be built with length of 15-60 m. In this part, the project foresees the regulation of Trebačka River on 7 locations in the total length about L=1,130m considering that the motorway route goes along the bed of Trebačka river. The motorway goes along the Kardaglijska River from chainage km 11+843.051 to km 12+775.479. The regulation of this river is foreseen on two locations in total length of about 500 m at the part near the settlement Alispahići. Going further, the motorway route is situated alongside the Strupinska River and regulations of this river is foreseen on 6 locations in total length of about L=1,046m up to the chainage km 23+351.663. The motorway route intersects Liješnica River from chainage km 23+351.663 to the end of section 2 and river Ozimica at chainage km 23+688.247. Culverts with dimensions ∅100, ∅150, ∅300, ∅400 (centimetres) are foreseen on the complete section 2 .

Section 3. Ozimica – Poprikuše (from chainage km 24+901.587 to 38+617.434)

In this section, the motorway route intersects large number of smaller and bigger streams at the chainage km 24+901.587 to 32+928.221. The most significant streams that the route intersects are Papratnica, Ljubna and Bljuva which flows into Bosna River. The culverts have been designed for these streams with dimensions ∅100 – ∅300 (centimetres). The motorway is situated alongside of Bosna River which meanders on this location from the cha inage km 32+928.221 up to the end of this section and intersects on 4 locations where the bridges will be built in a length of 60 to 660 m.

Section 4. Poprikuše – Nemila (from chainage km 38+617.434 to 46+289.378)

The motorway intersects a bigger meander of Bosna River from the designed interchange Poprikuše located at the beginning of this section, which further is situated alongside with right bank of Bosna River. Thereby, the motorway (from chainage km 41+606.494 to the end of this section – designed interchange Nemila) intersects a large number of smaller streams which flows into the Bosna River. For these streams, the culverts have been designed with dimensions ∅150 – ∅300 (centimetres), in the way that changes in surface water regime can not occur, moreover to ensure the adequate transit of these waters through the motorway body.

Section 5. Nemila – Donja Gračanica (from chainage km 46+289.378 to 58+434.599)

At the beginning of this section, the motorway intersects Nemilska River and up to chainage km 49+122.716 intersects a few smaller streams which flow into Bosna River. The culverts have been designed for these streams with dimensions ∅100–∅300 (centimetres), in the way that changes of surface water regime can not occur. The motorway intersects one bigger and one smaller meander of Bosna River from chainage km 49+122.716 to 51+236.909. The motorway is situated along the right bank of river Bosna from chainage km 51+236.909 to the end of this section where it intersects a few smaller streams which flows into the river Bosna. The motorway intersects Gračanička River on chainage km 57+833.182, which is the right tributary of river Bosna. Therefore, on this section the motorway intersects mentioned smaller water courses, as well as river Bosna on 15 positions. The bridges have been designed with length from 40-85m on the positions where the motorway intersects streams and smaller rivers that flow into Bosna River and on the positions where the motorway intersects Bosna River the bridges with length from 200-465 m are being designed.

Section 6. Donja Gračanica – Drivuša (from chainage km 58+434.599 to 66+959.592)

The motorway is situated along the right bank of the river Bosna on this section. On this section, the motorway intersects next rivers: Dobra voda, Babina rijeka, Stjenčica and Mrstava and three smaller streams. These watercourses are the right tributaries of river Bosna. The culverts for these rivers have been designed with dimensions ∅100, ∅200, ∅300 (centimetres), in a way that changes of surface water regime can not occur.

Section 7. Drivuša – Kakanj (from chainage km 66+959.59 to 82+595.000)

On first part of this section, the motorway intersects the meander of river Bosna and from designed interchange "Lašva" **arm** 1 up to the end of this section, the motorway route is situated along the right bank of river Bosna. Thereby, the motorway route completely follows the course of Bosna River and intersects several smaller streams which flow into the river Bosna. The culverts for these streams with dimensions ∅100, ∅200 (centimetres) have been designed, in a way that changes of surface water regime can not occur.

Section 8. Blažuj – Tarčin (from chainage km 0+000 to 19+100)

On the first part of this section, the motorway intersects a number of smaller and bigger streams, which starts with designed interchange Vlakovo (km 0+000) in Blažuj. It's necessary to mention some bigger streams: Kulićev potok, Rakovica, Kremikovac, Krmeljevac and Zečiji potok. The bridges are foreseen to be built on these streams in length from 20 to 340 m and also regulations of Rukodol stream in length about 700 m. The motorway route approaches to Lepenica River and it is situated along the right bank of this river from chainage km 8+537.00 up to the location where interchange Lepenica has been planned.

Following the motorway route further on at chainage km14+278.7 (Toplica settlement), the motorway intersects the streams which are gravitating toward the river Lepenica (Dobra voda, Mlinčići, Tisovački potok, and a few smaller streams which flows into the river Lepenica). The motorway partially goes away from the river Lepenica, from the Toplice settlement to Tarčin and passes across the region Sevid-Suvodo with poorly developed hydrographic network. The motorway approaches to the Bijela River on chainage km 18+000 and on this position; this section ends with the designed interchange Tarčin. The bridges are planned to be built in this section of motorway in length from 20-400m as well as relocation of Bijela River in the length of about 210 m.

4.5.3. Hydrological Characteristics

The Bosna River, with its bigger and smaller tributaries, is the main watercourse within the analyzed region. The main hydrologic parameters, which quantify hydrologic characteristics of Bosna River and its main tributaries, are presented in Table 4.5.3.1. and 4.5.3.2. The relation between the specific flow and the basin area is presented in Illustration 4.5.3.1. With this in mind, high water of phenomena rank 100-year are presented for watercourses within the analyzed region.

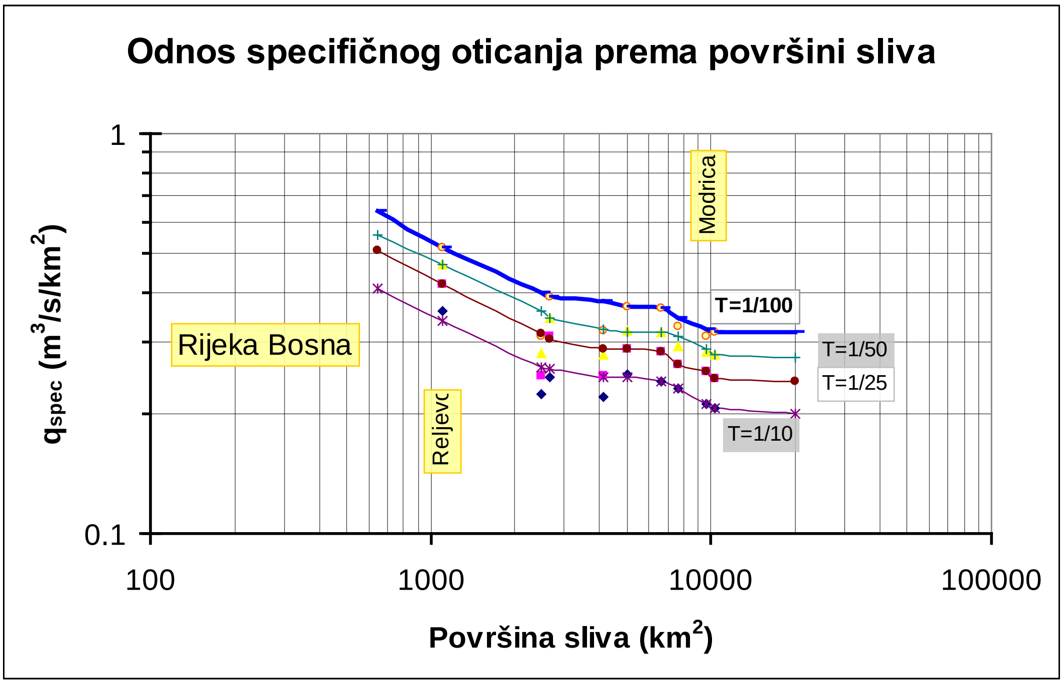
Table 4.5.3.1. The main hydrological characteristics of Bosna River along concerned section

Watercourse	No. Year of observation	Gauging station	High water of phenomena rank (m^3/s)				Basin area to the gauging station F(km^2)	Specific flow of 100-year phenomena rank ($m^3/s/km^2$)
			$Q_{average}$	Q_{25}^{min}	$Q_{mi.sr.m}^{Bio.mi}$	Q_{100}^{max}		
Bosna	50	Reljevo	28,1	3,4	4,6	560	1104	0,507
Bosna	50	Visoko	50	7,74	8,8	762	2486	0,306
Bosna	24	Dobrinja	53,6	7,9	9,2	1040	2663	0,390
Bosna	49	Zenica	70,8	11,4	13,4	1330	4124	0,322
Bosna	28	Zavidovići	86	12,8	14,3	1870	5033	0,371
Bosna	33	Maglaj	116	14,2	16,2	2442	6619	0,369
Bosna	40	Usora	139	18,9	23,9	2623	7672	0,317

Table 4.5.3.2. The main hydrological characteristics of Bosna River main tributaries along concerned section

Tributaries of Bosna River								
Watercourse	No. year observation	Gauging station	High water of phenomena rank (m^3/s)				Basin area to the gauging station F(km^2)	Specific flow of 100-year phenomena rank ($m^3/s/km^2$)
			$Q_{average}$	Q_{25}^{min}	$Q_{mi.sr.m}^{Bio.mi}$	Q_{100}^{max}		
Zujevina	24	Blažuj	3,1	0,150	0,250	120	172	0,698
Fojnica	50	Visoko	17,2	2,38	2,7	361	721	0,501
Krivaja	29	Zavidovići	22,4	-	-	1176	1387	0,848
Spreča	18	Stanić rijeka	26,9	3,3	5,3	490	1932	0,253
Usora	20	Karuše	17,0	1,57	2,1	681	847	0,804
Lašva	30	Merdani	16,8	3,49	4,4	466	949	0,491
Lepenica	24	Homoljska ćuprija	5,44	0,45	0,570	177	177	0,994

Illustration 4.5.3.1. The relation between the specific runoff and basin area



The elaborati on results are presented in the Table 4.5.3.3. used for hydraulic model of the flood line analysis along the motorway route and they are given within the Technical Study and the Conceptual design of the motorway on the Corridor Vc – section LOT2. The defined flood zones along the LOT 2 are elaborated in Annex 12.3.6.

Table 4.5.3.3. ***The review of high water elevations on the concerned gauging stations***

Gauging station	Elevation «0» of water meter	Discharge Q_{100} (m^3/s)	Water levels at flood wave occurrence of certain rank phenomena H (meters above sea level)			
			10	25	50	100
Visoko	411.97	994	415.27	415.83	415.97	416.41
Dobrinja	392.04	1044	395.34	396.29	396.64	397.14
Zenica	311.05	1546	314.67	315.00	315.37	315.59
Zavidovići	200.71	1862	206.11	206.56	206.96	206.48
Maglaj	168.92	2416	172.9	173.5	173.94	174.42
Usora	140.16	2685	145.61	146.06	146.66	147.06
Doboj	137.01	3097	141.50	141.93	142.05	142.51

For all sections of LOT 2, the defining of the hydrological parameters has been carried out in details in the Books of “Preliminary Design – design group I and D- Hydrology and Hydro engineering and Construction Design of the river training of the watercourse”. Those parameters served as the basis for designing of the internal and external drainage, as well as defining of the elevations of the flooding of relevant high waters of Bosna River and its tributaries along the Corridor Vc. The appropriate data on precipitations and discharges along the route are collected and analyzed, as well as the maximal discharges of the requested phenomena rank have been defined.

Quality of surface and ground water

In the framework of this section, zero state of the quality and quantity of surface and ground water along section LOT2 of the motorway of the corridor Vc will be presented. Subject of discussion are surface watercourses that normally passes along the accepted route of motorway, or the route crosses them. In the section LOT2, focus has been given to Bosna River and its bigger tributaries.

Regarding the ground water, focus will be on the sources of ground water that is used for public water supply system, and sources of water with local character of usage, located in our scope of research activities.

Quality of surface water

Pollution of watercourses is very complex and dynamic process that depends on different factors, primarily on the quantity and type of polluting substances and capability of recipient of the watercourse itself. Because of that, it is difficult to evaluate quality of water without systematic evaluation of it, i.e. long-term continuous sampling and analysis.

Quality of surface water within the scope of motorway route will be shown throughout two periods:

- Period till 1992.
- Period from 1992 to 2005.

This approach is restricted by the fact that in period till 1992 there was systematic monitoring of quality control of surface watercourses in B&H, while in the period from 1992 to 2005, the continuous assessment of water quality did not exist.

In the September 2005, a project "Examination of Surface Water Quality in Four Series in the Framework of One Hydrologic Year (physical – chemical, microbiological and biological parameters) on the area of Sava river basin in FB&H", financed by Public Water Management Enterprise for Watershed of Sava River Basin Catchment Area. Data from one series of sampling on characteristic profiles (sampling points) relevant for this study were available to the Consultant. Those were profiles on the rivers Bosna and Lašva. However, available data in the period of study development cannot totally present quality of discussed watercourses at the moment. In that sense, for the comparison, here the status of water quality will be presented only until 1992 (when the industries, located near the riverbanks, had worked with full capacity), and for the period from 1992 to 2005 (when the industries has worked with reduced capacities), but also the facts that results of one series of examination can not give relevant evaluations of quality of watercourses which are possibly the future recipients of wastewater from road surface of motorway (Bosna River, Tešanjka River, Trebačka River, Strupinska River, Ozimička River, Liješnica River, Gračanička River, Karadaglijska River, Lepenica, Bijela River).

a/ Historical data about surface water quality in the scope of section LOT-2

Quality control of surface water that is in the scope of section LOT 2, was conducted systematically on Bosna River and its tributaries Usora and Lašva until 1992. Method of "random sampling", which was practiced three times a year on selected profiles, had no aspire to present detailed insight in the state of quality during the relevant period. However, having in mind that examinations have been carried out for many years on same locations, the obtained results could give pretty real view about status of water quality. Classification of water (found quality status) was done according to The Act on classification of waters and coastal waters of Yugoslavia within borders of SR B&H (Official gazette SR B&H , no19/80)

On Bosna River, being a main watercourse on concerned section, quality of water was determined on the following profiles:

- profile B7 – upstream from Zenica (Raspotočje)
- profile B8 – downstream from Zenica
- profile B10 – upstream from Maglaj
- profil B11 – downstream from Maglaj
- profil Us1 – mouth of Usora into Bosna (Karuše) – end of section LOT 1 and beginning of section LOT 2
- profile Lš1 – mouth of Lašva into the Bosna River

According to The Act on classification of waters and coastal waters of Yugoslavia within borders of SR B&H (Official gazette SR B&H, no19/80), i.e. Act on categorization of watercourses (Official gazette SR B&H, no 42/67), categories were prescribed, in other words classes of water of the river Bosna and its tributaries Usora and Lašva, and it was necessary to maintain them on that quality level. According to the mentioned categorization along the concerned section, Bosna River should satisfy quality prescribed for III class of water, while its tributaries Usora and Lašva should satisfy quality prescribed for II class of water. Republic Hydro meteorological Institute from Sarajevo carried out monitoring of the prescribed class of watercourse in B&H. Monitoring was based on random instant samples of water. Within the physical and chemical, bacteriological and hydro biological analysis the following parameters were analyzed: temperature, present visible matter, pH value, alkalinity, dissolved oxygen, saturation by oxygen, total solids, consumption of potassium permanganate, orthophosphates and total iron level, while compounds of nitrogen were analyzed only on selected profiles. Heavy metals were determined periodically by technique that enables only general view, but not reliable concentrations characteristic for watercourse.

As an illustration for surface water quality on this area until 1992, Table 4 presents overview of determined and proscribed class of watercourse on the profiles along river Bosna in the scope of corridor Vc (LOT2). Evaluation of the proscribed and determined class of watercourse status was done based on results obtained during 1985, 1986, 1987, 1988 and 1989. The main quality indicators for conducting that kind of analysis were: dissolved oxygen, total suspended matter, consumption of KMnO4, biological oxygen consumption (BOD5), concentration of iron, bacteriological pollution and presence of micronutrients. For the purpose of general evaluation of water quality the saprobiological analysis was carried out.

Tabela 4.5.3.4. Prikaz propisane i zatečene klase vodotoka u periodu ispitivanja 1985.-1989. godine

River	Profile	Proscribed class	Determined class of watercourse					Satisfying the class YES/NO
			1985	1986	1987	1988	1989	
Bosna	Upstream from Zenica	3	4-VK[20]	3-4	3-4	3	3-4	NO
Bosna	Downstream from Zenica	3	3	VK	VK	VK	VK	NO
Bosna	Upstream from Maglaj	3	4	3-4	3-4	3	3	NO
Bosna	Downstream from Maglaj	3	4-VK	VK	4	4	3-4	NO
Usora	Mouth of the river	2	2-3	2	2	3	2-3	NO
Lašva	Mouth of the river	2	2-3	2	2	3-2	3	NO

From the table above, it is clear what the state of water quality was in the period until 1990, when there was maximal number of industrial facilities installed in Bosna river basin. Quality of the watercourse mostly was significantly worse then it was prescribed. However, in some sections, total destruction of water quality was recorded.

B/ Current (baseline) state of the surface water quality in the scope of section LOT-2

In the current circumstances, because of cessation of work of installed industrial capacities, surface water quality is much better. Currently, in the Bosna river basin, the main polluters work with the reduced capacities. However, in the period from 1992 to 1995, the biggest polluters in the basin stop with its work. First of all, it is necessary to highlight metal processing, leather processing and paper production industry. Currently, those capacities are in the process of restoration, and now they work with 10 to 15% of pre-war capacities.

On the territory of Federation of B&H (based on Low on Federal ministries and other federal authorities of FB&H, No. 3/96), Federal Meteorological Institute carry out expert and other kind of works under competency of Federation, which are, among all, in regard to monitoring of

[20] VK – out of the class

environment quality (air, water and soil). In that context, ten monitoring stations exist in the area of Federation under jurisdiction of mentioned Institute; among on which only two of them surface water quality has been measured. None of those two stations is not in the scope of section LOT – 2 of the motorway of the corridor Vc.

During development of this study, Investor of the overall project decided that baseline state of the quality of surface and ground water would be presented according to existing data collected from the relevant institutions working in the water sector, and from the water supply companies. All possible additional data on water quality, taken regarding determination of baseline state of water quality, are expected in the following phases, with the obligation for the future investor, i.e. contractor, to realize it before the start of any of construction work.

Current state of the surface water quality will be presented by the data received from the current project "Examination of Surface Water Quality in the area of Sava river basin in FB&H". As it is mentioned before, this project will realize quality control of surface water in four series in the framework of one hydrologic year (physical – chemical, microbiological and biological parameters) in the area of Sava river basin in FB&H. Taking in consideration that most of concerned section of designed motorway passes along Bosna River, profiles on which the quality of this river had been monitored was specially discussed. In that context, it was determined that 6 profiles are in direct proximity of the adopted route of motorway, so collected data from those profiles can serve as indicators of current status of water quality from river Bosna. It is necessary to emphasize once more that the data will be presented here obtained from the first sampling series only (October, 2005), while the real evaluation of the water quality requires long-term and continuous sampling and research. With regard to the above-mentioned project realization dynamic, as well as realization of this Study, only these data will be available, so it will be used for indication of baseline state of the quality of river Bosna and its tributaries. Financier of the activity on monitoring of surface water quality in FB&H expects that those activities will continue in the future in the certain continuity. Therefore, it has to be emphasized, that in the future, during the phase prior to any kind of construction works for motorway Vc- LOT – 2, it is necessary to analyze data obtained from systematic monitoring of water quality so far, and compare it with those presented here.

Profiles for examination of the quality of the river Bosna, located in the immediate vicinity of motorway are:

- profile B7 – upstream from Zenica (Raspotočje)
- profile B8 – downstream from Zenice
- profile B10 – upstream from Maglaj
- profile B11 – downstream from Maglaj
- profile Lš1 – mouth of Lašva into Bosna

Table*4.5.3.*5. presents data about water quality from Bosna River on selected profiles.

Table 4.5.3.5. Overview of the results of the classification of the selected watercourses based on results of physical – chemical and microbiological indicators. (October 2005.)

No.	Profile name	Water course	Profile code	Class
1	Upstream from Zenica (Raspotočje)	Bosna	B-7	II and III
2	Downstream from Zenica (Jelina)	Bosna	B-8	II and III
3	Upstream from Maglaj	Bosna	B-10	II and III
4	Downstream from Maglaj	Bosna	B-11	II and III
5	Mouth of Lašva into Bosna	Lašva	Ls-1	II and III

In the Table 4.5.3.6. presents the comparative overview of the water quality evaluation based on biological parameters (phytobenthos, zoobenthos-macroinvertebrates and ichtyofauna, October 2005.).

Table 4.5.3.6. Comparative overview of the water quality evaluation based on biological parameters (phytobenthos, zoobenthos-macroinvertebrates and ichtyofauna)

Location	Phytobenthos		Zoobenthos		Ichtyofauna	
	Bonitet class	Sapro index	Bonitet class	Sapro index	Bonitet class	Sapro index
Profile B7 – upstream from Zenica (Raspotočje)	II-III	2,4	III	2,89	II-III	β -α
Profile B8 – downstream from Zenice	II-III	2,7	II-III	2,48	II-III	β -α
Profile B10 – upstream from Maglaj	II-III	2,5	III	2,9	II-III	β -α
Profile B11 – downstream from Maglaj	III	2,8	II-III	2,5	III	α
Profile Lš1 – mouth of the Lašva to Bosna	II-III	2,4	II	2,03	II-III	β -α

Results of researches with interpretation of physical – chemical, microbiological and biological parameter, for each of selected profiles that were used for evaluation of baseline state are presented in Annex 12.2.

Quality of ground water

Quality of ground water is not controlled systematically on concerned area along LOT-2, except for water source Klopče, which is a part of the water supply system for the municipality Zenica. Continuous analysis of ground water quality is being carried out on the following local water sources:

- Water source Tešanjka, municipality Tešanjka
- Water source Oaza, municipality Tešanj
- Water source Tešanjska vrela, municipality Tešanj
- Water source Klopče - municipality Zenica

Results of the analysis of the drinking water quality are presented in the Annex 12.2, and according to it, water quality on each source satisfies requirements of "Rulebook on hygienic regularity for drinking water, (Official gazette of SR B&H, no 2/92). Regarding the rest of the local water sources, located in the scope of LOT -2 route, and which are used for water supply of larger or smaller number of households, it has to be emphasized that those water supply systems are managed by local group of citizens or local communities on which location it is placed. The current Cantonal Law on water (Article 89, for the cantons along which area the motorway route passes by in section LOT-2 i.e. Zenica-Doboj, Central Bosnia and Sarajevo Canton) prescribes the establishment and maintenance of sanitary water source protection zones as an obligation for the owner of the village water works, as well as carrying out the minimal number of prescribed hygienic analysis for drinking water for these structures by the relevant laboratory with the proper authorization. During collection of data regarding local water sources by the questionnaires that were forwarded to the municipalities Doboj-south, Tešanj, Usora, Maglaj, Zenica, Žepče, Kakanj, Hadžići and Kiseljak, (questionnaires are presented in the Annnex 12.2) within the period of development of this study, it is determined that most of these water sources are not registered according to law. In the same time, that means that the zones of protection for the drinking water sources have not been established (Cantonal Law on water, Article 91). Regarding the water quality control on these water sources, the current law prescribes the minimal number of prescribed hygienic and sanitary analysis for the drinking water within the registered sources. As most of these sources are used without registration, or they are in the process of registration, quality of water is not continually controlled, but has been organized according to decision made by groups of citizens that have constructed it. It is necessary to emphasize that municipalities, in other word, local communities on which area those water sources are located, it was hard to reach the data about water quality. In that context, data about water quality were obtained on following local water sources (presented in Annex 12.2):

- On the area of municipality Zenica – Dolača (Liska, Grohovac, Gorica-Bara, P.Polje-Cvrkalj I and II, Tišina-Grohovac), Klopče-Stražanj
- On the area of municipality Doboj – south - water sources Bukvik, Dubrava. Peraslika, Šume, Kilavi dolovi, as well as for a number of water sources on this municipality that is not within the scope of motorway route, on the section LOT-2.

From the attached results of analysis, it is obvious that those are sources where water quality satisfies requirements of "Rulebook on hygienic regularity for drinking water”.

All local sources obtained from the questionnaires from the municipalities on which territory they are located have been charted in the map of limitations related to water resources along section LOT-2 (Map 12.3.5)

4.6. Emissions and Air Quality

Antropogenous emission of pollutants in the air along the Corridor originates from:

- Industrial plants,
- Thermo-power plants,
- Traffic and
- Households.

As a part of this study the emissions have been studied from the areas of the six municipalities (Kakanj, Zenica, Zavidovići, Maglaj, Doboj and Hadžići). Estimates of the pollutants' emissions for 2002 in the above-mentioned six municipalities have been performed on the basis of the emission records collected for Bosnia and Herzegovina in 1979 by the Institute for Process Techniques, Energy and Environment (IPES) as well as on the basis of measuring of the pollutant emissions undertaken during 2002. It is stated that the emissions from the small sources (households and small industrial plants) are on the same level on which they were in 1979 due to the fact that mainly the same fuel is used (coal). Emissions from the large sources have been estimated on the basis of the results obtained by measuring and on the basis of the levels of production compared with the results from 1979. Emissions of Sulphur dioxide (SO2), particulate matters and Nitrogen oxides (NOx) in the above-mentioned municipalities in 2002 with respect to their sources are given in the Tables 4.6.1, 4.6.2 and 4.6.3.

The largest individual sources of pollutant emissions along the route are as follows:

- Steel Plant Zenica and
- The Factory "Natron" Maglaj

Due to their vicinity it is also very important to take into account influences of the Thermo Power Plant (TE Kakanj) and Kakanj Cement Factory (TC Kakanj) on the quality of air because both of them are very close to the south part of LOT 2 Section 4.

Emissions of TE Kakanj and TC Kakanj are estimated on the basis of measured concentrations of pollutants in the smoke gasses and the fuel consumption. Emissions from the Steel Plant are estimated on the assumption that it works with only 50% of its capacity (two times less than in 1979), while some other sources of emissions practically do not exist because the plants are not in operation any more. Emissions of the factory "Natrona" from Maglaj are estimated under assumption that the factory works with only 30% of its capacities.

Table 4.6.1. Estimated SO2 emissions from stationary sources in 2002 at LOT 2

SO_2 Emissions	Large sources [21] t/a		Other sources t/a	Total t/a
Kakanj	TE Kakanj	54500	500	55250
	TC Kakanj	250		
Zenica	Steel factory	15000	2500	17500
Zavidovići	-		560	560
Maglaj	Natron	5200	240	5440
Doboj	-		1420	1420

[21] Large sources are those sources whose emissions are larger than 5 % of the emissions in the whole territory of Bosnia and Herzegovina.

Hadžići	-	610	610
Total	75000	5830	80830

Table 4.6.2 Estimated emissions of particulate matter from stationary sources in 2002 at LOT 2

Particulate matter emissions	Large sources t/a		Other sources t/a	Total t/a
Kakanj	TE Kakanj	2800	300	3100
Zenica	Steel factory	1500	1250	2750
Zavidovići	-		300	300
Maglaj	Natron	2700	120	2820
Doboj	-		700	700
Hadžići	-		300	300
Total	7000		2970	9970

Table 4.6.3 Estimated NOX emissions from stationary sources in 2002 at LOT 2

NOx emissions	Large sources t/a		Other sources t/a	Total t/a
Kakanj	TE Kakanj	8500	25	9425
	TC Kakanj	900		
Zenica	Steel factory	1000	125	1125
Zavidovići	-		30	30
Maglaj	Natron	500	15	515
Doboj	-		70	70
Hadžići	-		30	30
Total	10900		295	11200

The essential products after combustion of fossil fuels in the internal combustion engines are carbon dioxide[22] and water. However, engine inefficiency and high temperatures produce many other gasses. Pollutants from the internal combustion engines, on the local level, are Nitrogen oxides (NO_x), Carbon hydrates (CH_4), Carbon monoxide (CO), Sulphur dioxide (SO_2), Particulate matter, Lead (Pb) and other secondary pollutants, while on the global level the most important pollutant is Carbon dioxide (CO2).

Emissions of the pollutants depend on various factors:

For single vehicle:

1. Type and power of engine;
2. Type and composition of fuel;
3. Efficiency of combustion;
4. Presence of emission monitoring equipment (i.e. catalyzer);
5. Actual speed of the vehicle.

For overall traffic:

1. Traffic flow - Number of vehicles;
2. Composition of vehicle fleet - average age and actual performance of engine types;
3. Traffic flow characteristics on a specific road section (average speed, free flow, or traffic jam)

[22] This is why the internal combustion engines have great influence on global warming, exactly a greenhouse effect.

Input data for the mentioned model result from traffic survey on the Corridor[23]. Characteristics of the existing roads have been obtained from the documents of the Traffic Institute of the School of Civil Engineering in Sarajevo, while the existing values of the climatic parameters have been obtained from the Statistical Almanac of the Federal Institute of Statistics. Composition of vehicle fleet, age of the vehicles and power of engines have been estimated on the basis of data obtained from the statistical data of the Federal Institute of Statistics and from the Study „Influence of Application of New Technologies on Emission of Internal Combustion Engines Pollutants in Urban Areas“[24]. Summary of the modelling results (for the whole corridor) are given in the table 4.6.4.

Table 4.6.4. **Estimated emissions of pollutants from the traffic in the area of LOT-a 2**

Pollutants	Total (t annually):	Ration between emissions from stationary sources and traffic emissions
CO	4171	-
VOC[25]	253	-
NO_x	1061	10,5 : 1
SO_x	9,8	8248 : 1
Particles	38	262: 1
Lead (Pb)	0,2	-
1,3 Butadiene	1,2	-
Acetaldehydes	2,4	-
Formaldehydes	7,1	-
NH3	7,6	-
Benzene	12	-
N_2O	3,5	-
CH_4	30	-

4.6.1. Air Quality at the Corridor

During eighties and nineties of the last century measuring of the air quality has been regularly carried out in Zenica and Kakanj. Concentrations of SO_2 and particulate matter have been monitored regularly. The results of the statistical data processing have shown very high concentrations of pollutants much higher that the recommended values and standards with regards to the quality of air.

Recent measuring of air quality undertaken in the area of Kakanj municipality (during 2002) indicates that the quality of air has significantly improved. On the basis of statistical processing of the results obtained by measuring of concentrations of SO2, particulate matters, ozone, CO and NOx at five locations in the wider area of Kakanj Municipality, during 2002, it can be stated that annual concentrations of pollutants do not exceed standard values of pollution in Zenica-

[23] Based on survey carried out in December 2004, average annual daily traffic on some sections was in range between 7682 and 11909 vozila.
[24] Prirodno matematski fakultet Sarajevo, 2003.
[25] Easily vaporable organic unit

Doboj Canton. The annual concentrations of pollutants in 2002 measured at the location of Dom Kulture Kakanj are given in table 4.6.5.

Table 4.6.5. Results of annual measuring of air pollutants in Kakanj - 2002

Dom kulture	CO (µg/m^3)	NO_2 (µg/m^3)	NO_x (µg/m^3)	SO_2 (µg/m^3)	Particulate matters (µg/m^3)
Mean value	1	18	20	30	130
95-i percentil	1,6	35	50	100	350
98-i percentil	1,9	45	70	160	450
c_{max}	2,4	55	110	260	650

Beside that, during 2002 in the wider are of Kakanj measuring of quantity of settled particle matters has been carried out at seven locations. The obtained results show that the standard values have been satisfied here.

4.7. Soil and Agricultural Land

4.7.1. Participation of the Soil Types

Participation of different soil types is given for the observed corridor of the motorway in width of 500 m. For all sections, participation of individual pedological-system units is represented in Table 1 in Appendix.

- **Section-1 Karuše - Medakovo**

The following soil types are presented at this section:

- Calcocambisol	14,8 ha	7,4 %
- Vertisols	4,5 ha	2,3 %
- Luvisols	75,9 ha	38,0 %
- Fluvisols	104,3 ha	52,3 %
Total	199,5 ha	100,0 %

At this section, Fluvisols predominate with 104,3 ha or 52,3 %, while the smallest participation has Vertisols with 4,5 ha or 2,3 %.

- **Section-2 Medakovo - Ozimice**

The following types of soil are presented at this section:

- Calcocambisols	1,8 ha	0,2 %
- Vertisols	103,6 ha	10,2 %
- Eutric cambisols	298,1 ha	29,2 %
- Dystric cambisols	74,3 ha	7,3 %
- Luvisols	311,9 ha	30,6 %
- Pseudogley	52,6 ha	5,1 %
- Fluvisols	177,3 ha	17,4 %
Total	1.019,7 ha	100,0 %

At this section, Luvisols predominate with 311,9 ha or 30,6 %, while Calcocambisols have the smallest participation with 1,8 ha or 0,2 %.

- **Section-3 Ozimice - Poprikuše**

The following soil types are presented here:

- Rankers	24,3 ha	3,6 %

- Vertisols	3,2 ha	0,5 %
- Eutric cambisols	256,5 ha	38,1 %
- Dystric cambisols	285,8 ha	42,5 %
- Pseudogley	41,3 ha	6,1 %
- Fluvisols	61,4 ha	9,2 %
Total	672,5 ha	100,0 %

At this section, Dystric cambisols are predominate with 285,8 ha or 42,5 %, the smallest quantities belong to Vertisols with 3,2 ha or 0,5 %.

- **Section-4 Poprikuše - Nemila**

The following soil types are presented here:

- Rankers	10,4 ha	2,9 %
- Dystric cambisols	278,0 ha	77,1 %
- Fluvisols	72,0 ha	20,0 %
Total	360,4 ha	100,0 %

At this section, Dystric cambisols are predominate with 278,0 ha or 77,1 %, while rankers take the smallest participation with 10,4 ha or 2,9 %.

- **Section-5 Nemila - Donja Gračanica**

The following soil types are presented here:

- Rendzinas	79,2 ha	14,0 %
- Rankers	34,3 ha	6,0 %
- Eutric cambisols	66,4 ha	11,7 %
- Dystric cambisols	300,4 ha	52,8 %
- Lithosols	21,7 ha	3,8 %
- Fluvisols	66,5 ha	11,7 %
Total	568,5 ha	100,0 %

At this section, Dystric cambisols are predominate with 300,4 ha or 52,8 %, and Lithosols take the smallest participation with 21,7 ha or 3,8 %.

- **Section-6 Donja Gračanica - Drivuša**

The following types of soil are presented at this section:

- Calcomelanosols	1,9 ha	0,5 %
- Rendzinas	193,2 ha	46,5 %
- Rankers	10,1 ha	2,4 %
- Eutric cambisols	166,4 ha	40,1 %
- Fluvisols	43,8 ha	10,5 %
Total	415,4 ha	100,0 %

Rendzina is presented the most at this section with 193,2 ha or 46,5 %, and last on the list are Calcomelanosols with 1,9 ha or 0,5 %.

- **Section-7 Drivuša - Kakanj**

The following soil types are presented at this section:

- Rendzinas	134,0 ha	19,9 %
- Eutric cambisols	336,6 ha	50,1 %
- Fluvisols	201,2 ha	30,0 %
Total	671,8 ha	100,0 %

Eutric cambisols are presented the most at this section with 336,6 ha or 50,1 %, and the smallest participation takes Rendzina with 134.0 ha or 19,9 %.

- **Section-8a Blažuj - Lepenica**

At this section, the following soil types are presented:

- Eutric cambisols	155,7 ha	35,0 %

- Dystric cambisols	95,5 ha	21,5 %
- Luvisols	77,6 ha	17,5 %
- Pseudogley	69,6 ha	15,7 %
- Fluvisols	46,0 ha	10,3 %
Total	444,4 ha	100,0 %

Eutric cambisol has the biggest participation with 155,7 ha or 35,0 %, while Fluvisol with 46,0 ha or 10,3 % takes the smallest participation.

- **Section-8b Lepenica - Tarčin**

The following soil types are presented at this section:

- Calcomelanosols	65,7 ha	12,8 %
- Calcocambisols	9,0 ha	1,7 %
- Eutric cambisols	105,0 ha	20,4 %
- Dystric cambisols	179,1 ha	34,8 %
- Fluvisols	156,1 ha	30,3 %
Total	514,9 ha	100,0 %

Dystric cambisols are presented the most at this section with 179,1 ha or 34,8 %, but Calcocambisols with 9,0 ha or 1,7 % take the smallest participation.

- **Whole route**

Participation of individual soil types in the motorway corridor Vc for LOT-2 in zone of 500 m is given here:

- Lithosols	21,7 ha	0,4 %
- Calcomelanosol	67,6 ha	1,4 %
- Rendzinas	40,6 ha	8,3 %
- Rankers	79,1 ha	1,6 %
- Vertisols	111,3 ha	2,3 %
- Calcocambisols	25,7 ha	0,5 %
- Eutric cambisols	1.384,7 ha	28,5 %
- Distric cambisols	1.213,1 ha	24,9 %
- Luvisols	465,4 ha	9,6 %
- Pseudogley	163,5 ha	3,4 %
- Fluvisols	928,6 ha	19,1 %
Total	4.867,1 ha	100,0 %

At complete motorway route, Eutric cambisols are predominant with 1.384,7 ha or 28,5 %, and the last on the list is Litosol with 21,7 ha or 0,4 %.

4.7.2. Categories of Land Usage

Participation of land usage categories is given for the motorway route corridor wide 500 m, for all sections, while participation of individual categories is represented in Table 2, in an Appendix.

- **Section-1 Karuše - Medakovo**

The following categories of land usage are presented at this section:

- Agricultural	115,5 ha	58,3 %
- Forest	47,0 ha	23,7 %
- Urban	20,4 ha	10,3 %
- River courses	2,7 ha	1,4 %
- Other (tunnels)	12,4 ha	6,3 %
Total	198,0 ha	100,0 %

The largest area belongs to agricultural land with 115,5 ha or 58,3 %, and the smallest belongs to River courses with 2,7 ha or 1,4 %.

- **Section-2 Medakovo - Ozimice**

The following categories are presented here at this section:

- Agricultural	555,1 ha	53,2 %
- Forest	271,9 ha	26,0 %
- Urban	84,0 ha	8,1 %
- Water courses	3,2 ha	0,3 %
- Other (tunnels)	130,3 ha	12,5 %
Total	1.044,5 ha	100,0 %

The agricultural land is presented mostly with 555,1 ha or 53,2 %, bu River courses are presented in the smallest amount with 3,2 ha or 0,3 %.

- **Section-3 Ozimice - Poprikuše**

The following categories are presented here at this section:

- Agricultural	149,0 ha	21,6 %
- Forest	133,0 ha	19,2 %
- Urban	33,7 ha	4,9 %
- River course	17,9 ha	2,6 %
- Other (tunnels)	357,8 ha	51,7 %
Total	691,4 ha	100,0 %

Other land is presented mostly at this section (tunnels) with 357,8 ha or 51,7 %, and the smallest quantity belongs to River courses with 17,9 ha or 2,6 %.

- **Section-4 Poprikuše - Nemila**

The following categories are presented here at this section:

- Agricultural	55,2 ha	14,4 %
- Forest	88,6 ha	23,0 %
- Urban	26,3 ha	6,9 %
- River courses	24,9 ha	6,5 %
- Other (tunnels)	189,0 ha	49,2 %
Total	384,0 ha	100,0 %

The biggest part belongs to other land (tunnels) with 189,0 ha or 49,2 %, and the smallest to River courses with 24,9 ha or 6,5 %.

- **Section-5 Nemila - Donja Gračanica**

The following categories are presented here at this section:

- Agricultural	120,6 ha	19,9 %
- Forest	179,5 ha	29,5 %
- Urban	38,4 ha	6,3 %
- River cporses	45,3 ha	7,5 %
- Other (tunnels)	223,4 ha	36,8 %
Total	607,2 ha	100,0 %

Other land (tunnels) are presented the most with 223,4 ha or 36,8 %, and urban land with 38,4 ha or 6,3 % is the smallest.

- **Section-6 Donja Gračanica - Drivuša**

The following categories are presented here at this section:

- Agricultural	191,0 ha	44,9 %
- Forest	57,0 ha	13,6 %
- Urban	74,1 ha	17,4 %
- River course	10,8 ha	2,6 %
- Other (tunnels)	91,6 ha	21,5 %
Total	425,4 ha	100,0 %

Agricultural land is presented the most with covering of 191,0 ha or 44,9 %, but River courses takes the smallest area of 10,8 ha or 2,6 %.

- **Section-7 Drivuša - Kakanj**

The following categories are presented here at this section:

- Agricultural	391,2 ha	53,4 %
- Forest	173,8 ha	23,7 %
- Urban	95,4 ha	13,0 %
- River course	72,5 ha	9,9 %
Total	732,9 ha	100,0 %

Agricultural land is presented mostly at this section with 391,2 ha or 53,4 %, and River courses take the smallest area 72,5 ha or 9,9 %.

- **Section-8a Blažuj - Lepenica**

The following categories are presented here at this section:

- Agricultural	217,5 ha	49,5 %
- Forest	121,8 ha	27,7 %
- Urban	77,1 ha	17,6 %
- Other (tunnels)	22,4 ha	5,2 %
Total	438,8 ha	100,0 %

Agricultural land is presented the most at this section with 217,5 ha or 49,5 %, while the other land takes the smallest (tunnels) area with 22,4 ha or 5,2 %.

- **Section-8b Lepenica - Tarčin**

The following categories are presented here at this section:

- Agricultural	173,5 ha	34,2 %
- Forest	60,6 ha	12,0 %
- Urban	39,1 ha	7,7 %
- River courses	7,7 ha	1,6 %
- Other (tunnels)	225,6 ha	44,5 %
Total	506,5 ha	100,0 %

Other land take the bigger ratio (tunnels) with 225,6 ha or 44,5 %, while River courses take the smallest with 7,7 ha or 1,6 %.

- **Whole route**

Participation of land usage in corridor of the motorway for LOT-2 in zone of 500 m, is:

- Agricultural	1.968,7 ha	39,1 %
- Forest	1.134,1 ha	22,5 %
- Urban	488,5 ha	9,7 %
- River course	185,0 ha	3,7 %
- Other (tunnels)	1.252,5 ha	25,0 %
Total	5.027,7 ha	100,0 %

The agricultural land with 1.968,7 ha or 39,1 % is presented the most at the whole route, while river courses are represented with the smallest quantity of 185,0 ha or 3,7 %.

4.7.3. The Way of Usage of Agricultural Land

Presence of different agricultural land categories is given for corridor of the motorway route in width of 500 m, for all sections, but participation of each category is given in Table no 3. in an Appendix.

- **Section-1 Karuše - Medakovo**

At this section, the following agricultural land categories are presented:

- Cultivated fields	111,5 ha	96,5 %
- Orchards	0,7 ha	0,6 %
- Meadows	3,3 ha	2,9 %
Total	115,5 ha	100,0 %

The area is covered mostly by cultivated fields 111,5 ha or 96,5 %, and the smallest part by meadows 0,7 ha or 0,6 %.

- **Section-2 Medakovo - Ozimice**

The following categories are presented at this section:

- Cultivated fields	519,0 ha	93,5 %
- Orchards	2,2 ha	0,4 %
- Meadows	33,5 ha	6,0 %
- Pastures	0,4 ha	0,1 %
Total	555,1 ha	100,0 %

Cultivated fields covered 519,0 ha or 93,5 %, but the smallest area is covered by pastures 0,4 ha or 0,1 %.

- **Section-3 Ozimice - Poprikuše**

The following categories are presented at this section:

- Cultivated fields	122,7 ha	82,3 %
- Orchards	4,7 ha	3,2 %
- Meadows	17,0 ha	11,4 %
- Pastures	4,6 ha	3,1 %
Total	149,0 ha	100,0 %

Cultivated fields are presented with 122,7 ha or 82,3 %, and the last at the list are pastures with 4,6 ha or 3,1 %.

- **Section-4 Poprikuše - Nemila**

The following categories of agricultural land are presented at this section:

- Cultivated fields	19,8 ha	35,9 %
- Meadows	33,4 ha	60,5 %
- Pastures	2,0 ha	3,6 %
Total	55,2 ha	100,0 %

Meadows cover the biggest area of 33,3 ha or 60,6 %, while pastures cover only 2,0 ha or 3,6 %.

- **Section-5 Nemila - Donja Gračanica**

The following categories of agricultural land are presented at this section :

- Cultivated fields	84,9 ha	70,4 %
- Orchards	6,6 ha	5,5 %
- Meadows	28,3 ha	23,5 %
- Barren land	0,8 ha	0,6 %
Total	120,6 ha	100,0 %

Cultivated land is presented the most with 84,9 ha or 70,4 %, the smallest area is barren land with 0,8 ha or 0,6 %.

- **Section-6 Donja Gračanica - Drivuša**

The following categories of agricultural land are presented at this section:

- Cultivated fields	146,5 ha	76,7 %
- Orchards	23,2 ha	12,1 %
- Meadows	17,5 ha	9,2 %
- Pastures	3,3 ha	1,7 %
- Barren land	0,5 ha	0,3 %
Total	191,0 ha	100,0 %

Cultivated area is the biggest area with 146,5 ha or 76,7 %, and barren land represents the smallest part with 0,5 ha or 0,3 %.

- **Section-7 Drivuša - Kakanj**

The following categories of agricultural land are presented at this section:

- Cultivated fields	297,8 ha	76,1 %
- Orchards	2,8 ha	0,7 %
- Meadows	64,4 ha	16,5 %
- Pastures	22,4 ha	5,7 %
- Barren land	3,8 ha	1,0 %
Total	391,2 ha	100,0 %

Cultivated fields cover the biggest area of 297,8 ha or 76,1 %, and the smallest area of 2,8 ha or 0,7% is covered by orchards.

- **Section-8a Blažuj - Lepenica**

The following categories of agricultural land are presented at this section:

- Cultivated fields	171,5 ha	78,8 %
- Orchards	19,1 ha	8,8 %
- Meadows	18,5 ha	8,5 %
- Barren land	8,4 ha	3,9 %
Total	217,5 ha	100,0 %

Cultivated land cover the biggest area of 171,5 ha or 78,8 %, while barren land cover the smallest area of 8,4 ha or 3,9 %.

- **Section-8b Lepenica - Tarčin**

The following categories of agricultural land are presented at this section:

- Cultivated field	151,3 ha	87,1 %
- Orchards	2,4 ha	1,4 %
- Meadows	16,8 ha	9,7 %
- Pastures	3,1 ha	1,8 %
Total	173,6 ha	100,0 %

Cultivated field cover the biggest ara of 151,3 ha or 87,1 %, while orchards and pastures cover the smallest area of around 3,1 ha or 1,8 %.

- **Whole route**

The following agricultural land categories are presented in zone of 500 m along the Corridor Vc for LOT-2 :

- Cultivated fields	1.625,0 ha	82,6 %
- Orchards	61,7 ha	3,1 %
- Meadows	232,7 ha	11,8 %
- Pastures	35,8 ha	1,8 %
- Barren lands	13,5 ha	0,7 %
Total	1.968,7 ha	100,0 %

At the whole route, cultivated fields cover the biggest part of 1.625,0 ha or 82,6 % of the zone, while barren land covers the smallest area of 13,5 ha or 0,7 %.

4.7.4. Bonity Categories of Agricultural Land

Bonity categories in zone of 500m (indirect impact) along the corridor

Presence of different bonity categories of agricultural land is given for the corridor of the motorway, in width of 500 m for all sections, while participation of each category is given in the Annex.

- **Section-1 Karuše - Medakovo**

The following bonity categories of agricultural land are presented at this section:

- II	52,6 ha	45,5 %
- III	27,1 ha	23,5 %
- IVa	0,6 ha	0,5 %
- IVb	32,1 ha	27,8 %
- V	3.1 ha	2,7 %
Total	115,5 ha	100,0 %

II bonity category is presented mostly with 52,6 ha or 45,5 %, while IVa category with 0,6 ha or 0,5 % takes the smallest area.

- **Section-2 Medakovo - Ozimice**

The following bonity categories of agricultural land are presented at this section:

- II	226,4 ha	40,8 %
- III	142,0 ha	25,6 %
- IVa	13,3 ha	2,4 %
- IVb	114,4 ha	20,6 %
- V	47,8 ha	8,6 %
- VI	9,9 ha	1,8 %
- VII	1,3 ha	0,2 %
Total	555,1 ha	100,0 %

II bonity category is presented mostly with 226,4 ha or 40,8%, while VII category with 1,3 ha or 0,2 % takes the smallest part.

- **Section-3 Ozimice - Poprikuše**

The following bonity categories of agricultural land are presented at this section:

- I	2,1 ha	1,4 %
- II	28,4 ha	19,1 %
- III	35,7 ha	24,0 %
- IVa	12,1 ha	8,1 %
- IVb	57,1 ha	38,4 %
- V	10,4 ha	7,0 %
- VI	0,6 ha	0,4 %
- VII	2,0 ha	1,3 %
- VIII	0,4 ha	0,3 %
Total	148,8 ha	100,0 %

IVb bonity category is mostly presented at this section with 57,1 ha or 38,4%, while VIII category with 0,4 ha or 0,3 % takes the smallest area.

- **Section-4 Poprikuše - Nemila**

The following bonity categories of agricultural land are presented at this section:

- II	16,6 ha	30,1 %
- III	12,6 ha	22,8 %
- IVa	4,7 ha	8,6 %
- IVb	7,4 ha	13,5 %
- V	4,3 ha	7,8 %
- VI	2,0 ha	3,6 %
- VII	7,6 ha	13,8 %
Total	55,2 ha	100,0 %

II bonity category is presented mostly with 16,6 ha or 30,1%, while VI category with 2,0 ha or 3,6 % cover the smallest area.

- **Section-5 Nemila - Donja Gračanica**

The following bonity categories of agricultural land are presented at this section:

- II	14,6 ha	12,1 %
- III	2,0 ha	1,6 %
- IVa	8,4 ha	6,9 %
- IVb	23,9 ha	19,8 %
- V	13,7 ha	11,4 %
- VI	50,3 ha	41,7 %
- VII	7,0 ha	5,8 %
- VIII	0,8 ha	0,7 %
Total	120,7 ha	100,0 %

VI category with 50,3 ha or 41,7% is presented mostly at this section, while VIII category with 0,8 ha or 0,7% takes the smallest part.

- **Section-6 Donja Gračanica - Drivuša**

The following bonity categories of agricultural land are presented at this section:

- II	21,2 ha	12,1 %
- III	30,0 ha	15,7 %
- IVb	6,2 ha	3,2 %
- IVa	79,1 ha	41,4 %
-V	23,2 ha	12,2 %
-VI	25,7 ha	13,5 %
-VII	4,2 ha	2,2 %
- VIII	1,3 ha	0,7 %
Total	191,0 ha	100,0 %

IVb category is presented mostly at this section with 79,1 ha or 41,4 %, while VIII category with 1,3 ha or 0,7 % covers the smallest part.

- **Section-7 Drivuša - Kakanj**

The following bonity categories of agricultural land are presented at this section:

- II	141,5 ha	36,2 %
- III	38,5 ha	9,8 %
- IVa	30,8 ha	7,9 %
- IVb	70,6 ha	18,1 %
- V	57,9 ha	14,8 %
- VI	37,7 ha	9,6 %
- VII	4,4 ha	1,1 %
- VIII	9,8 ha	2,5 %
Total	391,2 ha	100,0 %

II category is presented the most with 141,5 ha or 36,2 %, while VII category with 4,4 ha or 1,1 % takes the smallest part.

- **Section-8a Blažuj - Lepenica**

The following bonity categories of agricultural land are presented at this section:

- II	17,6 ha	8,1 %
- III	108,2 ha	49,8 %
- IVa	3,7 ha	1,7 %
- IVb	78,7 ha	36,2 %
- V	0,9 ha	0,4 %
- VIII	8,4 ha	3,8 %
Total	217,5 ha	100,0 %

III category with 108,2 ha or 49,8 % is presented mostly at this section, while V category with 0,9 ha or 0,4 % takes the smallest part.

- **Section-8b Lepenica - Tarčin**

The following bonity categories of agricultural land are presented at this section:

- II	72,0 ha	41,4 %
- III	86,5 ha	49,9 %
- IVb	11,4 ha	6,7 %
- V	3,7 ha	2,1 %
Total	173,6 ha	100,0 %

III category with 86,5 ha or 49,9 % is presented the most at this section, while V category with 3,7 ha or 2,1 %takes the smallest part.

- **Whole route**

Presence of different bonity categories of agricultural land in corridor Vc for LOT-2 in the zone wide 500 m is as follows:

- I	2,1 ha	0,1 %
- II	590,8 ha	30,0 %
- III	482,7 ha	24,5 %
- IVa	79,8 ha	4,1 %
- IVb	474,7 ha	24,1 %
- V	165,1 ha	8,4 %
- VI	126,2 ha	6,4 %
- VII	26,5 ha	1,3 %
- VIII	20,7 ha	1,1 %
Total	1.968,7 ha	100,0 %

At the whole route, mostly is presented II bonity category with 590,8 ha or 30,0 %, and the smallest part belongs to I bonity category with 2,1 ha or 0,1 %.

Bonity categories in zone wide 50 m (direct impacts)
Presence of bonity categories of agricultural land is given for corridor of the motorway route wide 50 m, for all sections, while participation of some categories is given in Table 5, in Appendix.

- **Section-1 Karuše - Medakovo**

The following bonity categories of agricultural land are presented at this section:

- II	10,6 ha	70,7 %
- III	2,0 ha	13,3 %
- IVa	0,3 ha	2,0 %
- IVb	1,2 ha	8,0 %
- V	0,9 ha	6,0 %
Total	15,0 ha	100,0 %

II bonity category is present the most with 10,6 ha or 70,7 %, while the least presented is IVa bonity category with only 0,3 ha or 2,0 %.

- **Section-2 Medakovo - Ozimice**

The following bonity categories of agricultural land are presented at this section:

- II	40,7 ha	63,7 %
- III	13,8 ha	21,6 %
- IVa	1,8 ha	2,8 %
- IVb	4,4 ha	6,9 %
- V	3,0 ha	4,7 %
- VI	0,2 ha	0,3 %
Total	63,9 ha	100,0 %

II bonity category is presented the most with 40,7 ha or 63,7 %, while the least presented is VI bonity category with 0,2 ha or 0,3 %.

- **Section-3 Ozimice - Poprikuše**

The following bonity categories of agricultural land are presented at this section:

- II	3,2 ha	20,4 %
- III	3,5 ha	22,3 %
- IVa	0,8 ha	5,1 %
- IVb	6,0 ha	38,2 %
- V	1,4 ha	8,9 %
- VII	0,7 ha	4,5 %
- VIII	0,1 ha	0,6 %
Total	15,7 ha	100,0 %

At the third section, the least presented is VIII category with only 0,1 ha or 0,6% of total area, while IVb category is presented the most with 6,0 ha or 38,2%.

- **Section-4 Poprikuše - Nemila**

The following bonity categories of agricultural land are presented at this section:

- II	1,0 ha	19,2 %
- III	0,2 ha	3,8 %
- IVa	0,4 ha	7,7 %
- IVb	1,3 ha	25,0 %
- V	0,7 ha	13,5 %
- VII	1,6 ha	30,8 %
Total	5,2 ha	100,0 %

VII bonity category is presented the most at this section 1,6 or 30,8 %, while III bonity category is presented the least with 0,2 ha or 3,8 %.

- **Section-5 Nemila - Donja Gračanica**

The following bonity categories of agricultural land are presented at this section:

- II	0,1 ha	0,7 %
- III	0,2 ha	1,4 %
- IVa	0,3 ha	2,2 %
- IVb	3,6 ha	26,1 %
- V	1,5 ha	10,9 %
- VI	7,7 ha	55,8 %
- VII	0,4 ha	2,9 %
Total	13,8 ha	100,0 %

VI bonity category is presented the most with 7,7 ha or 55,8 %, while II bonity category with 0,7 ha or 0,7 % is presented the least.

- **Section-6 Donja Gračanica - Drivuša**

The following bonity categories of agricultural land are presented at this section:

- II	3,5 ha	15,3 %
- III	2,6 ha	11,0 %
- IVb	0,5 ha	2,2 %
- IVa	9,2 ha	40,4 %
- V	4,2 ha	18,4 %
- VI	2,3 ha	10,1 %
- VII	0,6 ha	2,7 %
Total	22,8 ha	100,0 %

IVb bonity category is presented the most with 9,2 ha or 40,4 %, while IVa bonity category is presented the least with 0,5 ha or 2,2 %.

- **Section-7 Drivuša - Kakanj**

The following bonity categories of agricultural land are presented at this section:

- II	20,6 ha	48,6 %
- III	5,4 ha	12,7 %
- IVa	1,5 ha	3,5 %
- IVb	2,8 ha	6,6 %
- V	10,2 ha	24,1 %
- VI	1,5 ha	3,6 %
- VIII	0,4 ha	0,9 %
Total	42,4 ha	100,0 %

II bonity category with 20,6 ha or 48,6 % is presented the most at this section, while VIII bonity category is presented the least with 0,4 ha or 0,9 %.

- **Section-8 a Blažuj - Lepenica**

The following bonity categories of agricultural land are presented at this section:

- II	2,1 ha	8,4 %
- III	9,8 ha	39,0 %
- IVa	0,5 ha	2,0 %
- IVb	12,1 ha	48,2 %
- V	0,4 ha	1,6 %
- VIII	0,2 ha	0,8 %
Total	25,1ha	100,0 %

IVb bonity category is presented the most with 12,1 ha or 48,2 %, while VIII category is presented the least with 0,2 ha or 0,8 %.

- **Section-8b Lepenica - Tarčin**

The following bonity categories of agricultural land are presented at this section:

- II	7,2 ha	37,1 %
- III	10,9 ha	56,2 %
- IVb	0,6 ha	3,1 %
- V	0,7 ha	3,6 %
Total	19,4 ha	100,0 %

III bonity category is presented the most at this section with 10,9 ha or 56,2 %, while the least presented is IVb category with 0,6 ha or 3,1 %.

- **Whole route**

Presence of bonity category of agricultural land in corridor Vc for LOT-2 in zone of 50 m, is as follows:

- I	0,1 ha	0,0 %
- II	89,0 ha	39,8 %
- III	48,3 ha	21,6 %
- IVa	6,1 ha	2,8 %
- IVb	41,2 ha	18,4 %
- V	23,0 ha	10,3 %
- VI	11,7 ha	5,2 %
- VII	3,3 ha	1,5 %
- VIII	0,7 ha	0,4 %
Total	223,6 ha	100,0 %

At the whole route of LOT-2, II bonity category is presented the most with 89,0 ha or 39,8 %, while the least presented category is I bonity category with 0,1 ha or 0,04%.

4.7.5. Presence of Different Agro-zones of the Agricultural Land

Presence of different agro-zones of agricultural land is given in corridor of the motorway route wide 500 m for all sections, while participation of each category is given in Table 6, in an Appendix.

- **Section-1 Karuše - Medakovo**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	112,4 ha	97,3 %
- II agro-zone	3,1 ha	2,7 %
Total	115,5 ha	100,0 %

At the section 1, the most presented is the I agro-zone with 112,4 ha or 97,3 %, while the II agro-zone with 3,1 ha or 2,7 % is presented the least.

- **Section-2 Medakovo - Ozimice**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	496,1 ha	89,4 %
- II agro-zone	57,7 ha	10,4 %
- III agro-zone	1,3 ha	0,2 %
Total	555,1 ha	100,0 %

At the section 2, the I agro-zone with 496,1 ha or 89,4 % is presented the most, while III agro-zone with 1,3 ha or 0,2 %is presented the least.

- **Section-3 Ozimice - Poprikuše**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	135,5 ha	91,0 %
- II agro-zone	11,1 ha	7,4 %
- III agro-zone	2,4 ha	1,6 %
Total	149,0 ha	100,0 %

The I agro-zone is presented the most with 135,5 ha or 91,0 %, while the III agro-zone with 2,4 ha or 1,6 % is presented the least.

- **Section-4 Poprikuše - Nemila**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	41,3 ha	75,0 %
- II agro-zone	6,3 ha	11,3 %
- III agro-zone	7,6 ha	13,7 %
Total	55,2 ha	100,0 %

The most presented is I agro-zone with 41,3 ha or 75,0 %, while the least presented is the II agro-zone with 6,3 ha or 11,3 %.

- **Section-5 Nemila - Donja Gračanica**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	48,7 ha	40,4 %
- II agro-zone	64,1 ha	53,1 %
- III agro-zone	7,8 ha	6,5 %
Total	120,7 ha	100,0 %

The most is presented II agro-zone with 64,1 ha or 53,1 %, while the least presented is the III agro-zone with 7,8 ha or 6,5 %.

- **Section-6 Donja Gračanica - Drivuša**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	136,5 ha	71,4 %
- II agro-zone	49,0 ha	25,7 %
- III agro-zone	5,5 ha	2,9 %
Total	191,0 ha	100,0 %

The most is presented the I agrozone with 136,5 ha or 71,4 %, while the least presented is III agrozone with 5,5 ha or 2,9 %.

- **Section-7 Drivuša - Kakanj**

The following agrozones of agricultural land are presented at this section:

- I agrozone	281,4 ha	71,9 %
- II agrozone	95,6 ha	24,4 %
- III agrozone	14,2 ha	3,7 %
Total	391,2 ha	100,0 %

I agro-zone is presented the most with281,4 ha or 71,9 %, while the III agro-zone with 14,2 ha or 3,7 % is presented the least.

- **Section-8a Blažuj - Lepenica**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	208,2 ha	95,7 %
- II agro-zone	0,9 ha	0,5 %
- III agro-zone	8,4 ha	3,8 %
Total	217,5 ha	100,0 %

The most presented is the I agro-zone with 208,2 ha or 95,7 %, while the least presented is the II agro-zone with 0,9 ha ori 0,5 %.

- **Section-8b Lepenica - Tarčin**

The following agro-zones of agricultural land are presented at this section:

- I agro-zone	169,9 ha	97,9 %
- II agro-zone	3,7 ha	2,1 %
Total	173,6 ha	100,0 %

The I agro-zonais presented the most with 169,9 ha or 97,9 %, while the II agro-zone is presentedthe least with 3,7 ha or 2,1 %.

- **Whole route**

Presence of agro-zones of agricultural land in corridor Vc for LOT-2 in the zoneof 500 m, is:

- I agro-zone	1.630,0 ha	82,8 %
- II agro-zone	291,5 ha	14,8 %
- III agro-zone	47,1 ha	2,4 %
Total	1.968,7 ha	100,0 %

At the whole route of LOT-2, the most presented is the I agro-zone with 1.632,5 ha or 82,8 %, while the least presented is the III agro-zone with 47,1 ha or 2,4 %.

4.8. Flora and Fauna

4.8.1. Flora

During the Study preparation, the Consultants of the flora aspect contacted the representatives of the Forestry Enterprises in Municipalities Tešanj, Žepče, Zenica, and of the Public Companies ŠPD of Ze-Do Canton and of the PC „Sarajevo forests“ Ltd.

EUNIS classification of habitat types which repreents a comprehensive paneuropean system that promotes harmonisation of descriptions and data gathering from the whole Europe using criteria for habitat identification has been used for determination of important vegetation units in the investigated area. This classification includes all habitat types from natural to artificial, from terrestrial to freshwater and marine.

Habitat type has been defined for the needs of EUNIS classification of habitat types as «plant and animal communities as characterising element of biotic environment, which together with abiotic factors act on the given scale». All factors which have been included in the definition are elaborated in the descriptive framework of habitat classification. Database includes EUNIS habitats and Anex I habitats from EU Habitat Directive. Anex I of Directive 92/43/EEC represents a list of «types of natural habitats which are important for the Community and which conservatio demands establishment of special zones for conservation».

- **Section 1. Karuše – Medakovo (km 0+000 to 4+000)**

Communities of ecosystems of xerotherm forests of hornbeam and pubescent oak Querco–Ostryetum Carpinifoliae

EUNIS Habitat code G1.7C1

Plant communities of hornbeam and pubescent oak are present on several locations, such as Penavino brto on the right side of the alignment, at the distance of 1 km from the starting point, and Matanovićevo brto on the right side of the alignment at the distance of 1.5 – 2.0 km from the starting point. Fragments of this vegetation type could be found on the both sides of the alignment towards Medakovo (2.0 to 4.0 km from the starting point) on the average distance of 50 – 100 m from the aignmnent. Slope of the terrain is up to 20° on the E and SW aspects. Bedrock type is limestone, and soil types are represented with the complex of organomineral calcyc melanosols and rendzine. This community represents a permanent stage in the development of termophylle vegetation. From an ecological standpoint, this community has continuity with termophylle forests of hedge maple (*Acer obtusatum*) and hornbeam.

Typical species in this community are: Ostrya carpinifolia, Sorbus aria, Amelanchier ovalis, Arabis hirsuta, Mercurialis ovata, Carex humilis, Aristolochia palida, and Clematis recta. From species from the alliance and the order which have the highest value are present Fraxinus ornus, Evonymus verrucosus, Rhamnus catharcticus, Cotinus coggygria, Anemone hepatica, Polygonatum odoratum, Arabis turrita, Cornus mas, Potentilla micrantha, Festuca heterophylla, Hedera helix, Silene nutans, Helleborus otorus, and others.

Communities of shrubs Crataego-Prunetum and Evonymo-Thelicranietum sanguineae are developed as degradation stage of mezophylle and thermophylle forests in this zone.

Communities of the ecosystems of white willow Salicion albae

EUNIS Habitat code 91A0

Hygrophylle forests have been developed in the riparian zone of the river Tešanjka along all part of the alignment. As a result of the human activitities, it mainly forms a narrow more-less discontinous belt. It is possible to differentiate several plant associations of this community within the belt. The most important species is white willow (Salix alba).

Plant community Saponario - Salicetum purpureae auct. has been developed in the parts of this zone located in vicinity of highly nitrifiedjhabitats.

The most frequent species in the hygrophylle communities are: Salix alba, Salix fragilis, Salix purpurea, Alnus glutinosa, Solanum dulcamara, Populus nigra, Ulmus laevis, Rubus fruticosus and Rubus caesius, Viburnum opulus, Lycopus europaeus, Lysimachia nummularia, Mentha longifolia and Mentha rotundifolia, Petasites hybridus, Brachypodium silvaticum, Prunella vulgaris, and some others.

Hygrophylle communities of shrubs (Humuletum lupuli and Humulo-Rubetum fruticosae) are frequent besides forests and shrubs with willows.

- **Section 2. Medakovo - Ozimica (km 4+000 to 24+901,587)**

Community of ecosystems of xertotherm forests of hornbeam and pubescent oak Querco–Ostryetum carpinifoliae

EUNIS Habitat code G1.7C1

Plant communities of crnog graba and pubescent oak are present on the several locations in this part of the alignment: Salkovića brijeg on the left side of the alignment at the distance of cca. 250 m from the alignment and some 800 m from the starting point, and in the region of Križanovo brto on the right side at the distance of cca. 100 m from the alignment and some 1.0 to 1.5 km from the starting point. Slope of the terrain is between 10° and 30°, on the E and SW aspects. This vegetation types is developed in the zone of the hill Strahovac (400 m) on the left side of the alignment and the hill Brezik(288 m) just on the right side of the alignment, and at the distance of 5.0 to 5.5 km from the starting point. Also, it is well developed in the broader area of Jablanica, Kardaglije, and Točila where it covers significant area.

Bedrock type is limestone, and soils are complex of organomineral calyc melanosols and rendzine. This community represents a permanent stage in the development of the

thermophylle vegetation. From an ecological standpoint, this community has continuity with thermophylle forests of klena (Acer obtusatum) and hornbeam.
Typical speciea are: Ostrya carpinifolia, Sorbus aria, Amelanchier ovalis, Arabis hirsuta, Mercurialis ovata, Carex humilis, Aristolochia palida, and Clematis recta. The most important species from the alliance ant he order are: Fraxinus ornus, Evonymus verrucosus, Rhamnus catharcticus, Cotinus coggygria, Anemone hepatica, Polygonatum otoratum, Arabis turrita, Cornus mas, Potentilla micrantha, Festuca heterophylla, Hedera helix, Silene nutans, Helleborus odorus, and others.

Communities of shrubs Crataego-Prunetum and Evonymo-Thelicranietum sanguineae are developed as a degradation stage of mezophylle and thermophylle forests in this zone.

Communities of the forests of white willow Salicion albae

EUNIS Habitat code 91A0

Hygrophylle forests have beend developed in the riparian zone of Trebačka river at the distance of 2 km from the starting point in the form of narrow and dicontinous belt, as well as in the riparian zone of Strupinska river between villages Čakrame and Ljubatovići. Very small fragments of this vegetation are developed by the river Ozimica and Sarajlića brook at the end of this part of the alignment

The most frequent species in the hygrophylle communities are: Salix alba, Salix fragilis, Salix purpurea, Alnus glutinosa, Solanum dulcamara, Populus nigra, Ulmus laevis, Rubus fruticosus and Rubus caesius, Viburnum opulus, Lycopus europaeus, Lysimachia nummularia, Mentha longifolia and Mentha rotundifolia, Petasites hybridus, Brachypodium silvaticum, Prunella vulgaris, and some others.

Hygrophylle communities of shrubs (Humuletum lupuli and Humulo-Rubetum fruticosae) are frequent besides forests and shrubs with willows.

Bazphylle pine forests on the serpentines (Pinetum silvestris-nigrae serpentinicum)

Pine forests from the order Erico-Pinetalia and the alliance Orno-Ericion are developed in the zone of Šiljati vrh just on the left side of the alignment and at the distance of 10.0 to 12.0 km from the beginning of this part of the alignment. Soil which generates after deterioration of serpentine rocks is prone to the significant leaching of alkaline compounds, and in this way parallel with this process there are changes in vegetation cover. In this forests tominant role in the layer of low vegetation play erica (Erica) and variou grasses, mainly from the order Sesleria. In the communities of pine forests with erica (Pinetum silvestris-nigra typicum) tominant role play erica. Since Erica carnea could not find its optimum on the extreme arid habitats, this typical subassociation of pine forests is developed on the N or E aspects, as well as on the slopes above brooks. On the smaller slopes, these forests are developed on the S and W aspects. Humous layer is well developed, at least 20 cm, and even more. It has compact structure and in certain was it serves to vegetation as a source of humidity.

Typical species from this subassociation are Galium lucidum, Genista januensis, Daphne blagayana, and Vicia villosa. Daphne blagayana prefers more humid habitats. Species Galium lucidum and Vicia villosa grow also in some other subassocations of pine forests, as well as in the xerophylle oak stands. Aquilegia vulgaris is a very rare species on the serpentines in Bosnia, and it is more frequent in mesophylle beech forests.
The most frequent species in this community are Cytisus heuffelii var. maezius and Lathyrus pratensis var. densifolius. These taxa have the same height as erica, and they with its dense

growth and narrow leaves are more visible. Besides, here are alos present species Potentilla malyana and Galium vernum, as well as Peucedanum oreoselinum, Brachypodium pinnatum, Epimedium alpinum, Scabiosa leucophylla, Spirea ulmifolia, Rosa pendulina, Potentilla alba, Chrysanthemum corymbosusm, and some others. Beginning of acidification of thick humous layer could be noted with appereance of acitophylle elements, such as Vaccinium myrtillus, Sieglingia decumbens, and Danthonia calicina.

Subassociation Pinetum silvestris-nigrae seslerietosum latifoliae is developed on warm, sceletone and steep slopes. This community makes transition towards vegetation of rock stands, since through regression of pine stands which have rare canopy, begins creation of optimal conditions for grass Sesleria latifolia var. serpentinica, and some other species. Since this communities grows on a very sceletone soil, in its stands grow significant number of serpentine species, such as Sesleria latifolia. Thereore, here also grow Halacsya sendtneri, serpentine ferns Asplenium cuneifolium, Notholaena marantae, and some other species typical for rocks, such as: Festuca sulcata, Stachys chrysophaea, Calamintha alpina ssp. hungarica, Euphorbia montenegrina, Genista januensis, Galium purpureum, Silene longiflora, Seseli rigida, Carex humilis, Bromus pannonicus, Centaurea micranthos, and others.

Another stage of the Austrian pine forests growt on the warmest, a very steep slopes on the S or W aspects. Here tominant role play various grass species, such as Festuca sulcata. Bedrock type is shallow, moderate sceletone, and humous layer formed after decomposition of organic residues is only few cm deep. It is dry and sandy. Layer of lower shrubs is very scarse, and besides grass Festuca sulcata here are sporadically developed species Festuca vallesiaca, F. amethistyna, Bromus pannonicus, Calamagrostis varia, as well as Euphorbia montenegrina, Dorycnium germanicum, Alyssum murale, and others.

- **Section 3. Ozimica – Poprikuše (km 24+901,587 to 38+617,434)**

From the standpoint of natural values protection, the highest importance on this part of the alignment has serpentine zone Mt. Borja which in the north borders with river Mala Usora, that is with its alluvial deposits, and in the south with Velika Usora. In the east from the Usora serpentine complex goes as a narrow belt to Maglaj where it becomes broader, and in the vicinity of the setllement Mostarići it goes to the river Bosna. On the left bank of the river, serpentine build hills Kobiljača (490 m) i Moševački Šiljak (417 m), in which foothills exists locus classicus of the species Halacsya sendtneri. On the right bank, serpentine goes further towards Brusnica and Rakovac brook in the east. The highest peaks here are hills Čerkez (600 m) and Čolopek (550 m).

Serpentine complex near Žepče is linked with Mt. Borja. It begins on the east from the Blatnica brook and it goes to the river Bosna, where it ends in the zone between Žepče andd Želeće (Map 3 and 5). Serpentine complex is particularlly well developed in the zone of Papratnica, just by the alignment and on its left side btween 7.0 and 8.0 km of the alignment. Serpentine complex near Žepče is priotected by the decision of responsible municipal authorities of Žepče municipality.

On serpentines, as well as on the other bedrock types that belong to the extreme habitats, features of the flora could be seen only on the barren geological foundation, on the rocks or on the rough, deteriorated, sceletoneous detritus where features of bedrock type could have a direct impact on the flora. Through the process of development of vegetation and accumulation of humus, which goes simultaneously, link with bedrock is lost, and life conditions become more suitable. Mezophylle species slowly progress and gradually they draw back pioneer vegetation. In this way generate serpentinophyta, serpentinomorphoses, as well as all other features of vegetation.

Relic serpentinophyta include species which are also even on the other habitats strictly linked with serpentine, and therefore their distribution which follows serpentine habitats has mosaic shape. These taxa are spatially isolated from thei relatives, and therefore they belong to the old Tertiary plants, that is to paleoendemics which grow only on serpentines as refugial habitats. They are linked with barren bedrock. Here belongs Halacsya sendtneri (Boiss.) Dörfl. This species grows on serpentines in Bosnia, Serbia and Albania. It was described in 1847 near Maglaj, and later on it was discovered in the region of Gostović (K. Maly 1920), as well as in the valley of Župeljeva. The species Potentilla visianii Panč. Is isolated and without any closer relatives, and therefore it belongs to paleoendemics. It is limited to the serpentine areas in Bosnia, Serbia, and Albania.

Species growing on serpentine bedrock that are not spatially isolated from relative taxa are linked with these paleoendemics.

Typical (exclusive) serpentinophyta are: Scrophularia tristis K. Maly which from an ecological standpoint has specific demands. It grows as a pinoeer species on serpentines in Bosnia. The species Sesleria latifolia (Adam.) Degen. var. serpentinica Deyl. has been linked with barren serpentine bedrock. Sometimes it grows in pine forests with sparse canopy.

Due to the very pronounced microclimate conditions the largest area of vegetation on serpentine cover xerophylle vegetation forms. Xerophylle features has vegetation of rocks, screes, and same features have forests of Scots and Austrian pine and English oak.

Serpentines are prone to erosion and degradation. This process is particularlly pronounced on the sites where clear cutting took place. For these reasons on these locations are frequent a large areas of sceletone soil, that is barren rocks and rocky meatows. On these sites grow plant species which are most important for serpentine flora.

Xerophylle forest build basophylle communities of Scots pine and English oak. Mesophylle forests on serpentines in Bosnia build communities from the order of Illyrian beech forests, where the most frequent communites are forests of kitnjaka i običnog graba, beech forests on the hills, and forests of beech and fir. Considering beech forests, the largest distribution have forests of beech and fir, while other forest types have limited distribution. They are mainly developed around brooks. Due to the significant acidification of bedrock type in beech forests on serpentines exist a large number of acitophylle species. After regression of tree layer, these vegetation forms slowly transforms into heaths.

The highest influence on the distribution of the vegetation on serpentines have aspect and morphology of terrain. Naturally on this dark rocks, which during summer season heats up to 50 or 60 °C, aspect has key impact on the composition of vegetation, as well as on the development of the soil, differences in humidity and other factors linked with this phenomenon. The same importance has distribution of vegetation and slope of the terrain, as well a feature of serpentine that is prone to the fast washing out of alkalines. Gentle slopes are heating slower than steep ones, and they are also less prone to the erosion. This enables development of soil which offers better living conditions to the plants regarding humidity than sceletone bedrock.

Bosnian serpentine zone is located in climatogenous belt of beech forets. However, due to the specific conditions of bedrock type, natural development of vegetation is going slowly, and therefore diversity in plant cover has been caused by diversity in vegetation types linked with variations in climate and edaphic factors. Therefore, there is no pronounced distribution in vegetation on serpentines. Mesophylle forms of vegetation which should come on the hiher altitudes are located by the brooks, on the bottom of the valleys, and regarding altitude, on the steep slopes, they have been replaced by the xerophylle plant groups.

The most typical development of serpentine vegetation could be noted on disected terrain , where xerophylle communities are distributed on the steep slopes, up to the peaks made of sharp ridges. On the complexes with gentle relief, where zone around the peaks are developed on the larger areas, forest stands are developed. They are present in the western part of the complex near Žepče. The forests are made of fir and beech, while spruce comes only on the higher altitudes. However, here are quickly change composition of vegetation depending on the relief.

Xerophylle oak forests on the serpentines Forests of sessile oak with erica Erico-quercetum petraea (K. et L.) Ht.

In the similar way that pine forest developed on the sites with higher amount of humidity in the air than on the extreme arid habitats, forest of sessile oak with erica are limited to the similar habitats. On this part of the alignment, this vegetation comes in the zone of Suvi križ and Vučijak at 8.0 km from the beginning of this part of the alignment on the right side, as well as on the Pavlovo brto on the left side of the alignment at the distance of several hundred meters from the alignment.

There are no any significant differences in floristic composition within pine and oak forests in the layer of erica. The species typical for xerophylle forests on the serpentines, and which are particularlly present in the forests of oak with erica are: Epimedium alpinum, Potentilla alba, Galium vernum, Betonica officinalis, Poa pratensis. Species which are acitophylle elements are Vaccinium myrtillus, Calluna vulgaris, Potentilla erecta, and others, which could be found in the layer of erica under the Austrian pine.

HEATHS

On the certain serpentine complexes heaths cover a large areas, such is the case with the complex near Žepče, and particularlly in the zone Varošišta and peak Kamenitovac (288 m) on the left side of the alignment. These heaths belong to the community Genisto-callunetum Horv. The typical species are Agrostis vulgaris, which sporadically covers barren stands among facies of erica, then Sieglingia decumbens, Veronica officinalis, Achillea millefolium, Lotus corniculatus, Rubus candicans, Aira capillaris, Carex pallescens, Polygala vulgaris, Trifolium campestre, and sporadically Betula pendula, as well as Genista ovata.

VEGETATION OF ROCKS AND ROCKY MEATOWS

Plant cover on the rocks and rocky meatows considering floristic composition is similar, which is natural, since these habitats have similar living conditions. Besides, serpentines easily degrade and decompose into larger rocks and smaller detritus, and therefore larger rocks are not present at all. Rocks, and particularlly on the steeper slopes, are prone to the erosion, and they are formed as the result of the erosion after destruction of forests. This vegetation is developed on the similar sites as vegetation of screes in the vicinity of Žepče, and they are in the direct contact with this vegetation type.

VEGETATION OF ROCKS

Vegetation on the rocks is very similar to the flora of low plants in the Austrian pine forests. Vegetation units where develops Halacsya sendtneri as a tominant element are developed on the rocks. Species which build vegetation on the rocks and rocky meatows belong partially to the communities from the alliances Bromion erecti, Festucion vallesiacae, as well as to the suballiance Orno-Ericion serpentinicum. Characteristical and differential species in this alliance are species typical for serpentine habitats, such as Euphorbia montenegrina, Anchusa barrelieri, Allysum murale, etc. Numerous other species which are abundant on serpentines also belong to this category. They are, among others, Silene longiflora, Centaurea stoebe ssp. micranthos, Thlaspi avalanum, Satureja hungarica, Thymus jankae var. subacicularis, etc. In this part of the alignment, on the steep slopes in the zone of Kamenitovac on the right side of the alignment, and in the zone of Kik (551 m) on the left side of the alignment at 8.0 to 9.0 km from the beginning of this part of the alignment is particularlly well developed this vegetation type.

Here tominant role play species from the class Festuco-Brometea, as well as the species from the alliance Orno-Ericion serpentinicum. It is important that within the class Festuco-Brometea the largest number of species from the vegetation of rocks belong to the alliance Festucion vallesiacae, while on the rocky meatows tominant role play species from the alliance Bromion erecti, where the most abundant species belong to the suballiance Mesobromion. On the rocks where Halacsya sendtneri toes not grow ratio between species from the alliances Bromion erecti and Festuca vallesiaca is equal, while in the stands of that species tominant role play representatives of the alliance Festucion vallesiacae.

Representatives from this alliance are more resistant to drought: they are exposed to higher temperature fluctuations, much more than communities from the alliance Bromion erecti.

The communities of ecosystems of forests of white willow Salicion albae

EUNIS Habitat code 91A0

Hygrophylle forests are developed in this part of the alignment in the form of discontinous belt in the riparian zone of the river Bosna and its tributaries from Brezovo polje to Golubinje. It mainly forms a narrow belt which is more-less intersected due to the very pronounced human impact.

The community Saponario - Salicetum purpureae auct. is developed in the parts of this area which are located in the vicinity of very nitrified stands.

The most frequent species in the hygrophylle communities are: Salix alba, Salix fragilis, Salix purpurea, Alnus glutinosa, Solanum dulcamara, Populus nigra, Ulmus laevis, Rubus fruticosus and Rubus caesius, Viburnum opulus, Lycopus europaeus, Lysimachia nummularia, Mentha longifolia and Mentha rotundifolia, Petasites hybridus, Brachypodium silvaticum, Prunella vulgaris, and some others.
Hygrophylle shrub communites (Humuletum lupuli and Humulo-Rubetum fruticosae) are frequent by the forests and shrubs with willows.

The communities of hygrophylle forests and shrubs of sticky elder

EUNIS Habitat code 91E08*

Plant communities of hygrophylle forests and shrubs of sticky elder cover relatively small areas in the investigated zone, forming mainly narrow discontinuous belt by the waterways. In the investigated area these communities are present by the river Bosna and its tributaries in the zone between Brezovo polje and Golubinje.

These communities are present on the flat terrains on the alluvial deposits of various ages. Soils are fluvisols. The communities of this forests and shrubs have high ecological importance from conservation standpoint, and they also play an important role in the flood control in this area.

The most important species in the communities of sticky elder are: Filipendula ulmaria, Cirsium oleraceum, Lysimachia nummularia, Equisetum palustre and E. maximum, Carex gracilis and

Carex brizoides, Lamium maculatum, Urtica dioica, Lythrum salicaria, Galium palustre, Brachypodium silvaticum, Prunella vulgaris, Veronica serpyllifolia, and some others.

Section 4. Section Poprikuše – Nemila (km 38+617,434 to 46+289,378)

The community of ecosystems of oak – hornbeam forests Querco- Carpinetum betuli

EUNIS Habitat code G1.A1A

Typical stands of this community in this area are located in the zone between 1.0 and 3.0 km from the beginning of this part of the alignment, at Budakovac, Ravno brdo and Golubinjska forest. This community has a very broad distribution and it is present in the broader area of Topčić polje, Gusta jabuka, Hrašće, Nemilsko brdo, Kragunjka, to Nemila (from 3.0 km to 8.0 km of this part of the alignment) where it is linked with the communities of hornbeam and oak Carpino betuli – Quercetum roboris, and it represents the most productive forests in this area. Vertical organisation of ecosystems is visible through presence of the storey of high and middle high trees, storey of shrubs and the storey of herbaceous plants.

The most important plant species in this community are Quercus petraea, Carpinus betulus, Prunus avium, Acer campestre, Acer tataricum, Pyrus pyraster, Ulmus campestre, Evonymus europaea, Ligustrum vulgare, as well as Anemone nemorosa, Pulmonaria officinalis, Melica nutans, Polygonatum multiflorum, Asarum europaeum, Carex sylvatica, Stellaria holostea, Crocus vernus, Epimedium alpinum, Erythronium dens-canis, and some others such as Carex pilosa, Potentilla micrantha, Festuca heterophylla, Viola sylvestris, Crocus vernus, Aremonia agrimonioides, Symphytum tuberosum, Luzula pilosa and Euphorbia amygdaloides.

The communities of ecosystems of white willow Salicion albae

EUNIS Habitat code 91A0

Hygrophylle forests are developed in the riparian zone of the river Bosna, and particularly in the zone between Topčića polje and Hrašće at Ada (5.8 km from the beginning of this part of the alignment). It mainly forms a narrow belt which is less discontinuous due to the strong human impact. It is possible to differentiate several plant associations of this community: one of them is the community where dominant role play white willow (Salix Alba). Besides this community, here are also developed communities of fragile and white willow Salicetum albae – fragilis.

The community Saponario - Salicetum purpureae auct. is developed in the parts of this area located in the vicinity of highly nitrified habitats.

The most frequent species in hygrophylle communities with willows are: Salix alba, Salix fragilis, Salix purpurea, Alnus glutinosa, Solanum dulcamara, Populus nigra, Ulmus laevis, Rubus fruticosus and Rubus caesius, Viburnum opulus, Lycopus europaeus, Lysimachia nummularia, Mentha longifolia and Mentha rotundifolia, Petasites hybridus, Brachypodium silvaticum, Prunella vulgaris, and some others.

The communities of ecosystems of hygrophylle forests and shrubs of sticky elder

EUNIS Habitat code 91E08*

Plant communites of hygrophylle forests and shrubs of sticky elder cover a relativelly small areas, forming mainly narrow, discontinous belt by the river Bosna from Topčića polje to Hrašće (3.5 km to 5.5 km of this part of the alignment).

These communities are developed on the flat terrains on the alluvial deposits of various age. The soils are fluvisols.

All communities of these forests and shrubs have high ecological importance from conservation standpoint in this area, and they also play an important role in the primary flood control.

The most important species in the communities of sticky elder are: Filipendula ulmaria, Cirsium oleraceum, Lysimachia nummularia, Equisetum palustre and E. maximum, Carex gracilis and Carex brizoides, Lamium maculatum, Urtica dioica, Lythrum salicaria, Galium palustre, Brachypodium silvaticum, Prunella vulgaris, Veronica serpyllifolia, and some others.

- **Section 5. Nemila – Donja Gračanica (km 46+289,378 to 58+434,599)**

The community of ecosystems of oak – hornbeam forests Querco- Carpinetum betuli
EUNIS habitat code G1.A1A

These ecosystema are alos developed along all alignment, on the both sides, while along the river Bosna valley are developed typical hygrophylle communities typical for previous sections. By the waterways, in this zone, on the alluvial soils are successivelly developed ecosystems of hygrophylle forests and shrubs of willows and poplars, which have been already described for previous sections, such as:

- ecosystem of forests of white willow vrbe Salicetum albae
- ecosystem of white and fragile willow Salicetum albae-fragilis
- ecosystem of forests of willows and poplars Salici – Populetum
- ecosystem of white and black poplar Populetum nigro-albae
- ecosystem of forests of bademaste vrbe Salicetum triandrae i
- shrubs with rakitom Salicetum purpureae

Forests of sticky elder cover, as a rule, the most humid habitats within this biome and they frequently follow waterways, going deeply into land. They are differentiated into several communities, such as:

- forests of Frangulo alni- Alnetum glutinosae
- forests of Alnetum glutinosae montanum
- forests of Carici elongatae-Alnetum glutinosae

The belt of mezophylle forests which are the most frequently developed on the gentle slopes and more developed soils in comparison with previous vegetation has been continued to the belt of hygrophylle vegetation. This vegetation belong to the order of broadleaved forests from the order Fagetalia Bleč. et Lkšić 70 (montane beech forests) wit the association Fagetum moesiacae montanum Bleč. et Lkšić 70 and alliance Carpinion betuli Oberd. 53 with associations Carpinetum betuli-orientalis Lkšić et al. 75 (meso-thermophylle forests of hornbeam and bjelograbića) and Querco-Carpinetum betuli Ht et al. 74. This vegetation is developed in this area in the zone of the hill Vepar, and from D. Vraca to D. Gračanica on the left side of the alignment.

- **Section 6. Donja Gračanica – Drivuša (km 58+434,599 to 66+959,592)**

The community of ecosystmes of xerotherm forests of hornbeam and pubescent oak Querco–Ostryetum carpinifoliae

EUNIS Habitat code G1.7C1

Plant communities of hornbeam and pubescent oak are present from settlement D. Gračanica, through Ričica, Kopila, Klopča, to Perin han, at terrain slopes from 10° to 30°, in the SW and NE aspects. Bedrock type is limestone, and soils are complex of organic mineral calcyc melanosols and rendzines. This community represents a permanent stage in the development of thermophylle vegetation. From an eological standpoint, this community makes a continuity with thermomphylle forests of hedge maple Acer obtusatum and hornbeam.

Typical species in this community are: Ostrya carpinifolia, Sorbus aria, Amelanchier ovalis, Arabis hirsuta, Mercurialis ovata, Carex humilis, Aristolochia palida, Clematis recta. The most important species from the alliance and the order areFraxinus ornus, Evonymus verrucosus, Rhamnus catharcticus, Cotinus coggygria, Anemone hepatica, Polygonatum odoratum, Arabis turrita, Cornus mas, Potentilla micrantha, Festuca heterophylla, Hedera helix, Silene nutans, Helleborus odorus, and others
The communities of shrubs Crataego-Prunetum and Evonymo-Thelicranietum sanguineae are developed as degradation stage of mesophylle and thermophylle forests in this zone at the largest part of the section on the both sides of the alignment.

The communities of ecosystems of forests of white willow Salicion albae

EUNIS Habitat code 91A0

Hygrophylle forests are developed in the riparian zone of the river Bosna and its tributaries. It mainly forms a narrow belt which is more-less interrsected due to the strong human impact. It is posible to differentiate several plant associations o this community: one of them is the community where tominant role play white willow (Salix alba). Besides this community, here are also developed communities of fragile and white willow Salicetum albae – fragilis.

The community Saponario - Salicetum purpureae auct. has been developed in the parts of this area located in the vicinity of the highly nitrified habitats.

The most frequent species in hygrophylle communities with willows are: Salix alba, Salix fragilis, Salix purpurea, Alnus glutinosa, Solanum dulcamara, Populus nigra, Ulmus laevis, Rubus fruticosus and Rubus caesius, Viburnum opulus, Lycopus europaeus, Lysimachia nummularia, Mentha longifolia and Mentha rotundifolia, Petasites hybridus, Brachypodium silvaticum, Prunella vulgaris, and some others.

Hygrophylle communities of shrubs (Humuletum lupuli and Humulo-Rubetum fruticosae) are frequently developed by the forests and shrubs with willows (Figure 5,6,7).

As it has been already described for the previous section, here is also by the river Bosna and its right tributaries Tobra voda, the river Babina, the river Đulahova developed hygrophylle vegetation of the communities of the forests of white willow Salicion albae (Habitat code 91A0) and the community of ecosystes of hygrophylle forests and shrubs of sticka elder (Habitat code 91E08*).

- **Section 7. Drivuša – Kakanj (km 66+959,59 to 82+595,000)**

The community of ecosystems of oak – hornbeam forests Querco- Carpinetum betuli

EUNIS Habitat code G1.A1A

These communities are here linked with the communities of hornbeam and oak Carpino betuli – Quercetum roboris, and they represent the most productive forests in this area. Vertical organisation could be seen through the presence of the storey of high and middle height trees, storey of shrubs and the storey of herbaceous plants.

In this area these communities are present on the slopes on the both sides of the alignment through morphostructure of Vijenac (Okruglo 749 m) to the south from the settlement Tonji Lučani.

The community of ecosystems of xerotherm forests of hornbeam and pubescent oak Querco–Ostryetum carpinifoliae

EUNIS Habitat code G1.7C1

Plant communities of hornbeam and pubescent oak are presnt on the several sites in the broader area of Gornji and Tonji Lučani. Slopes of the terrain is from 10° and 15°, on E and SW aspects. Bedrock types is limestone, while soils are represented by the complex of organic mineral calcyc melanosols and rendzines. This community represents a permanent stage in the developments of thermophylle vegetation. From an ecological standpoint, this community makes a continuity with thermophylle forests of klena (Acer obtusatum) and hornbeam.

Typical species in this community are: Ostrya carpinifolia, Sorbus aria, Amelanchier ovalis, Arabis hirsuta, Mercurialis ovata, Carex humilis, Aristolochia palida, Clematis recta. The most important species from the alliance and the order areFraxinus ornus, Evonymus verrucosus, Rhamnus catharcticus, Cotinus coggygria, Anemone hepatica, Polygonatum odoratum, Arabis turrita, Cornus mas, Potentilla micrantha, Festuca heterophylla, Hedera helix, Silene nutans, Helleborus odorus, and others.

The communities of the ecosystems of thermophylle forests of hedge maple and hornbeam Aceri obtusati-Ostryetum carpinifoliae

EUNIS Habitat code G1.7C3

The communities of mapple and hornbeam are developed on the terraces on the southern aspect on the right side of the river Bosna from D. Lučani to Kakanj. This endemic and refugial community is developed thanks to specific orographical and microclimate conditions, and therefore it represents long-term oroclimate stage. In the process of the further syngenesis, this community will slowly progradate in the certain variants of the community Querco-Ostryetum.
The most frequent species in this community are: Ostrya carpinifolia, Sorbus aria, Fraxinus ornus, Evonymus verrucosus, Cotoneaster nebrodensis, from the storey of low trees and shrubs, and Sesleria angustifolia, Melica ciliata, Sedum ocholeucum, Helleborus odorus, and some others.

Communities of ecosystems of hygrophylle forests of oak and hornbeam Carpino betuli-Quercetum roboris

EUNIS Habitat code 91F0

Communities of oak and hornbeam forests are developed at alluvial soils in two segments: from Drivuša to settlement Klanci, and from G. Lučani to Kakanj, in the form of ffarments at flat terrains by the river Bosna and its trbutaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica.

Key species in these ecosystems are: Quercus robur, Fraxinus angustifolia, Alnus glutinosa, Populus alba, Populus nigra, Salix alba, Salix fragilis, Prunus padus, Viburnum opulus, Genista elata, Humulus lupulus, Rubus caesius, Solanum dulcamara, Myosotis palustris, Lysimachia nummularia, Stachys palustris, Carex elongata and Carex brizoides, Arum maculatum, Polygonatum latifolium, Melampyrum silvaticum, Asarum europaeum, Sanicula europaea, and many others.

Communities of ecosystmes of white willow Salicion albae

EUNIS Habitat code 91A0

Hygrophylle forests are developed in the riparian zone of the river Bosna and its tributaries, in the same wa as it is previous community. It mainly forms a narrow belt which is more less interrsected due to the various human impacts. It is possible to distinguish several plant associations of this ommunity: one of them is the community where dominant role plays white willow (Salix alba). Besides this community, here are also developed communities of fragile and white willow Salicetum albae – fragilis.

The community Saponario - Salicetum purpureae auct. is developed in the parts of this area located in the vicinity of highly nitrified habitats in the zone of settlements Drivuša, Putovići, Bilješevo, and D. Kakanj.

The most frequent species in hygrophylle communities with willows are: Salix alba, Salix fragilis, Salix purpurea, Alnus glutinosa, Solanum dulcamara, Populus nigra, Ulmus laevis, Rubus fruticosus and Rubus caesius, Viburnum opulus, Lycopus europaeus, Lysimachia nummularia, Mentha longifolia and Mentha rotundifolia, Petasites hybridus, Brachypodium silvaticum, Prunella vulgaris, and some others.

Hygrophylle communities of shrubs (Humuletum lupuli and Humulo-Rubetum fruticosae) are frequently developed by the forests and shrubs with willows.

Community of ecosystems with bracken Pteridietum aquilini

EUNIS Habitat code E 5.3
This community is developed on the limestone bedrock type, and on the brown limestone soils and colluviums with deep profile. It grows on the flat terrains and gentle slopes, various aspects, mainly in the gentle VRTAČE, depressions and similar habitats in the zone of oak forests. In the investigated aera it is found in the forest cuttings developed on the slopes on the both side of the alignment, in the broader area of the settlement Klanac, and in the zone of the brook Smiljevac, and Donji and Gornji Tičići.

In this community a dominant role plays bracken (Pteridium aquilinum). Typical species are: Leontoton autumnalis, Potentilla erecta, Euphorbia cyparissias, Geum urbanum, Aremonia agrimonioides, Veronica chamaedrys, Helleborus odorus, Fragaria vesca, etc. In the analysed stands with high level of frequency come numerous species from the open stands, such as Agrostis capillaris, Hieracium pilosella, Filipendula vulgaris, Cruciata glabra, Plantago media, Plantago lanceolata, Leontoton hispidus, and others.

Communities of ecosystems of hygrophylle forests and shrubs of sticky elder Alnetum glutinosae

EUNIS Habitat code 91E08*

Plant communities of hygrophylle forests and shrubs of sticky elder cover relativelly small areas in the investigated zone, forming mainly narrow discontinous belt by the waterways. In the investigated area these communites are present by the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji potok, Desetnički potok, and Ribnica from Drivuša to setllement Klanci, and from G. Lučani to Kaknja.

These communities are present on the flat terrains on the alluvial deposits of various age. Soils are fluvisols. Depending on the hydrothermic regime. Groundwater level and floristic composition, it is possible to differentiate two groups which could be clearly distniguished by their physiognomical features. The first group includes hygrophylle forests and shrubs of sticky elder and ŠAŠIKA, sometimes at peat bogs, and other one hygrophylle forests of sticky elder on the hydrogenous black soil, the communities Alnetum glutinosae montanum

All communities of this forests and shrubs have high ecological importance from conservation standpoint, and they also play an important role in the flood control in this area.

The most important species in the communities of sticky elder are: Filipendula ulmaria, Cirsium oleraceum, Lysimachia nummularia, Equisetum palustre and E. maximum, Carex gracilis and Carex brizoides, Lamium maculatum, Urtica dioica, Lythrum salicaria, Galium palustre, Brachypodium silvaticum, Prunella vulgaris, Veronica serpyllifolia, and some others.

Communities of ecosystems of mesophylle meadows

EUNIS Habitat code 6510

Intensity of human impact in the past in this area was very strong, and for these reasons numerous forest ecosystems are today transformed into meadows, that is into secondary type ecosystems.

Meadow ecosystems are developed in the zone of forest ecosystems, and therefore they are by their hydrothermic regime similar to them. Pronounced dynamics of basic ecological factors causes a high level of their biodiversity.

Meadow communities are developed on semigley, illimerised and brown soils in the hilly belt and in the flooded belt mainly on the left side of this part of the alignment in the forms of fragments. Mezophylle meadows in this area belong to the alliance Arrhenatherion elatioris which includes meadows in the valeys, developed on the neutral, deep soils. They are differentiated into two types of communities: Arrhenatheretum elatioris and Festucetum pratensis.

Communities of ecosystems of hygrophylle meadows

EUNIS Habitat code 6410, 2330

Vegetation of hygrophylle eadows, in this are covers larger areas, mainly by the waterways, and sporadicaly o the sites with high groundwater level. In this area, hygrophylle meadows are located mainly by the forest ecosystems with white willow and sticky elder by the waterways.

From and ecological and phytocoenological standpoints, they are differentiated into two alliances: Molinion coeruleae and Calthion. Although the cover smaller areas they are very important in the evaluation of total biodiversity level in this area.

Vegetation of hygrophylle meadows is developed on gley and wetland soils, gentle slopes, on habitats which have high level of groundwater throughout the vegetation season.

The most hygrophylle are communities off beskoljenke Succiso-Molinietum coeruleae which are ecologically directlylinked with the vegetation of ponds and wetlands from the alliance Phragmition australis. This is a very important plant community and which contributes to the high coenological diversity. This community is distinguished by its colors particularlly during summer season when blossom the largest numer of species from families of grasses, daisies, and roses. Beside building species Molinia coerulea, very important role play: Sanguisorba officinalis, Galium verum, Potentilla erecta, Filipendula ulmaria, Carex elata, Stachys officinalis, Vicia cracca, Phleum pratense, Stellaria graminea, Trifolium pratense, T. pannonicum, T. Montanum, Holcus lanatus, Filipendula vulgaris, Deschampsia caespitosa, Ranunculus acer, Lotus corniculatus, and some others. Large number of species from this community are rare or ecologically very specific taxa.

In the hygrophylle types of medow vegetation also belong fragments of the community Rorippo-Agrostetum albae, which is developed on the alluvial soils, behind of hygrophylle forests by the river Bosna and its tributaries.

The communities from the alliance Caltion are developed on peat soils which are under permanent impact of groundwater in the vicinity of waterways, where processes of decompositions are slower due to the high humidity and relativelly low temperature. The community Epilobio - Juncetum effusi has been also found in the investigated area.

Ecosystems of tertiary vegetation

Communities of ecosystems of urban and rural areas

In the process of transformation of ecosystems and naturak resources through various human activities, during a very long period of human civilisation in this area, numerous so called tertiary ecosystems have been developed after transformation of forests and meadows as organised vegetation types.
Besides sigbificant change of their structure, these ecosystems belong o the group of high productive ecosystems. Depending on the nature of the human factor and hydrothermic conditions on their habitats, this vegetation is diferentiated into several types:

- Communities of ecosystemy on nitrified habitats from the class Artemisietea,
- Communities on arid nitrified habitats from the class Chenopodietea,
- Antropogenous communities on the humid nitrified habitats from the class Agrostietea,
- Communities of Plantaginetea majoris.

This vegetation is developed by the settlemenzs in this part of the alignment.

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

Communities of ecosystems of oak – hornbeam forests Querco- Carpinetum betuli

EUNIS Habitat code G1.A1A

Oak – hornbeam forests represent climatogenous forests in the hilly belt of the central part of Bosnia and Herzegovina. Typical stands in the investigated area are located in the zone of waterways Trnava, Vitovac, Rakovica, Kremikovac, Krmeljevac, and Mlinčići, and the rivers Bijela and Kalašnica. In the zone of the alignment these communities are linked with the communities of hornbem and oak Carpino betuli – Quercetum roboris, and they represent the most productive forests in this area. Their vertical structure is expressed through the presence of the storey of high and middle height tress, storey of shruby and the storey of herbaceous plants.

In the investigated are these communities are developed on the slopes on the both sides of the alignment.

The most important plant species in this community are Quercus petraeaCarpinus betulus, Prunus avium, Acer campestre, Acer tataricum, Pyrus pyraster, Ulmus campestre, Evonymus europaea, Ligustrum vulgare, as well as Anemone nemorosa, Pulmonaria officinalis, Melica nutans, Polygonatum multiflorum, Asarum europaeum, Carex sylvatica, Stellaria holostea, Crocus vernus, Epimedium alpinum, Erythronium dens-canis, and some other species, such as Carex pilosa, Potentilla micrantha, Festuca heterophylla, Viola sylvestris, Crocus vernus, Aremonia agrimonioides, Symphytum tuberosum, Luzula pilosa and Euphorbia amygdaloides.

Communities of willows and poplars from the order Populetalia albae Br.-Bl. 31

Hygrophylle forest communities of willows from the order of white poplar Populetalia albae, are developed on the alluvial deposits, on wetland soils in the valley of the river Lepenica in the zone Kuliješi – Bukovica – Zabrđe – Toplica. On the basis of the floristic composition these stands belong to the association Salicetum albae fragilis Tx., which is in general developed by the rivers and brooks in the region of the Dinaric Alps and even broader. Fragments of this community are developed by the narrow riparian zone. The most important species are white willow (Salix alba) and fragile willow (Salix fragilis), and here also come Ulmus laevis, Populus nigra, Acer campestris, Evonymus europae, Rubus caesisus, Crataegus monogyna, Ligustrum vulgare, Hedera helix, Clematis vitalba, Humulus lupulus, Thelycrania sanguinea, Frangula alnus, Viburnum opulus), etc. Storey of herbaceous plants make Glechoma hederacea, Scrophularia notosa, Geranium robertianum, Brachypodium sylvaticum, Lysimachia nummularia, Lycopus europaeus, Stachys palustris, Roripa sylvestris, Angelica sylvestris, Potentilal reptans, etc.

Stands of flooded forests of willow and poplar Salici-Populetum are made of the species which find their optimum of distribution in the montane and submontane belt of broadleaved forests. In relation to the humidity tis community build speciess adapted to the high level of floods and groundwaters. Considering nitrogen in the soil, these stands have high indicator values, which emphasize the fact that this community has made of the plant species growing on tha habitats which are from time to time rich in nutrients. Plant species which build this community belong to the species of shadows and semi shadows and which are halofobic, considering salinity.

The communities of white willow (Salicetum albae) are developed by the narrow riparian zone in sthe SE and flat aspects by the river Lepenica and its tributaries Zečji potok and Bukovin storey a. Bedrock is made of alluvial deposits and soil is fluvisol. Dominant species in the tre storey are white poplar (Populus alba), white willow (Salix alba), and Ulmus effusa, Robinia pseudaccacia and others. In the shrub storey dominant role play Rosa canina, Sambucus nigra and fragile willow (Salix fragilis). In the storey of herbaceous plants, which is rich in species, the most frequent are Aegopodium podagraria, Cirsium arvense, Calyistegia sepium, Galium molugo and Petasites hybridus. This community is made of plant species which find optimum of their distribution in submontane belt of broadleaved forests. These species are more less indiferentand they are adapted to the humid soils. They are plants of shadows and semi shadows, and in the realtion to the continentality they belong to the subocean species with main part of their distribution in the central Europe. Values of index of this community for salinity show that it is build of halophobic species.

Communities of ecosystems of hygrophylle forests and shrubs of sticky elder

EUNIS Habitat code 91E08*

Plant communities of hygrophylle forests and shrubs with sticky elder cover relativelly small areas, forming mainly narrow, often intersseced belt by the river Lepenica.

These communities are developed on the flat terrains on the alluvial deposits of various age. The soils are fluvisols. Depening on the hydrothermic regime, the level of groundwater and floristic composition, they are differentiated into two groups clearly distinguished by their physiognomical features. The first group includes hygrophylle forests and shubs of sticky elder and ŠAŠIKA on wet, somtime peat soils, and the other one, hygrophylle forests of sticky elder on peat black soils, the communities of Alnetum glutinosae montanum.

Vegetation of wet deposits from the order Bidentalia, that is from the allianceMenthion pulegii Lkšić 73. with association Menthetum pulegii Lkšić 73., is developed in the zone of hygrophylle forests, while on the moderate wet and nitrified stands develops vegetatation from orders Onopordetalia Br.-Bl. et Tx. 43 and Chenopodietalia Br.-Bl.this vegetation is developed in the vicinity of settlements, such as Rakovica, Kuliješ, Bojakovići, Bukovica, Zabrđe, Toplica, and Tarčin.

4.8.2. Fauna

Data on composition of animal species on the analysed area of the motorway Vc alignment (Lot-2) was collected on the basis of conversations and consultations with the local inhabitants, while for additional data on the state of hunting game population, the hunting clubs from existing municipalities were consulted. In the data about fauna composition there is also data about hunting game, which as such presents the main and most distinctive part of fauna from the scientific as well as from expert point of view.
During preparation of the Study, those who elaborated the aspects of fauna and hunting, contacted the hunting representatives in the Public Company FES (Forest Economic Society) of the Zenica-Doboj Canton, and hunting clubs: “Borje” Teslić, “Jeleč” Žepče, “Klek“ Zavidovići, “Zmajevac” Zenica, “ Zec and Stari Zec” Busovača, “Srndać” Kakanj, “Srndać” Visoko, “Bjelašnica” Sarajevo Canton (Blažuj-Tarčin) Hadžići, “Ljestarka” Kiseljak.
During elaboration of data about fauna for each section of the LOT 2, data from Earth Museum from Sarajevo was used, and Hunting Clubs and local inhabitants were consulted. For the analysis of important species, the IUCN's Red List was applied, and recommendations of the Council Directive 92/43EEC.

Main features of composition of the fauna in the investigated part of the alignment are determined in the first place by the level of development and degradation o plant cover. Globally, all this area is distinguished by pronounced human impacts which is reflected in the construction of settlements which have a direct impact on withdrawal of the faun ain the wild parts of ecosystems. Analysis of the composition of ecorded animal species was carried out on the basis of the field investigations carried out in August and September in 2005. Within the analysis, particular attention was paid to the species protected by some of the legal measures in Bosnia and Herzegovina, and their importance within Biodiversity Convention (Rio de Janeiro, 1992), IUCN Red List, and global species protection (IUCN, 2000), EU Council Directive 79/409EEC of 2 April 1979 on conservation of wild birds, Council Directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora has been emphasized.
The results of the field investigations and analysis of existing literature data during last 50 years have shown that in this area exist 26 bird species, and some of them are protected by the Annex I and Annex II of Council Directive 79/409EEC, such as: *Picus canus, Columba palumbus, Larus ridibundus, Venellus venellus, Dnedocops major, Scolopax rusticola, Chilodonais niger, and Bubo bubo.*

The overview of fauna or the most distinctive part of fauna at sections of the corridor Vc motorway – LOT 2:

- **Section 1. Karuše – Medakovo (km 0+000 to 4+000)**

In this section of the alignment live less abundant continental animal taxa with small faunistic importance. In the composition of the fauna of insects certain endemic species (dragon flies) have been recorded. These species in larval stage are linked to the aquatic ecosystems of the river Usora (at the part km 0+000 – 0+207.684), and as imago for banks of the river. In the riparian zone live rare bird species. In the wetland parts there are rare specimens of amphibians (frogs).

- **Section 2. Medakovo - Ozimica (km 4+000 to 24+901,587)**

<u>Mammals</u>

Investigated part is distinguished by the dense settlements and adequate natural features. In the composition of the mammalian fauna here are recorded sporadically hare, fox, squirell, and wild boar. The habitats of these species are partially located in the wider impact zone of the highway.

<u>Birds</u>

Birds are typicall for this area, and in the composition of more important species are pheasant and quail. In the broader area of Trešnja (Crni vrh) from the owl family recorded are fly overs of Tyto alba, Cuculus cnorus, Asio otus, Jynx torquilla.

- **Section 3. Ozimica – Poprikuše (km 24+901,587 to 38+617,434)**

<u>Mammals</u>

From the beginning of the section from both sides of the alignment to the km 34+000,00 there is partially developed mammalian fauna with typical representatives for previous sections, but to certain extent with more dense populations.

<u>Birds</u>

In the surroundings of Žepče live the following species: Picus canus, Coracias garrulus, Apus apus, and Columba aenas.

- **Section 4. Poprikuše– Nemila (km 38+617,434 to 46+289,378)**

<u>Mammals</u>

In the composition of the land fauna mamals are represented with rare specimens of squirells and hares in the areas of partially preserved woods.

<u>Birds</u>

Beside standard species, here is also recorded the presence of pigeon Columba palumbus in the region of Nemila at Mt. Jezeračka..

- **Section 5. Nemila – Donja Gračanica (km 46+289,378 to 58+434,599)**

In this section the alignment passes by the existin highway and animal speciesare present only sporadically, and they are represented with species typical for this area. In the are of Vranduk from km 50+000 – 51+000 the following bird species have been registered: Cuculus canorus, Otus scopus, and Larus ridibundus.

- **Section 6. Donja Gračanica – Drivuša (km 58+434,599 to 66+959,592)**

The area of this section passes in its initial part through the settlements, and in the area of Drivuša it is directly linked to the river Bosna. In this part, in the area of the city of Zenica (km 60+000 – 64,000) the following bird species have been recorded: Pluvialis apricaria, Corcius garrulus, Larus ridibundus, and Otus scopus.

- **Section 7. Drivuša – Kakanj (km 66+959,59 to 82+595,000)**

The area of this section mainly follows exiting highway. On the both sides of the road the large areas are covered by the tertiary ecosystems (arable land) and therefore there are no recorded land animals that could be endangered by the construction of the new highway.
For the region of the town of Kakanj (km 75+000 – 80+000) by the river Bosna live different bird species: Asio atus, Columba aenas, Chardarius dubius, Venellus vanellus, Picus canus, Dendrocops major, and Jynx torquilla. Almost all of them are migratory birds and this part of the alignment is just the area for their fly over, and not for their permanent stay.

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

In the composition of the fauna, particular attention has been paid to the overview of possible impacts on the aquatic fauna in the river Lepenica. The river is distinguihed by the hgh biodiversity level of aquatic taxa, both aquatic insects and sporadical presence of river cancer.
Fly overs of the birds: Bubo bubo, Merops apiaster, and Chliodonais niger are recorded in the area of the town Blažuj.
This bird species are typical for wetland habitats. Species Scolopax rusticola is recorded by the right side of the river Lepenica.

Tabela 4.8.2.1. Tabular overview of the most distinctive part of fauna at sections of the corridor Vc motorway – LOT 2.

SECTION 1. KARUŠE-MEDAKOVO	Site	Penavino hill from the right side of the alignment, 1.5-2 km from the starting point
	Fauna	Rare bird species, squirrels, rabbits
	Site	Usora River 0,207.684 km
	Fauna	Endemic species of water moth (*Trichoptera)*

SECTION 2. MEDAKOVO-OZIIMICE	Site	Part of alignment with the plant communities Salkovića hill, Križanovo hill, Šiljati vrh (Sharp Peak), Tešanj – Crni vrh (Black Peak)
	Fauna	Birds: wryneck, quail, pheasant, squirrels, rabbits, foxes and wild boars
	Site	River: Trebačka, 2km from the beginning of the section, Strupinska River between the Cakrame village and Ljubatovići
	Fauna	Birds, insects that are water dependant during the larva period

SECTION 3. OZIMICE-POPRIKUŠE	Site	24+901,587 to 34+000
	Fauna	• Birds: roller, swift, pigeon, quail, pheasant; • mammals: squirrels, rabbits, foxes and wild boars with dense populations
	Site	Žepče surroundings
	Fauna	Birds

SECTION 4. POPRIKUŠE-NEMILA	Site	38+617,44 to 39+618
	Fauna	Rare specimens of birds, squirrels, rabbits, foxes
	Site	Jezeračka mountain -Nemila
	Fauna	Birds: type of pigeon *Columbia palumbas* which is protected specie according to the IUCN´s Red List and Bird Directive
	Site	Bosna river
	Fauna	Important place within the aquatic fauna belongs to the densely populated colony of cyprinid type of fish, while in the other part of aquatic fauna, the dipterous insects are dominant, sparsely bristled animals, and leech as typical inhabitants of polluted running water

SECTION 5. NEMILA-DONJA GRAČANICA	Site	Vranduk km 50+000 - 51+000
	Fauna	Birds: gull, pigeon, *Otus scopus* i *Cuculus canorus*. The type of gull registered in this area is one of the protected species according to the European Directive – Annex II – III, rare specimens of small game.

SECTION 6. DONJA GRAČANICA-DRIVUŠA	Site	Bosna river bank zone
	Fauna	Rare specimens of birds, ducks Water fauna: well developed cyprind fish fauna, aquatic species of insects, rare specimens of crayfish, leech, snails
	Site	Zenica km 60+000 to 64+000
	Fauna	Birds: gull, *Pluvialis apricaria, Corcius garrulus i Otus scopus*

SECTION 7. DRIVUŠA-KAKANJ	Site	Kakanj from 75+000 to 80+000 – Bosna river bank
	Fauna	Migratory bird types: gull, pigeon, magpie, wryneck, swift
	Site	Vijenac (Okrugla) – Donji Lučani – oak and hornbeam forest
	Fauna	Squirrels, rabbits, quails, pheasants, rare specimens of reptiles
	Site	Bosna river with smaller tributaries
	Fauna	Cyprinid fish types, barbel, sparsely bristled animals, leeches, dipterous insects

SECTION 8. BLAŽUJ-TARČIN	Site	Lepenica
	Fauna	Water fauna: Trout, Miller's thumb, water moth, large diversity of water flowers, wheateater, crayfish
	Site	River Bijela – crossroads Tarčin-Kreševo
	Fauna	Appearance of crayfish, which is according to the IUCN´s Red List the rare and endangered species
	Site	Blažuj
	Fauna	Birds flying over this area: eagle-owl, bee-eater

4.9. Landscape

The motorway route project should not harm the landscape through which it passes. It should be harmonised with the surrounding natural features, such as the existing autochthonous forest colonies of plants, groups or individual trees or bushes. The best organic relation between motorway and landscape is the one which corresponds to the character of its basic natural components – the relief of surroundings, the lines of river banks, surfaces of water and forests' edges.

The motorway route in the corridor Vc through Bosnia and Herzegovina lies in the basin of the Bosna River, which goes along the right side of the basin from Doboj (south) to Žepče at which point it passes to the left side of the valley. As far as morphology is concerned, the wider area of the route relates to two morphological types of relief: from 30 to 100 and from 100 to 300 m. The first relief type includes the area next to the alluvial flood plain in the bottom of the River Bosna valley. The slopes with more prominent morphological entities belong to the higher relief type (100 – 300 m), on which the largest part of the route is situated. This is reflected in a large number of tunnels and viaducts on the edges of the morphological entities, especially in the section Doboj (south) – Kakanj, which is approx. 150 km long. Two traffic intersections have been anticipated in the route area, for the purpose of connecting the motorway route with the surrounding towns.

There are four main landscape categories of wider surrounds:

- Natural landscape
- Cultivated landscape
- Built landscape
- Cultural-historical landscape

4.9.1. Description of landscape arrangement and repairs of individual landscape categories

By forming a sound protection belt on both sides of the motorway, protection of settlements and agricultural lands (from noise, dust, air pollutants and other harmful effects from the motorway) is achieved. In this case, the protective belts represent new landscape elements, so it is necessary, during the choice of bushes and trees types, to take care of habitat appearance, leaf, flower and fruits forms. This will enable better adaptation to the existing ambient appearance.

It is very important that these are large and vital plants, and that they have good regeneration and rooting abilities.

AGRICULTURAL LAND

Agricultural land is protected from the undesirable effects which are manifested by the motorway vicinity. Because of this, wind protection belts are formed to protect these lands from wind, harmful pollutants, deposits and pollution. Physical balance and balance of appearance are achieved by forming greenery. This balance was disrupted by violent terrain interventions, and it will serve to create visual effects which will outline the road direction and directly influence the perception of the driver. It will also decrease the effect of headlight dazzling.

The negative influence of the motorway traffic is felt in a radius of 50 – 100 m from both sides. Because of this, trees that have a larger capability of air filtering should be grown.

The density of the wind protection belt depends on wind activity. The protection belt should be placed as directly as possible towards the direction of the wind. It should be formed on the side of the motorway where the wind usually blows. To enable a gradual change of the wind intensity at the exit from the forest area, it is necessary to plant trees and bushes, whose height and density will drop in the direction of the unprotected section, until it reaches a forest or a protection notch.

FORESTS

Forests have, as high vegetation, significant importance and value to the landscape, and are necessary to preserve, as the most important part of the landscape.

To preserve the original image of the landscape, it is not recommended to reclaim forests, except in the case where it is necessary because it threatens the visual overview of traffic.

While doing this, it is necessary to take care of:

- Whether or not it is deciduous or pinewood forest; if it is a pinewood forest, it is not necessary to remove the stump, because new trees will grow from them, while in the deciduous forest, the stump must be removed.
- Whether or not it is flat or slanted terrain; tree removal on flat terrain is easy, but it is very difficult on slanted terrain because the removal of tree stumps could cause a disruption of the terrain, so the stumps are left in the ground, but they are cropped. The cropping can last from 3 -5 years, to give a certain look to the tree tops.
- The forest edge should be formed by creating a compact texture to protect the forest form the harmful effects of the motorway (damage, tree uprooting and destruction). These measures represent a type of ecological repair and biological compensation for the lost or destroyed forests.
- Forestation, to stabilize the terrain, if there is some damage to the forests during the motorway construction.

NATURAL WATER SURFACES

These measures are applied to stabilize the watercourse by engineering – biotechnical works. Also they are applied to model the landscape and adapt to the existing natural ambient.
This is achieved by planting plants which can root quickly, and they stabilize the terrain around the water surfaces. By planting the long-term plants in the immediate vicinity of the water surfaces, great esthetic effects in the area can be made.

ENTRANCES AND EXITS FROM THE TUNNELS

Landscape modeling of the entrances and exits from the tunnels is very particular. These entrances and exits have to be designed in a way to protect them from erosions which influence terrain degradation, and also to protect the road from possible landslides. The choice of bushes and trees should be consistent with the existing landscape ambient.

It is necessary to use engineering – biotechnical precautions for reparation. On slants and at the entrances and exits from the tunnels, the usual forestation method is recommended, for terrain stabilization.

It would be preferable to use autochthonous species which have a high capability to cover slanted areas, during the arrangement of the tunnel entrances and exits. There are also long-term plants and climbing plants, which can give a certain visual atmosphere to the area. All selected biological elements will be integrated in the environment, in compliance with the existing landscape ambient.

LOOP

The arrangement of the space surrounding the loop does not include bioengineering precautions, but it is based on landscape modeling. The planning and organizing of this valuable and attractive space represents planning of the "identity concept", or the greenery category identifying.

The loop space organization determination is composed of the total valuation of the natural characteristics space, and all other parameters, as well as the existing conditions. The plant material should be chosen regarding the beautification of the loop space appearance in the summer, autumn and winter periods. These plants should have high decorative values.

Defining the vegetation elements on the road loops, from the aspects of their basic parameters, ecological potentials and landscape forming elements for the arrangements of individual green areas (such as: park-forest, or forest-park). This is the key goal of the space purpose concept.

The manor of arrangement of this space must be based on total respect for the natural conditions and the vegetation, which needs to be protected and integrated into the landscape forming concept, with newly projected species of trees, bushes, flowers and etc.

At the places where there are settlements near the loop, protection belts have been formed to protect the settlements from noise and pollution.

PUO – ANCILLARY SERVICE OBJECT

The goal of the concept design is arrangement of individual contents, which are belonging to the motorway route. Each of these contents has a different purpose and function, and it is necessary to resolve them.
The special approach, considering the landscape forming and arrangement is necessary for the platform category, which is within the motorway, on the locations of Tugovo and Strupina.

The platforms are viewed as locations designed for the needs of vehicles and passengers and are located between the road tracks and the surrounding landscape. Driving and access for all types of vehicles is not allowed on the platforms. If the platforms do not provide enough elements of rest for passengers, the road will seem repellent and becomes tiresome and difficult.

The choice of trees and bushes and other plants is planed to create a space for passive rest for adults, and active rest for children.
There should be about 70% of vegetation and 30% of paved roads and all other non vegetation content on the platforms.

Autochthonous species of plants are used for the landscape forming of the platforms, because of their easier placement and smaller costs of maintenance. Autochthonous species faster enter the faze of physiological ripeness, and display the valued attributes of their species (habitat, form of leaf, fruit and flower, the time of blooming, color, etc.)
The landscape stile which is determined by groups of trees and bushes, large grass spaces and water surfaces is most appealing for the platform landscape forming. It is necessary to plant long-term plants, while forming the platform landscape, which are used widely than season flowers, because they are longer lasting plants and do not require a lot of material means for their maintenance.

Slants, which are a part of PUO, should be resolved by applying engineering – biotechnical measures.
Platforms are protected from harmful effects of the motorway by forming protection belts (protection from noise, pollution, wind dust, snow-drifts, etc.)

The following contents are within the platform composition:

Resting spaces
Resting spaces are meant for resting and passive recreation for passengers and drivers, and for active rest for children. The resting space, as well as the entire platform, is formed by plants which fit into the existing ambient, making a unique landscape appearance. At the resting place, there are: benches, tables, trash cans, water faucets, telephone, occasional rain protection platforms, etc. There is a lookout on a hill, from which, a view of the surrounding landscape is enabled. This view is usually not visible from the parking place.

Parking places
There should be some high trees, for protection from intensive sunlight during the summer and for protection from harmful motorway effects, and also for richer appearance of the greenery component.

Children playground
It is preferable to install a space for an active recreation for children, with appropriate requisites for playing. This space should be located as further away from the road as possible, but close to the place where adults rest. Plants with high decorative values should be used here, to increase interest in playing.

Space for "auto - picnic"
Many drivers and travelers like to rest near their vehicles. For this purpose, large grass areas with groups of trees, bushes and other plants, with some space to place benches and tables. The choice of plants can make this area look appealing for rest in every season, including the winter season (these plants should be pinewood species).

Green splitting island
Island – square separates the resting place from the motorway and it should be observed from the aspect of protection, and solved by a combination of trees and bushes, which should create a thick green wall. This will be made for protection from the harmful effects of the motorway and for securing of the visual intimacy of the platform.

CP – TOLL-PAY PASSAGE
The concept design of the CP landscape arrangement prescribes the choice of trees, bushes and other plants, to integrate objects which are within the CP into the environment, road and landscape.

By placing many different objects into the landscape forming, visual effects are created, which inform the driver that it is necessary to reduce the driving speed.

The choice of plants has been set to create a nice appearance of this area during every season. This is achieved by planting plants which have an interesting form of leaf, fruit and flower, various color specters and the possibility of a nice look during winter (pinewood species).

Long lasting plants are included in the landscape forming of CP. They have the ability to bloom in different time periods, and while they are a part of a larger composition, they provide continued blooming, which can make extraordinary visual effects, which can only have a positive effect on drivers and travelers.

There are tree lines around the CP, and on the characteristic places, there are some protection belts, placed to protect the nearby settlements from the negative effects of the motorway (pollutants, noise, wind, dust, etc.).

COKP – CENTER FOR TRAFFIC MAINTENANCE AND CONTROL
The contents on the route have different purposes and functions, so it is necessary to resolve them. COKP is placed within the motorway route and it is resolved by landscape forming, which will satisfy ecological and visual criteria. Moss can be placed on the surfaces that are within the COKP, to maintain the terrain meuble, to provide equal terrain moisture, to moderate the presence of extreme temperatures, to provide nutrient elements, etc.

It is necessary to locate a protection belt around the objects for protection from the harmful motorway effects (pollutants, dust, noise, snow-drifts, etc.)
High trees, bushes, long lasting trees and other plants are used for the landscape forming. During the choice of plants, autochthonous plants have a priority, because they will grow and develop easily and they will fit into the existing landscape ambient.

4.9.2. Cultivated Landscape

The cultivated landscape category includes areas that have been preserved from significant interventions and have recognisable rural identity. They are urban entities with a lower degree of urbanisation (villages, small towns) which fit into the existing surroundings and create a harmonious picture. The dominant content of cultivated landscape is agricultural land. Within the motorway route area, agricultural land can be mainly found in the valleys of the following rivers: Bosna, Lašva, Lepenica, Tešanjka etc. In some parts the rural landscape has been changed by cutting the land in smaller pieces, or through illegal building without appropriate infrastructure which has resulted in the loss of its original values.

The look of rural landscape is often damaged by frequent building of facilities which are not adapted to the natural features of the space or they are located in valuable and protected areas.

4.9.3. Built Landscape

This type of landscape is characterised by urban structure of newly built settlements. This refers to the towns along the motorway route, industrial facilities or the extension of the existing residential or industrial facilities. Such actions cause devastation of the existing landscape and in some cases it is not possible to establish the type of landscape.

Consequences of such unplanned and unprofessional actions are unnatural urban entities, i.e. the settlements are concentrated along the motorway route in the valleys of the rivers Bosna and Lašva, with a tendency to merge.
This tendency of merging settlements along the route results in the loss of original identity of the existing landscape and harms the look of the settlements.

Water

Water is one of the most important components of landscape and plays a significant role in forming of the landscape. Specific flora it its immediate vicinity is rich in varieties of plants, a large number of different shapes and colours, which provide special aesthetic and visual quality to this area. The usage of aesthetic qualities of water and natural features of its surroundings can contribute to the establishment of an attractive environment for passive and active recreation. Varieties of plants in the valleys of the rivers Bosna and Lašva and their aesthetic features provide special quality to the area along the motorway route.

Settlements

The arrangement of settlements near the motorway route is mainly dispersed. Most of the settlements are rural and they fit into the existing landscape. This type of settlement can be found in urban areas like Zenica, Tešanj, Maglaj and Žepča, mainly on the outskirts.

4.9.4. Cultural and Historical Landscape

Cultural-historical landscape has been created over a longer period of time and it is a part of construction entities with monumental value. The motorway area in corridor Vc section LOT2, is full of cultural-historical values, which differ in their function and purpose. Actually, they belong to the group of special-purpose facilities and thus they need to be protected, by selecting appropriate measures for protection and preservation of the landscape. Landscape protective measures (reconstruction, revitalisation, restoration, conversion, re-composition etc.) should be selected in a way which will not harm the basic character of the cultural-historical entities.

In the area affected by the motorway in corridor Vc section LOT2, there are a large number of buildings which are a part of the cultural and historical heritage, e.g.:

- Buildings in the urban part of Tešanj town (mosques, clock tower, old town) have significant aesthetic, scientific and environmental value,
- Most valuable urban entity of national significance (old town, mosque) - Maglaj,
- Urban-rural entity of national significance Vranduk and Varošište ,
- Historical town entity - Zenica etc.

4.10. Protected Parts of Nature

Section 2. Medakovo - Ozimica (chainage km 4+000 to 24+901,587)
Section 3. Ozimica – Poprikuše (chainage km 24+901,587 to 38+617,434)
From the standpoint of natural values protection, the highest importance on this part of the alignment has serpentine zone Mt. Borja which in the north borders with river Mala Usora, that is with its alluvial deposits, and in the south with Velika Usora. In the east from the Usora serpentine complex goes as a narrow belt to Maglaj where it becomes broader, and in the vicinity of the setllement Mostarići it goes to the river Bosna. On the left bank of the river, serpentine build hills Kobiljača (490 m) iand Moševački Šiljak (417 m), in which foothills exists locus classicus of the species Halacsya sendtneri. On the right bank, serpentine goes further towards Brusnica and Rakovac brook in the east. The highest peaks here are hills Čerkez (600 m) and Čolopek (550 m).

Serpentine complex near Žepče is linked with Mt. Borja. It begins on the east from the Blatnica brook and it goes to the river Bosna, where it ends in the zone between Žepče and Želeće (Picture 4.10.1.; Map 3 and 5). Serpentine complex is particularlly well developed in the zone of Papratnica, just by the alignment and on its left side btween 7.0 and 8.0 km of the alignment. Serpentine complex near Žepče is priotected by the decision of responsible municipal authorities of Žepče municipality.

Illustration 4.10.1. Endemic species Halacsya sendtneri

4.11. Cultural-Historical Heritage

The following properties are protected legally in area of municipalities through which the motorway corridor Vc, LOT2 passes:

A. Decisions of the Commission for protection of national monuments on proclamation of national monuments in B&H the19th session (March 2005) inclusive:

- Architectural entirety– Old town Tešanj inTešanj, FB&H
- Architectural entirety - Monastery Vozuća in Vozuća, Municipality of Zavidovići, FB&H
- Mobile property – Board of high judge Gradeša, property of Museum of town Zenica, FB&H
- Architectural entirety – Old town Vranduk in Vranduku, Municipality Zenica, FB&H,
- Mobile property - Collection of 22 incunabulas, property of St. Franjo Monastery in Kraljeva Sutjeska, Municipality Kakanj, FB&H
- Archeological area – The Ruler Palace in Kraljeva Sutjeska, Municipality Kakanj, FB&H
- Architectural entirety – The mosque in Kraljeva Sutjeska, Municipality Kakanj, FB&H
- Architectural entirety- St Franjo Monastery and Church of St.Ivan Krstitelj in Kraljeva Sutjeska, Municipality Kakanj, FB&H
- Historical area – Remains of Pre-Romanic Church and medieval cemetery Crkvina near the Vrutci village, Municipality of Ilidža, FB&H
- Archeological area – Romans excavations at Ilidža, near Sarajevo, FB&H
- Archeological area – Pre-history settlement in Butmir, Municipality Ilidža, FB&H
- Natural-architectural entirety – Bridge in Plandište ("Roman" bridge; bridge over the Bosna river in Plandište), Municipality Ilidža, FB&H

B. Temporary list of national monuments of Bosnia and Herzegovina[26]

289. Kakanj – Bosnian house of Ivo Dusper[27]
290. Kakanj - Kraljeva Sutjeska – St Franjo Monastery
291. Kakanj - Kraljeva Sutjeska – Royal Palace, complex
363. Maglaj – Tap near Kuršumlija mosque
364. Maglaj - Fazli-pašina mosque
365. Maglaj - Kalaun Jusuf-pašina (Kuršumlija) mosque
366. Maglaj – Old town
367. Maglaj - Tabhana tap
368. Maglaj – Uzeirbegović's house
528. Sarajevo - Bridge Plandište
566. Sarajevo - Ilidža - Rimske substructions
567. Sarajevo - Ilidža - Gornji Kotorac - Gradac (Ilinjača)[28]
568. Sarajevo - Ilidža, Vrutci – Archeological locality
617. Tešanj - Mosque Ferhadija (Čaršijska)
618. Tešanj – Eminagića's house
619. Tešanj - Ferhad-begov sarchopagus
620. Tešanj - Sahat-tower
621. Tešanj – Old town Tešanj
770. Zavidovici - Monastery Vozuća
771. Zavidovići – Remains of Monastery Udrim – Gostović
772. Zenica – Medieval town and fortress Vranduk

C. Petition for proclamation of the following properties as national monuments issued to the Commission for protection of national monuments (properties that are temporary protected one year after issuing of petition or until making the final decision of the Commission)

[26] Listu je usvojila Komisija/Povjerenstvo za očuvanje nacionalnih spomenika u prethodnom sazivu, na 15. sjednici održanoj 14.06.2000. godine
[27] Broj označava redni broj pod kojim se odobro vodi na Privremenoj listi nacionalnih spomenika
[28] At 17. session of the Commission proclaimed as national monument named **Archeological area – Gradac at Ilinjača in Gornji Kotorac in East Sarajevo, Municipality Kasindol, RS**

- Roman bridge in Tešanj
- Icons from Serb Orthodox Church in Tešanj
- Orthodox Church of Oracle Ilija
- Temple of St. Jovana Krstitelja in Bilješevo with cemetery, Kakanj
- Elementary School ”15. april” in Doboj, Kakanj
- Orthodox Church and school in Blažuj, Ilidža
- Tower Kovači, Ilidža
- Complex Stojčevac, Ilidža
- Semizova’s house, Ilidža
- Old school in Hrasnica, Ilidža
- Hasanbegovića Tower in Hrasnica, Ilidža
- Old Bosnian house of family Zečević in Butmir, Ilidža
- Old Bosnian house of family Čomara in Butmir, Ilidža
- Chatholic Church at Stup, Ilidža
- Cemetery (Mezarje) at Stup, Ilidža
- Complex of sources Vrela Bosne, Ilidža
- Roman bridge at Vrelo Bosne, Ilidža
- Roman bridge in Vreoci, Ilidža
- Roman excavation in Lužani, Ilidža
- Monument in Osjeku, Ilidža
- Monument to soldiers killed in (2nd-World War) NOR-a in Lužani, Ilidža

4.12. Hunting

Within the consideration of the fauna composition, the hunting game is abstracted as a special segment. The Hunting associations mainly manage with data on fauna. During the preparation of the Study, the data on hunting game are obtained from: Public Company ŠPD of Ze-Do Canton, „Borja“ Teslić, „Jeleč“ Žepče, „Klek“ Zavidovići, „Zmajevac“ Zenica, „Zec i Stari Zec“ Busovača, „Srndać“ Kakanj, „Srndać“ Visoko, „Bjelašnica“ Sarajevo Canton (Blažuj-Tarčin), „Ljestarka“ Kiseljak.

Proposed alignment at LOT 2 wil without any doubt cause physical separation of populations of above mentioned species, that is, it will limit free migration of the hunting animals. Field investigations and the data from the Hunting associations in municipalities have shoen that composition o the hunting animals is as follows:

- **Section 1. Karuše – Medakovo (km 0+000 to 4+000)**

At this part, proposed alignment includes habitats of small hunting animals. Species that live in this part, and which are imprtant for hunting are: hare (Lepus europaeus Pallas), jarebica poljska (Perdix perdix L.), phaesant (Phasianus colchicus L.), , and varous species of wetland birds (wild ducks, etc.). Large animals are roe deer (Capreolus capreolus L.) and wild boar (Sus scrofa L.). Other species are fox (Vulpes vulpes L.) and badger (Meles meles L.)

- **Section 2. Medakovo - Ozimica (km 4+000 to 24+901,587)**

In this part of the alignment there are habitats of smaller animals.

- **Section 4. Section Poprikuše – Nemila (km 38+617,434 to 46+289,378)**

Besides smaller hunting animals in this part are sporadically present large hunting animals: srna and wild boar.

- **Section 5. Nemila – Tonja Gračanica (km 46+289,378 to 58+434,599)**

In this part of the alignment prevail habitats of large hunting animals, which are the most abundant in this area. Particularlly are frequent wild boar and srna. Small hunting animals wit smaller number of individuals are also very frequent here (hare, phesant, and jarebica).

- **Section 6. Tonja Gračanica – Drivuša (km 58+434,599 to 66+959,592)**

There are habitats of large hunting animals. The most abundant species are: srna, wild boar, rarely wolf, and very rare is brown bear. Passages over communications are frequent for srne and wild boars, as well as for the wolf, regardless they are not frequently noted (which is understandable). Main representative of smaller animals are jazavac, fox, kuna, and wild cat and hare

- **Section 7. Drivuša – Kakanj (km 66+959,59 to 82+595,000)**

In this part of the alignment on the intersection Lašva and from the very beginning of this section in the forest ecosystem exist habitats of large animals: srne and wild boar. In the composition of the fauna smaller hunting animals are very frequent and they are reprsented with standard species (hare, fox, squirell, etc.)

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

In this part of the section, there are sigificant impacts on the habitats of large animals, and therefore here is the same situation as it was in the previous parts of the sectiion. It should be noted that towards Tarčin there are relativel frequent pasages of brown bear over traffic communications, as well as of roe deer and wild boar. Considering smaller animals, here are the most frequent species hare, rarely jarebica as well as fox, wild cats, etc.

4.13. Ambient Noise and Head Lights Impact

4.13.1 Ambient Noise

One of the most significant impacts caused by traffic is noise exposure of people living in the settlements in the vicinity of an alignment. Surveys in the EU reveal that a great part of the population feels annoyed from noise caused by road traffic29.

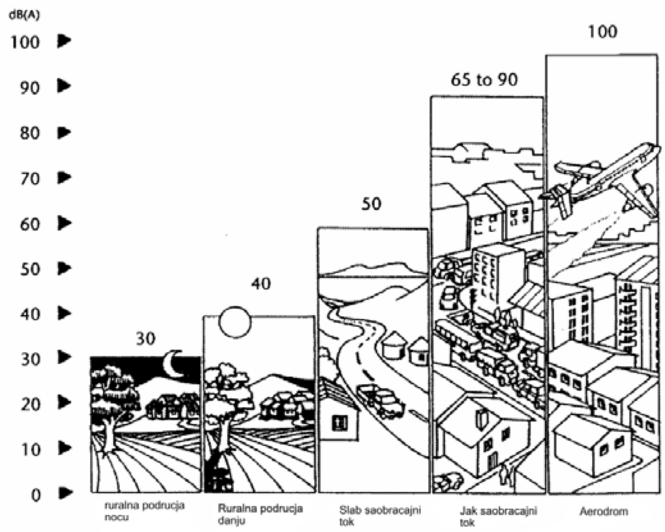
The unit for noise levels is decibel (dB) which is based on a logarithmic scale. This means that for example a doubling in source intensity (e.g. doubled traffic load) will show up as an increase of +3 dB. On the other hand, from the receptor’s side, the subjective impression of a human being that noise has doubled requires an increase of about +10 dB. Generally changes of less than 1 dB are not considered significant.

Basically noise impact problems caused by traffic using the road can be solved by mitigation measures that can be used in the road design, construction and operational phases. These measures do not refer only to designing of the roads but also to designing of the areas in the vicinity of the considered road.

[29] Noise exposure and noise stress can cause a variety of diseases in human beings, like e.g. circulatory troubles, hardness of hearing, or nervous system troubles. Recent medical investigations even show correlation of noise impact with cardiac infarction.

Since human beings have a sensitivity to sound which depends on the frequency, there is the convention to use a frequency adjustment curve (curve A) to get a measure for the frequency independent noise level (indicated as dB(A)).

Illustration 4.13.1.1. Average levels of traffic noise



Examples for noise levels of common environmental sounds are:

• Emergency siren at three metres	140 dB(A)
• Aeroplane take-off at 100 metres	110 - 120 dB(A)
• Jackhammer	90 - 110 dB(A)
• Crowded restaurant (inside)	65 - 75 dB(A)
• Busy office (inside)	60 - 65 dB(A)
• Normal conversation	40 - 60 dB(A)
• Quiet living room	30 - 40 dB(A)
• Quiet bedroom at night	20 - 30 dB(A)
• Quiet garden	30 dB(A)

To establish a noise level, when only one source of noise is concerned, is a relatively simple task, such as, for instance, establishing of the traffic noise at the motorway. However, when the noise originates from several sources then the task is much more complex. Great numbers of difference noise sources contribute to the extent of ambient noise level.

Ambient noise is a result of the combination of the different noise sources: business operation of a company, traffic noise, birds singing, gurgling of water and similar. Specific noise is a noise from a source which can be analysed. The remaining noise, apart from the specific noise, is classified as ambient noise.

This terminology originates from the ISO 1996 Standard which is generally in use. There are a lot of different methods for determination of the specific noise. These methods can vary from a drastic one, such as cessation of business activities in a company in order to determine the level of remaining noise, to more sophisticated methods which are based on simultaneous and connected tests carried out at several points in the vicinity of the source of the noise. Having in mind that the Lot 2 section of the motorway passes outside the larger settlements and that there are no significant sources of noise in the vicinity of the motorway in our study we have taken into account only the protection measures from the noise caused by a specific source, that is, in this case from the noise caused by the motorway traffic.

4.13.2 Vehicles Light Impact

The central reserve area forms an integral part of the motorway. Where it is necessary, the measures for increased aesthetics and safety criteria are given in the landscaping design. From the aesthetic point of view, the central reserve area can reduce the domineering role of a grey pavement surface by planting with adequate vegetation and it can contribute to a visual separation of the traffic directions and in that way reduce the possibility of blindness caused by vehicle headlights from the opposite direction.

Measures for mitigation of vehicle headlights' blindness are contained in other landscaping elements. If the motorway runs on an embankment in the vicinity of settlements, the noise protection measures (protecting walls, verges and similar) at the same time prevent illumination of the surrounding houses by the vehicle headlights. Planting of vegetation is also one of the measures used very often for mitigation of headlights beams on the surrounding houses.

4.14. Infrastructure

4.14.1. Water Menagement Infrastructure

Water supply system and water infrastructure
The motorway route has satisfied all required criteria, by avoiding motorway route definition through the area of planned water accumulations, as it is the case with planned accumulation Toplice, and water protected area in municipalities Tešanj and Maglaj. The route alignment was adjusted to the levels of the maximal backwater for planned hydropower plants on the River Bosna. Besides that, attention has been paid to the motorway impact on primary structures of water supply city systems of Zenica and Žepče. The route has been adjusted with location of the reservoir and the plant for treatment of these water supply systems. As the points of collision could be recognized the rural areas, through which the motorway route passes and in which exist large number of small individual village water supply systems. First of all, that relates to the areas of municipalities of Maglaj and Kiseljak. In these areas, the problem of passing the route over feeding pipelines of smaller capacities is evident. That points out to a need for application of certain technical solutions, namely, displacement of these water supply pipelines through de-leveling in passages foreseen for relocation of local roads.

Existing condition of water supply and wastewater disposal
Data about the existing water management infrastructure along the section of LOT 2 of motorway on corridor Vc is taken from the "Planning documentation background – LOT 2", which was prepared by the Urban Institution of B&H in October 2005.

A level of available data for the analysis of existing condition of water supply system and wastewater disposal, in the range of immediate influence of motorway construction, is relatively unequal. Mitigating circumstance is the fact that there is an appropriate level of data availability about important urban systems and smaller systems, which might find them in collision with the adopted motorway route.

Both in the framework of previous environmental impact assessment and in this Study, a special type of analysis were scopes of consideration, which are important from the aspect of source protection, those existing as well as planned sources.

Guided by this assumption, the identification of existing systems of water infrastructure has been carried out according to their importance in the following order:

- Primary structures and network of urban water supply system of Zenica town.
- Primary structures and network of urban water supply system of Žepče town.
- Water supply system of settlements in the upper course of river Lepenica.
- Water supply system of settlements in the contact area of Žepče municipality and Maglaj municipality.
- Identification of scopes of consideration, which are important for protection of water resource in the contact area of Maglaj municipality and Tešanj municipality.
- Identification of primary structures of water supply system Tešanjka.
- System for wastewater disposal in the area of settlement Tarčin.

At the Technical study level, within Spatial planning documentation, the graphic interpretation of analyzed systems and structures was partially carried out in the scope of consideration of motorway route. Furthermore, at the level of previous environmental impact assessment, water protection zones of previously mentioned water supply systems are charted in the maps. For one smaller part there were no reliable location data and no relevant information about rural and individual water supply systems, which exist within the scope of consideration of motorway route. This data was collected and elaborated within this study, in item 4.5.1.1. – Description of the environment.
Similar approach is possible in evaluation of existing condition of wastewater disposal system of Tarčin settlement. The only reliable information is that Babina rijeka watercourse is the recipient of wastewater. The watercourse is located in river basin of planned water reservoir “Toplice”.

Two main groups can be separated from the performed identification of water management structures and systems:

- First group consists of structures and systems, whose location determination is primary with regard to adopted motorway route. That means that in horizontal or vertical sense, the adopted route had to go around the locations of this group. First of all, it is consisted of existing and planned water reservoirs and more important sources with established protection zones, as well as existing primary structures of water supply. Based on all previous information these locations are avoided for the Conceptual Design phase.
- Second group consists of structures and systems, whose horizontal and vertical position is important from the aspect of its dislocation or reconstruction. Smaller rural waterworks also belong to this group, as well as pipelines of bigger water-supply systems. At the level of previously elaborated documentation, an accurate identification has not been done for this group, but within this Study, some data has been found regarding these rural water works in the area of our scope of consideration. Regarding existing pipelines of bigger water-supply systems and other water management installations, their identification has been conducted, and the need for their protection has been determined as well as finding an adequate technical solution for their relocation. Within the “Conceptual design– the book of Protection and relocation of existing installations” designers are obliged to find out an adequate technical solution in order to avoid the damage during construction and exploitation of the structures and to avoid disruption of water supply.

Existing condition of water supply system and wastewater disposal in the scope of immediate impact of motorway construction for section LOT 2 is given for municipalities in the following text. Map of limitations related to water management infrastructure is given in Annex 12.3.11. Area of Usora and Tešanj uses water intakes in the alluvium of Usora River as well as less water intakes of sources in the area of Crni vrh. Municipal centers have incomplete sewerage systems of mixed type with outlets in the nearest recipients without previous treatment.

For the town of Maglaj, water has been pumped from the well in the area of Misurići. River Bistrica enriches the capacity of the source in the alluvium of Misurići area, for approx. 25 l/sec in minimum, which is enough only for transitional period. Area of Maglaj has an important water resource in river Bistrica with the possibility to provide additional 60 l/sec of water. This could be accomplished by smaller water reservoir, for which a technical documentation has already been elaborated. Factory Natron has its own system of drinking and technological water.

In order to provide water supply for town Žepče and its surrounding settlements, water supply systems with water intakes have been constructed: Ravna rijeka, Mala rijeka, Ograjina, Buković, Jakovac and source III. A total capacity amounts to approx. 27 l/sec. The other settlements are supplied with drinking water by smaller local waterworks, with limited capacities and inadequate water quality, as well as from local wells. Wastewater disposal is somewhat organized only in urban area.

In the area of Zenica municipality, practically all-possible water resources have been used. Limited capacity of available drinking water quantity on municipality territory from sources Babina rijeka, Strmešnjak and Klopče has caused a need for finding necessary quantities of drinking water on territory of neighboring municipalities. Hence, Kruščica system has been built with drinking water intake in Vitez municipality. Further increase of drinking water consumption has caused lack of necessary quantities and the need for finding new water resources, which would cover the designed needs for drinking water. Research analysis have indicated a possibility of long-term fulfillment of drinking water needs with intake “Plava voda” in Travnik having approx. 700 l/sec, out of which approx. 60% would be used for needs of town Zenica. This project has been compromised by the price of delivered drinking water, which has been determined by the concession owner of this important water resource. An alternative to this planned system could be a construction of water reservoir on river Ribnica in Kladanj municipality. Constructed primary reservoir system is of satisfying capacity. The other settlements of Zenica municipality have local systems of frequently very limited capacity and inadequate technical-hygienic characteristics. A separate drinking water system and technological water intake from river Bosna has been built for the needs of Zenica Iron-factory. Only town Zenica has an organized system for wastewater disposal. The constructed system is of mixed type without wastewater treatment plant. Zenica Iron-factory has a separate system with direct discharge into river Bosna.

Kladanj municipality has relatively significant drinking water quantities. Sources Bukovica, Ilidža, Pitka voda and Stog, with total capacity of approx. 150 l/sec, have been put in function of urban water supply system, which, apart from municipality centre, also supplies suburban settlements. The other settlements are supplied by drinking water from local waterworks. Only municipality center has more significant collector network. Larger part of the urban network is of mixed type with discharge into recipients without any previous treatment.

The main resource of drinking water for the city of Sarajevo is underground reservoir Sarajevsko polje (Bačevo, Sokolovići, Stup) from which around 90% of total water quantities is provided, while the available quantities were in average 2,400 l/s in 2003. Currently this is sufficient for normal water supply of all consumers. Water protection zone covers about 320 hectares of land.

Table 4.14.1. Sources in Sarajevsko polje

Sources	Water intake structure	Intake method	Source capacity l/s
Bačevo	29 water-wells	Pumping	1870,1
Sokolovići	4 water-wells	Pumping	275,6
Stup	3 water-wells	Pumping	72,2
Vrelo Bosne	tapped	Pumping	13,8
Vrelo Hrasnica	tapped	Pumping	40,1
Filter Bosna			123,7

Central sewage system covers the narrow urban area of the following municipalities: Old town, New Sarajevo, Center, New town and Ilidža. About 75% of inhabitants in urban area of Canton are connected to the central sewage system. Before the war, realization of many structures on completion of the existing sewage system created prerequisites for complete protection of river Bosna and its tributaries: Miljacka, Dobrinja, Željeznica, as well as for forming one modern sewage system. However, after the war there has been significant uncontrolled construction in areas, which, according to planning documentation, were not foreseen for those purposes, nor were they planned for infrastructure equipment according to the long-term planning documentation. That has resulted in significant disproportion in equipment of those areas with communal infrastructure, and especially with sewage, which is specifically emphasized on territory of Ilidža municipality. During the war period, there has been a total devastation of central treatment plant.

Lately, there has been an “explosion” of individual housing construction, and growing of settlements, practically without any systems for monitoring of wastewaters.
In best cases, individual septic tanks have been built, but mostly wastewater is discharged into the nearest watercourse or in permeable underground. Especially serious condition exists in territory of Ilidža municipality, in segment of illegal construction in the area of protected zones of drinking water sources in Sarajevsko polje.

Water supply of Kiseljak municipality is based on usage of large number of sources of small capacity, especially during the summer season. Also, the problem is side consumption on longer supply pipelines, which causes lack of necessary quantities of drinking water in the final, and also the most significant point of consumption, and that is municipality center. A large number of disperse smaller sources complicates a possibility of an adequate protection of these water resources. The construction level of existing system characterizes absence of overall consideration during solving the problem of disposal and treatment of wastewaters. A certain level, but incomplete one, exists only in the municipality center. Absence of application of separation system and wastewater treatment plant, as well as application of partial solution with drainage by shortest way to the recipient, has significant impact on the quality of watercourses of this municipality.

Total of 13 sources from 29 tapped sources with total capacity of 79,6 l/s to 158,5 l/s is connected into the water supply system of Hadžići municipality. The length of distribution network is 42,050 meters, and there are 16 reservoirs in the system with total capacity of 1.702 m^3. Water supply system of Hadžići settlement is supplied from mountain sources. Existence of certain quantities of ground water contained in alluvial deposits of river Zujevina is significant for Hadžići settlement, but more precise evaluations of exploitation possibilities have not been done yet. In this area wastewater collector Bjelašnica-Igman-Brezovača-Hadžići exists with approx. 19 km of length. Collector Hadžići was constructed which connected the Bjelašnica collector from Hadžići to the connection to collector Blažuj, which is connected to collector Hrasnica before the plant. In Hadžići municipality, concerning primary canals, a connection of collector has been done from Hadžići to Raskršće, with approx. 5800 m of length. However, that collector is very inadequately constructed (concrete pipes with poor connections). In narrow area of Hadžići, existing sewage network has approx. 13,500 m in length. Moreover, some basic sections of canals have been built for sewage system Tarčin, with approx. 2,100 m of length, for Pazarići system in the length of 2,250 m which represents a solid.

Collision of adopted route with water management infrastructure

Adopted motorway route has satisfied all requested criteria by avoiding route design through areas of planned water reservoirs, as it's the case with planned reservoir Toplice, and water protected area of Tešanj and Maglaj municipalities. Furthermore, level of the route is harmonized with elevations of maximal slow down of planned hydro-energetic structures on river Bosna, and high waters of 100 and 500-year return period of river Bosna and its bigger tributaries.

Special attention was given to the influence of the motorway on primary structures of water supply system of Zenica and Žepče towns, meaning that adopted route is harmonized with the position of the reservoir and treatment plant of these town systems.

Passing of motorway route through rural areas could be marked as collision points, where a large number of smaller individual and rural waterworks exist. First of all, this concerns the areas of municipalities Maglaj and Kiseljak. In these areas, the problem of route passing over supply pipelines of smaller capacity is registered, which points out the need for application of certain technical solutions of dislocation of these pipelines through delevelling passages foreseen for dislocation of local roads.

Basic concepts of water management development in scope of consideration of LOT2

Municipalities Tešanj, Maglaj, Žepče, Kakanj, Ilidža, Hadžići and Kiseljak, where the route of section LOT 2 passes through, from the aspect of water supply could be grouped into three entities. These entities are integral parts of wider area of water supply of planned regional systems based on the principle of long-term problem solutions of drinking water supply.

Water supply system of municipalities Hadžići, Ilidža and Kiseljak represents the first entity, which has a tendency of connection within planned expansion of the city water supply system of Canton Sarajevo. Treated parts of municipalities Hadžići and Kiseljak, which are located in the upper course of river Lepenica, as well as peripheral part of Ilidža municipality (wider area of Rakovica), take long-term solution of water supply problem as a basis on planned water reservoir Toplice on river Lepenica.

Municipalities Kakanj and Zenica represent the second entity, whose potential joint water intake on planned water reservoir Ribnica could be an alternative to the initiated realization of regional waterwork "Plava voda", and together with the existing capacities it could form a complete system for water supply of Zenica municipality and west part of Kakanj municipality.

Municipalities Usora, Tešanj, Maglaj and Žepče create a third entity, where a long-term solution for water supply problem is planned to be a regional water supply system with intake from the planned water reservoir Krajinići on river Krivaja. Upstream from this reservoir Buk is planned, whose primary purpose is water supply of Tuzla region. If realization of Krajinići reservoir does not happen, construction of accumulation Buk would be a priority, which would satisfy the needs for drinking water of municipalities which are all part of Zeničko-Dobojski Canton who manages water resources of river Krivaja.

Considering that section of LOT 2 generally passes through Bosna river basin, in this area, 42 plants are registered and planned from the aspect of water reservoirs (according to elaborate "Basin hydro-energetic solution of river Bosna", 1965, Institute for water management/Energoinvest). Their total power is 365.78 MW with annual production of 1593.60 GWh. Some rivers, which are located in the scope of consideration of motorway route, also participate in realization of this overall hydro-energetic potential of Bosna river basin:

- River Bosna – 993,60 GWh
- Bijela River - 8,00 GWh
- River Lepenica -11,00 GWh
- River Fojnica – 30,10 GWh
- River Lašva – 28,50 GWh
- River Usora – 39,90 GWh

18 dam-type hydroelectric power plants are planned on river Bosna, in watercourse between Kakanj and Maglaj, and in the scope of consideration of designed motorway:

1. HE Šan Kamen
2. HE Maglaj
3. HE Dubravica
4. HE Žepče
5. HE Želeće
6. HE Begov Han
7. HE Kovanići
8. HE Zenica I
9. HE Zenica II
10. HE Zenica III
11. HE Janjići
12. HE Merdani
13. HE Lašva
14. HE Radići
15. HE Kakanj
16. HE Dobrinje
17. HE Poljice
18. HE Toplica

According to these solutions, locations of planned partition profiles are charted on the map of limitations related to flooding zones and planned hydro-energetic objects along corridor Vc (Annex no. 12.3.6). They are taken from the Study "Basic hydro-energetic solution" (Energoinvest, 1965). It should be emphasized that planned hydro-energetic structures within these solutions have no foundation in Spatial plan of Republic of Bosnia and Herzegovina (Data taken from Spatial planning documentation elaborated on the level of the Conceptual Design for motorway on corridor Vc).

There are no possibilities for construction of more significant reservoirs, which could influence the flood protection on river Bosna. However, on tributaries of river Bosna there is a possibility for construction of number of reservoirs with bigger coefficient of leveling. In that context, from rivers located in the motorway proximity, we should mention a planned construction of reservoir "Bijela rijeka" on Bijela River (section Blažuj – Tarčin).

From the aspect of water management, in the scope of consideration of motorway route, we should point out areas significant for planned construction of reservoir Toplice on river Lepenica, as well as construction of dam-type hydroelectric power plants on river Bosna. Spatial plan of the Republic of Bosnia and Herzegovina has planned a construction of water reservoir Toplice on river Lepenica with maximal slow down elevation of 638,00 above sea, with total volume of 24,5 x 10^6 m^3, and useful volume of 21,5 x 10^2 m^3. This multipurpose structure is significant for water supply of Sarajevo Canton and part of Srednje-Bosanski Canton from the aspect of flood control, increase of low waters, and energetic utilization. As opposed to this structure, whose function is based on more significant accumulating of waters and their multipurpose management, on river Bosna it is possible to construct only small cofferdam stairs without more significant water reservoir.

4.14.2 Electric Power Supply

The existing power-transmission lines, the ones with high voltage 400 kV, 220 kV, 110 kV and 35 kV, cross the corridor at a number of points:

- 400 kV Power Line Tuzla – Banja Luka
- 35kV Power Line PS „Jelah“ – PS Matuzići Doboj Jug
- 110 kV Power Line PS Misurići Maglaj - PS Bukva
- 35 kV Power Lines Zavidovići – Žepče – Maglaj and Maglaj – Zenica
- 110 kV Power Line PS 220 kV Zenica 2 - PS 110 kV Zenica 1
- 220 kV Power Lines for Tuzla and Kakanj
- 110 kV Power Line Zenica 2 – Cementara, Zenica 2 – PS Sjever
- 220 kV Power Line Zenica 2 – Kakanj
- 110 kV Power Lines Zenica 1. – Kakanj i Zenica 2. – Cementara
- 220 kV Power Lines Kakanj – Jablanica i Kakanj – Konjic
- 110 kV Power Line Kiseljak – Blažuj.

4.14.3 Gas Transport

In the observed area of the municipalities where the motorway route passes through, there is an installed gas pipeline in the municipalities of Kakanj and Zenica. Highway gas Semizovac – Kakanj - Zenica, 54km long, in the municipality of Kakanj, passes beside the route of the existing highway M.-17 (along the right side in the direction of Zenica), switching to the right bank of the river Bosna, in the urban areas Karaula and Donji Kakanj, and crossing over Mioč, into the municipality of Zenica, that is into the urban area Perin Han.

In the municipality of Zenica, gas pipeline route intertwines with the motorway route on the section Perin Han–Crkvica, therefore the points of collision between gas pipelines and motorway will have to be technically solved in the conceptual design. In Crkvica, a separation of the highway gas pipeline for the urban areas of northern Bosna is proposed. The construction of gas pipelines in the municipality of Kiseljak is proposed, and the primary gas pipeline is supposed to pass along the route of the regional road Blažuj-Kiseljak. Routes of these planned gas pipelines have to be accorded with the adopted motorway route.

4.14.4 Telecommunications

Analyzed area of the Corridor Vc, LOT 2 uses two separate telephone systems, fixed and mobile, including: HT Mostar and BH Telekom. Part of the observed area is covered with the Eronet network. Within the narrow impact area of the corridor motorway route, BH Telekom has the following foundation stations in function: Tešanjaka, Jablanica, Novi Šeher, Ozimica and a business centre. Due to a number of collision points between the telephone wires and the motorway route, small range reconstructions are necessary to be performed locally, protecting the points of crossing the motorway. In the process of planning and designing the new telecommunications capacities, locations have to be accorded with the motorway route of the corridor, which applies to all the foundation stations including those in the tunnel. Considering that all roads intersect with the motorway on two levels, it is estimated that it will not be necessary to allocate telecommunication wires, and any construction works will be brought down to their protection. Installed telecommunication wires are mainly located near the existing highway in the Bosna river valley.

4.15. Unexploded Mines Impact

The Mine Action Centre (MAC) has prepared the information on the potential mine fields on their charts in scale 1:100.000 and 1:25.000. All data concerning the mines available up-to-date are specified in the Annex. The area surrounding the corridor should be completely cleared from mines before commencement of the motorway construction works. However, special attention should be paid during the construction in these areas.

4.16. Impact by the Motorway Services

The facilities that will be constructed along the motorway are mainly as follows:

- Toll collection facilities
- Rest and service areas
- Facilities for maintenance and traffic control

Toll collection and monitoring of the motorway are implemented at the toll plazas located at the points of entry to or exit from the motorway. The motorway user takes the toll card at the entry to the motorway and hands over the same to the cashier at one of the exists, who collects the amount of the toll depending on the type of the vehicle and the length of the motorway used. There is also a possibility to use a pre-paid magnetic card, the utilization of which avoids stopping at the toll plazas and simultaneously reduces consumption of time and energy. The number of traffic lanes and toll collection booths is determined by intensity of the traffic flow at the considered toll plaza. Toll collection is carried out from the toll collection booths located next to the traffic lanes under the canopy. The unit which monitors individual toll collection booths is located in the central building together with other facilities for the toll plaza personnel.

There are four basic types of motorway services (rest and service areas):

Type A – parking area + public toilets + petrol station + restaurant + motel
Type B – parking area + public toilets + petrol station + restaurant
Type C – parking area + public toilets + petrol station
Type D – parking area + public toilets

Monitoring of traffic safety for each individual section of the motorway is carried out from the Maintenance Centre. Such centres consist of the following:

- Facility for traffic safety control
- Facility for maintenance of the motorway
- Storage area of the material to be used for salting in the winter period
- Petrol station
- Power Supply block

The facility for traffic safety control is a central building which is occupied 24 hours a day. Besides video surveillance rooms this building also houses emergency medical units and fire fighting units, workshops, restaurant, changing rooms for the staff and other accompanying facilities.

The facility for maintenance of the motorway covers the area for storage of the equipment and the road maintenance vehicles, as well as workshops for necessary repairs and maintenance of the equipment and vehicles.

The storage area for the material to be used for salting of the roads in the winter period is a semi-closed facility built of materials that are resistant to aggressive salting materials together with a tank for storage of the de-icing fluids and with a storage area equipped with a ramp for access of heavy vehicles.

The petrol station, together with the car washing facility, is intended only for the motorway maintenance vehicles. The power supply block is located separately and fire protected and it consists of the boiler plant and a workshop, also room for a generator and UPS, as well as transformer station with power supply cells.

A common characteristic of these facilities is that they are intended for utilization by persons, either the employees or the passengers, the result of which is accumulation of the utility waste as well as sewage water.

5. DESCRIPTION OF POSSIBLE SIGNIFICANT IMPACTS OF THE PROJECT ON THE ENVIRONMENT

5.1. Basis for Estimation of Impact on Environment

Environment means target system consisting of nature, society and economy. *Impact on environment* means impacts on nature, impacts on society and impacts on economical development. Impact on environment can be neither positive nor negative. Impact itself inevitably results with decrease of biological variety. Economic and social impacts can be positive or negative, depending on the criteria set. Finally, for some categories of society the impact can be positive and for others negative. Sustainable growth means such growth in which (i) the loss of biological variety and ecosystems is justified by social and economic benefits for the national and local population of a country, and (ii) impacts on nature do not exceed certain limits. The whole procedure is ensured in the first phase, through harmonisation of social, economic and natural elements and requirements, while in the second phase impacts on environment are minimised. These impacts can be: (a) consequences of the change of facilities purpose, (b) impacts during construction and (c) impacts during operation of motorway. Impacts which are a result of the change of facilities purpose are solved through physical planning.

5.2. Impacts During Construction

5.2.1. Introduction

A construction site is a temporary production facility of the construction industry; its life cycle is mainly determined by the construction period. («Construction site is a plant under the stars », without walls or (permanent) infrastructure. Preparatory works are needed for setting up construction production. Implementation of construction works (main works) is the essence of construction production and it is necessary to develop in details its technical and technological aspects; final works and removal of the construction site are the end of life cycle of a construction site.)

Construction process is implemented / progressively in a physical space and there is strong interaction between the construction process and the environment. Due to a seeming predominance of technique, the influence of the construction process on the environment is more obvious. A variety of impacts can be observed in all components of the environment: population, flora, fauna, water, land, cultural-historical heritage, landscape, and climate. How intense these impacts will be and what kind of space and time dispersion they will have depends on the dimensions of the construction (works volume), technical solutions due to construction technology and physical form of the area encompassed by the construction. Construction of a motorway, as a complex and exceptionally large construction, is an example of significant impact on the environment by all the above-mentioned impacts.

5.2.2. Social Impacts (Population and Density)

Almost the entire mechanisation of motorway construction causes a lot of noise and vibrations in the area where works are implemented but also in the pre-fabrication area (stone-crushing, separation, concreting, asphalt base) and on the roads where vehicles travel. At the same time, significant emission of harmful materials into air occurs (CO, sulphur, soot, CO_2), and "raising" of dust when machines and vehicles work. The local population is directly exposed to such impacts. Explosions for the purpose of excavation in rocks present a special problem and risk for the population – especially in the open (on a section of the road, in stone-pits – borrow sites) and to a smaller degree in tunnels. Besides a threat to life, short and intensive impacts of vibrations, noise and emission of harmful substances also occur – products of explosions and large quantities of stone dust. Special impact can be caused by the seismic effect of explosions.

Some residential buildings, parts of settlements and entire towns will be directly physically endangered by the implementation of construction works (not only in the expropriation zone, but also in the area through which construction roads pass / temporary roads), which will lead to emigration of the population.

Due to occupation of the area for the purpose of construction of a motorway, traditional routes for movement of the local population will be partially or entirely changed (usage of usual routes such as footpaths, field paths for agricultural machinery and roads for mixed vehicles), which will slow down the normal routine.

A special risk is the closeness or overlapping of traditional routes used by the local population with construction routes of the contractor, due to interference, disturbance, collision and the increased possibility of accidents.

Since some works are performed near or immediately by the existing main roads (motorways and regional roads), there is a high risk to normal functioning of traffic, including the danger for the participants in traffic and the contractor's workforce.

Due to the loss of land and making it impossible to perform normal activities in agriculture, cattle breeding and forestry, the economic power of the local population is weakened.

Obstacles created by road construction can lead to an increase in the time needed to travel to work.

There is also a possibility of spreading contagious diseases, socially deviant behaviour, immoral lifestyle, stealing etc. by the employees of contractor towards the local population..

In possible accidental situations the lives of the employees and the local inhabitants (and also animals) are seriously endangered. In the following tables we provide a list of factors for the possible work and site organisation by sections, which indicate the type, scope and intensity of social and other impacts:

1. SECTION: KARUŠE - MEDAKOVO	Site:	
	- location	Medakovo, area in the vicinity of the River Tešanjka (km 3+5)
	- occupied area	4 ha for the construction site and 1 ha for work-site
	- capacity	80 workers; 30 machines, 30 vehicles
	Site location	
	- tunnels:	Adjacent to M4 Doboj-B.Luka road (km 0+200)
	- bridges:	Km 0+900, km 1+400, km 1+700, km 2+800, km 3+100, km 3+900
	Location of the borrow/ waste area:	New borrow pit has to be opened (material excavated from the tunnel is not enough!) for the quantity of approx. 500.000 m^3 in the area south of Medakovo village: borrow pit has to be filled with material not usable for motorway construction at the site and after that re-cultivation of that area
	Concrete plant location:	Tešanj or Doboj; total quantity of concrete: 40.000 m^3
	Asphalt plant location:	Mravići – Doboj South; total quantity of asphalt mixture: 27.800 t
	Most significant environmental impact – type of the location:	Physical impact of the motorway with the existing settlements along the River Tešanjka, occupation of land properties, bisecting of local communications; adverse effect on the Tešanjka river bed (on the water course as well as on flora and fauna); negative impacts on agricultural and forest land and on flora and fauna

2. SECTION: MEDAKOVO - OZIMICA	Site:	
	- location	a) North sector: 1. Čifluk, 2. Jablanica b) Tunnel «C.Vrh»: 1. Karadaglije (north portal) 2. Brezove Dane (south portal) c) Viaduct «Strupine»: 1. Lukići / Strupine d) South sector: 1. Novi Šeher, 2. Ljubatovići
	- occupied area	2-3ha for each construction and work site
	- capacity	Average: 40 workers, 15 machines, 25 vehicles
	Site location	
	- tunnels:	1. Karadaglije (north portal) 2. Brezove Dane (south portal)
	- bridges:	1. Lukići / Strupine
	Location of the borrow/ waste area:	Total quantity of the material excavated out of the tunnel is approx. 700.000m^3; of which 50% will be used for construction of the embankments in the north and 50% in the south sector; for the embankments the total quantity of necessary material is 2.734.000m$^{3;}$ if this amount is reduced by 900.000m^3 excavated on the route there is still a need for about 1.100.000m^3. With the assumption that at least 50% of the material is lacking in both sectors that means that we need two borrow pits for the quantities of 550.000m^3 each. Possible locations are: area of Jablanica (north sector) and area of Grabovica (south sector) – depending on geological and petrographic conditions
	Concrete plant location:	Jablanica or Karadaglije (north sector); Novi Šeher (south sector); total quantity of concrete: 372.000 m3
	Asphalt plant location:	Mravići-Doboj South (north sector); Žepče-tunnel (south sector) – transportation of asphalt; total quantity of asphalt mixture: 135.000 t
	Most significant environmental impact – type of the location:	Pollution and physical impact on all segments of village settlements , rural roads, private estates, forests, water courses of the Trebačka river, Strupinski creek, river Lješnica and its tributaries; pollution and physical impact on agricultural and forest land.

3. SECTION: OZIMICA - POPRIKUŠE	Site:	
	- location	1. North (length 7,7km) – Tupanovac village 2. Viaduct «Žepče» L=831m – Tatarbudžak settlement 3. Tunnels T3 and T4 «Donje ravne», L=1.840m (north portal: Vašarište; south portal: D. Ravne 4. South (length 6.0km) - Papratnica 5. Bridges over the River Bosna M8, M9, M10, M11 – Brezovo Polje 6. Tunnels T5, T6, T7 and north part of the tunnel «Cvitove njive» - Golubinja
	- occupied area	3 ha for each construction site and 1 ha for the work-site
	- capacity	Average: 50 workers, 20 machines, 20 vehicles
	Site location	Next to the main structures: tunnels and bridges
	- tunnels:	T1, T4, T5, T6, T7 – construction sites at both portals (+ north portal of the tunnel «Cvitove nj.)
	- bridges:	M3 – Tatarbudžak; M8 – Papratnice; M9 – Brezovo polje; M10 – Brezovo Polje; M11 – Golubinje/Poprikuše
	Location of the borrow/ waste area:	Waste areas: material excavated from the large tunnels T4, T5, T6, T7 and part of the tunnel «Cvitove njive» can not be used for construction of the motorway embankments, therefore waste areas are necessary for depositing of this material - T4, the quantity of 450.000m^3 to be deposited in villages Bljuva and D. Ravne 50% in each - T5, the quantity of 100.000m^3 to be deposited at the bank of the river Bosna (regulation of the river) - T6, the quantity of 180.000m^3 to be deposited in the vicinity of the river course at Brezovo polje T7, the quantity of 370.000m^3 along the bank of the River Bosna (regulation of the river) - one part of the tunnel «Cvitove njive», the quantity of 600.000m^3 in the area of the river floodplain in Golubinje
	Concrete plant location:	1. Žepče (existing concrete plant) – transported concrete, 2. Brezovo polje (total quantity of concrete: 161.000 m^3)
	Asphalt plant location:	Žepče; total quantity of asphalt mixture: 50.300 t
	Most significant environmental impact – type of the location:	Physical impact on and pollution of the agricultural and forest land, bisecting of estates and traditional communications in the north sector. Physical impact on the water course of the River Bosna including impact on flora and fauna due to the works in the river bed itself or at the river banks; contamination of water; pollution of minor river courses: Lukošnice, Bljuve, Ljubne, Papratnice. As there are several locations of the construction and work sites there is a great possibility for pollution of the surrounding by sewage waters or solid waste materials (construction waste or sewage). Many intersecting points with the existing road (M17) and with the dual railway line Doboj-Zenica under very heavy traffic create additional risk for both sides: to the contractors and to the traffic participants.

4. SECTION: POPRIKUŠE - NEMILA	Site:	
	- location	1. Tunnel «Cvitove njive» - south tunnel portal - Kahrimani village 2. Bridge over the River Bosna, L=453m – left bank of the River Bosna (Kovanići village) 3. Alignment in the south sector (together with the tunnels and bridges) – Nemila (right bank of the River Bosna)
	- occupied area	3-4 ha for each construction site and 1 ha for the work-site
	- capacity	Average: 40 workers, 15 machines, 20 vehicle
	Site location	
	- tunnels:	T1 – Kahrimani village, T4 i T5 - Nemila
	- bridges:	Kovanići village
	Location of the borrow/ waste area:	Material excavated from the tunnel «Cvitove njive» in the quantity of approx. 600.000m^3 should be deposited along the left bank of the River Bosna between Topčić polje and Kahrimani village. Material excavated from the tunnels T4 and T5 in the quantity of approx. 250.000m^3 should be deposited at the right bank of the River Bosna.
	Concrete plant location:	Topčić polje or Nemila; total quantity of concrete: 101.000 m^3
	Asphalt plant location:	Zenica – existing plant; total quantity of asphalt mixture: 75.000 t
	Most significant environmental impact – type of the location:	Physical impact on the water course of the River Bosna including flora and fauna due to execution of construction works directly in the river bed or at the river banks; water pollution. Many intersecting points with the existing road (M17) and with the dual railway line Doboj-Zenica under very heavy traffic create additional risk for both sides: to the contractors and to the traffic participants. There is a danger of material sliding down the slopes onto a local road during construction of the alignment at the section between km 42 and km 46. Construction of the motorway and the interchange in the area of Nemila will have adverse effect on lives, movement and business activities of the population as well as on the health of the people. Young forest trees will be jeopardized in the areas of the motorway alignment running on open embankments (km41,5-45).

5. SECTION: NEMILA – D. GRAČANICA	Site:	
	- location	1. Nemila (between km 46 and km 49) 2. Vranduk-North (section between km 49 and km 51,5: tunnels and bridges) 3. Ponirak (section km 51,5 to km 55,5) 4. D. Vraca (km 55,5-56,8) 5. D. Gračanica (km 56,8-58,4)
	- occupied area	2 ha for each construction site
	- capacity	Average: 40 workers, 15 machines, 20 vehicle
	Site location	
	- tunnels:	Vranduk-Northe; Ponirak, D. Vraca, D. Gračanica
	- bridges:	Vranduk-North; Ponirak, D. Vraca, D. Gračanica
	Location of the borrow/ waste area:	Not necessary
	Concrete plant location:	Transportable concrete plants: Nemila, Vranduk-North, D. Gračanica; total quantity of concrete: 252.000 m^3
	Asphalt plant location:	Existing asphalt plant in Zenica; total quantity of asphalt mixture: 120.000 t
	Most significant environmental impact – type of the location:	Jeopardizing and physical destruction of young coniferous and deciduous forests and trees in the areas of the open motorway alignment. Physical destruction and pollution of water courses and of flora and fauna of the River Bosna and its tributaries. Physical impact of the motorway alignment with the existing trunk road and with dual track railway line creates a risk for both parties: the builders and the participants in the traffic (this is greatly emphasised near the tunnel at km 49+4). There is a potential danger of sliding of material down the slopes onto the trunk road M17 during construction of the motorway at the section between km 46 and km 49. Unavoidable utilisation of the local road at the right bank of the River Bosna (section of bridges and tunnels near Vranduk) for the site needs will disturb the traffic needs of the local population. Construction of the motorway and the interchange in the area of D. Gračanica settlement will cause an adverse effect on lives, movement and business activities of the population as well as on the health of the people.

Illustration 5.2.2.1. SECTION 5: View of D. Gračanica and the area of the future intersection

6. SECTION: D.GRAČANICA - DRIVUŠA	Site:	
	- location	1. Ričice (section: km 58,4-59,8) 2. Crkvice (section: km 59,8-61,2) 3. Radakovo (section: km 61,2-63,2) 4. Perin Han (section: km 63,2-65,5) 5. Drivuša (section: km 65,5-66,8)
	- occupied area	2 ha for each construction site and work area
	- capacity	40 workers, 15 machines, 20 vehicles
	Site location	
	- tunnels:	Tunnel «Pecelj» (km58,9), tunnel «Crkvice» (km 60,7), tunnel «Radakovo» (km 62,3), tunnel «Klopče» (km63,4)
	- bridges:	Bridge M1 (km 58,5), bridge M2 (km 59,6), bridge M4 (km61,1), bridge M5 (km65,5), bridge M8 (km 66,1)
	Location of the borrow/ waste area:	Borrow pit could be opened in the area of Klopačke stijene (km 63-64); scope of necessary exploitation around 300.000m^3.
	Concrete plant location:	Zenica – transported concrete; total quantity of concrete 137.000 m^3
	Asphalt plant location:	Zenica – transported asphalt; total quantity of asphalt mixture: 36.000 t

	Most significant environmental impact – type of the location:	Due to the fact that the motorway alignment passes through suburban area of the town of Zenica (the largest urban area in LOT 2), mutual disturbance between the motorway construction functioning and functioning of the local population, such as residing, working and transportation, is extremely emphasised. There are numerous impacts on the population (noise, vibrations, dust, emissions of pollutants; traffic accidents; disturbance of normal usage of landed properties etc.). Disturbance of the archaeological locations along the whole alignment is a separate aspect. Physical impact of the motorway with the network of the existing local roads and especially with the trunk road (at the section between km 65,5 and km 68,9) creates the risk for both parties: the contractors and the participants in the traffic. Construction of bridges will physically affect the water courses such as: Dobra voda, Babina rijeka, Stijenčice, Mrstava, Mutnica and the River Bosna, with the potential threat of destruction of flora and fauna by emissions of the pollutants and harmful materials.

7. SECTION: DRIVUŠA - KAKANJ	Site:	
	- location	1. Drivuša (section: km66,9-68,6) 2. Gorica (north portal of tunnel «Vijenac») 3. D. Lučani south portal of tunnel «Vijenac») 4. Bilješevo (section: km72,5-77,5) 5. Tičići (section: km77,5-82,5)
	- occupied area	2 ha for each construction site
	- capacity	30 workers, 15 machines, 20 vehicles
	Site location	
	- tunnels:	Tunnel «Vijenac» L=2965m (km 70,7)
	- bridges:	Bridge over the River Bosna L=270m (km 68,4), Overpass L=380m (km 81,9)
	Location of the borrow/ waste area:	Borrow pit in the Vijenac hill for the quantity of approx. 300.000m^3 for construction needs at the section between km 72,5 - km 82,5
	Concrete plant location:	Kakanj – transported concrete; total quantity of concrete: 105.000m^3
	Asphalt plant location:	Zenica; Visoko – transported asphalt; total: 97.500 tonnes
	Most significant environmental impact – type of the location:	At the first part of the section (km 67-69) the motorway alignment passes through settlements, therefore it affects local population (business activities, movement, utilization of land and farms, etc.) local communications, agricultural land and so on. There is a possibility that the motorway will affect some of the archaeological locations along the alignment. At the second part of the section (on the other side of the tunnel and to the end of the section) the existing trunk road will be upgraded to motorway standard. As a result the impact with the existing traffic will be extremely pronounced and it will create risks for both parties: the contractors and the participants in the traffic. Construction of bridges will physically affect the water course of the River Bosna with the potential threat of destruction of flora and fauna by emissions of pollutants and harmful materials.

8a. SECTION: BLAŽUJ - LEPENICA	Site:	
	- location	1. Gladno polje (section km0,0-6,0) 2. D.Azapovići (section km6,0-9,7)
	- occupied area	3-4 ha for the construction site
	- capacity	50 workers, 20 machines, 25 vehicle
	Site location	
	- tunnels:	Tunnel «Azapovići» (km 6,7), tunnel «Lepenica» (km 8,5)
	- bridges:	Viaduct M5 (km 1,7), Bridge M8 (km 3,9)
	Location of the borrow/ waste area:	One of the existing quarries close to the alignment to be used for necessary construction material (quantity 441.000m^3)
	Concrete plant location:	Hadžići (I part); Brnjaci (II part) / total quantity of concrete: 80.000m^3/
	Asphalt plant location:	Gladno polje /total quantity of asphalt mixture: 57.500 tonnes/
	Most significant environmental impact – type of the location:	At the first part of the section (km 0-6,0) the alignment passes through settlements and the local population is affected (business activities, movement, utilization of land and farms, etc), as well as local communications, agricultural and forest areas. Possibility of affecting of the archaeological locations along the alignment. At the second part of the section (on the other side of the tunnel and to the end of the section) the alignment again passes through the settlements and the problems are similar as above. Possibility of affecting the local water courses and pollution of the same. (Stanjevac).

8b. SECTION: LEPENICA - TARČIN	Site:	
	- location	1. Bukovice 2. Toplica 3. North portal of the tunnel «Suhodol», Suhodol settlement 4. South portal of the tunnel «Suhodol», Tarčin settlement
	- occupied area	2 ha for each construction site and work area
	- capacity	50 workers, 15 machines, 20 vehicle
	Site location	
	- tunnels:	Tunnels in Toplice (km 14,7; km 15,2), Tunnel «Suhodol» (km 17,1)
	- bridges:	Bridge M10 (km 14,3), bridge M11 (km 18,8)
	Location of the borrow/ waste area:	Borrow pit in area of Toplice, for the quantity of approx. 200.00m^3
	Concrete plant location:	Brnjaci (total quantity of concrete: 93.000 m^3)
	Asphalt plant location:	Gladno polje (total quantity of asphalt mixture: 46.500 tonnes)

	Most significant environmental impact – type of the location:	At the first part of the section (km 9,5-13,8 the alignment passes through settlements and the local population is affected (business activities, movement, utilization of land and farms, etc), as well as local communications, agricultural and forest areas. Possibility of affecting of the archaeological locations along the alignment. Possibility of affecting the local water courses and pollution of the same. (rivers Lepenica and Bijela rijeka). The most sensitive problem is execution of the construction works at the very end of this section due to physical impact of the motorway alignment with the railway tracks and the trunk road (both with extremely high traffic volumes).

5.2.3. Impacts on Microclimate

During execution of the works the change of microclimate in this zone will be insignificant. There is only a possibility of increased warming and emissions of pollutants in the air, which can lead to the effect of 'hazy' atmosphere and consequences in terms of increased ambient temperature.

5.2.4. Impact on Waters

The motorway causes changes in environment whether to a small or great extent mainly depending on the manner of its construction and exploitation. Certain impacts on waters can be avoided in the designing phase, through the use of appropriate designing solutions concerning internal and external drainage systems, watercourses crossings using bridge constructions, under conditions that openings are adequate for flowing of established high waters, and that difference in height between high water levels and lower bridge construction, river training, horticultural arrangements of buffer zone are respected. Also, bumper fence along the motorway should be designed, on localities recognized as vulnerable and sensitive from the aspect of water resources. Appropriate organization of the construction site and practical application of the prevention measures during the construction, as well as appropriate maintenance of internal water drainage structures and treatment of waste waters from motorway during the exploitation can prevent potential adverse impact on quality of ground and surface waters.

Accidental situations present a risk of pollution, especially if they involve heavy vehicles transporting hazardous cargos (traffic accidents, malfunctions), since they represent particular danger, and cannot be predicted in time and space.

The analysis of hydro-geological characteristics of corridor showed 33 sensitive areas classified as aquifers (designated by orange hatch in the Annex No. 12.3.5.). Additionally, in terms of construction and exploitation, watercourses banks along the motorway (located near the motorway route or those over which the motorway passes) can be considered as sensitive areas, as well as surface waters (springs) within or out of public water supply systems.

Graphical presentation of sensitive areas has been made using hydro-geological maps in the scale of 1: 25.000. Having in mind importance of these sensitive areas and large scale potential adverse impacts, there is a need to carry out detailed hydro-geological investigations, and present them in the scale of 1:5.000, within the next phases of motorway design. Above-mentioned sensitive areas should be presented on this graphical base. Only detailed hydro-geological investigations of terrains over which the motorway route passes, enable appropriate estimation of potential adverse impact on water resources.

Route of the planned motorway is nowhere situated within defined water protection zones of drinking water sources, but it passes through aquifer areas which can be used for water supply in the future.

Taking into consideration concrete local conditions, described within the present state (hydro-geological characteristics, hydrological characteristics, etc.) it can be concluded that these are very important water resources and there is a particular interest to make an overview of all potential adverse impacts and define adequate measures for prevention/minimization.

Bearing in mind all mentioned above, impact of the motorway on waters will be observed through two aspects, as follows:

- Impact on waters during construction phase,
- Impact on waters during exploitation phase.

Impacts on waters during construction phase

During construction operations on motorway route there is a certain number of activities, which can have adverse impact on water flow regime as well as on water quality. From that point of view, the greatest dangers are as follows:

- The construction activities (mining, deep excavations, destruction and removal of natural surface cover, etc). Disturbances can be caused to natural water recharging directions and at the same time by removing of surface cover and creating of new runoff areas turbid or in the other way polluted water can be quickly drained into the underground.
- Construction machines – potential danger of spilling or accidental leakages of oil and oil derivates, throwing away of motor oils and similar wastes.
- Uncontrolled disposal of excavated materials, placing mechanical bases or asphalt bases near surface and ground waters.
- Using inappropriate construction materials.
- Uncontrolled drainage of sanitary waters from the camps for workers lodging, which can cause minor pollutions from the food preparing process, as well as from sanitary facilities.

According to physical position of the route of planned motorway there are potential very significant impacts on surface and ground waters as consequence of motorway construction operations.

The water sources within the public water supply systems of Zenica, Žepče, Kakanj, Maglaj and Kiseljak, are significantly distanced from the motorway route, so there is **no expected adverse impacts** on them.

Having in mind hydrological characteristics and relations along the examined section of LOT 2, as well as passing of the motorway route in relation to some **local** (village) **drinking water sources**, mentioned in the Chapter 4.5.1.1., stationed along the motorway route within the examined corridor, it can be said that construction operations can pose **significant impact** on these water sources. That is especially related to water sources turbidity, but also to disturbances in hydraulic water flow regime in the case of massive mining, and pollution caused by different harmful substances used for construction or operation of construction machines

By analyzing hydro-geological aspects, as well as hypsometric position of these water sources in relation to motorway route, above-mentioned adverse impacts during the construction operations are most pronounced on the following local water sources:

- Water source of the local water supply system Tešanjka (Municipality of Tešanj)
- Water sources: "Kilavi Dolovi", "Šume" and "Grab" (Municipality of Doboj – Jug)
- Water sources on the area of MZ "Novi Šeher" (Municipality of Maglaj)
- Water sources: "Jezera", "Studenac", "Trnčić", "Orašje", "Sojtovača", "Ivićeva voda", "Hasanbegova voda", "Skakavac", "Grab", "Markova voda", "Matina voda", "Maline", "Krmare", "Torovi", "Vučijak", "Jurjevac", "Brezik", "Dolina", "Šuma" (Municipality of Žepče)
- Water source "Klopče" (Municipality Zenica)
- Group of water sources of thermal, mineral and thermo-mineral water in the area of Tičići, group of water sources within MZ "Hrasnica", group of water sources MZ "Slivnica", group of water sources MZ "Dumanac", group of drinking water sources MZ "Tičići", water source "Lokvač", water source "Dumanac", "Crvena voda" (Municipality of Kakanj)
- Water sources "Laze", "Gaj", "Vukuše" (Municipality of Kiseljak, MZ "Lepenica")

All mentioned water sources are marked on the map of limitations for water resources (Annex 12.3.5.), with the exception of local water sources within Žepče Municipality, which are, on this map, marked as a group of water intakes, according to the small distance between them. Detailed data on these water sources (capacity, number of inhabitants they supply) are presented in the questionnaires in the Annex 12.2.

In the case of water sources turbidity, which is the most probable impact, it should be emphasized that this phenomenon is not permanent and after termination of construction operations with taking of necessary measures on remediation of excavations and appropriate drainage, the turbidity will be reduced or completely disappear. With the aim of prevention and minimization of potential adverse impacts on these water sources during the construction operations, there is a need to take all necessary measures in order to prevent erosion in the zone of excavation, as well as leakages of oil from construction machines as much as possible.

The **ground water sources of permanent or temporary character** have been identified along the route of the LOT 2, whose position has been identified through analysis of hydro-geological soil structures within the motorway route area. There are potential **significant impacts** on water regime and quality in all places where the route is passing closely to these water sources. Having in mind that those water sources are great potential for water supply in the future, there is a need to apply all measures for prevention of adverse impacts described in the chapter 6.3.2. It should be emphasized that there is no data on their capacity, as well as their basic hydro- geological parameters, which should be investigated in detail within the further work on the project design.

Having in mind results of hydro-geological investigations of **Tičići** water source, i.e., that terrain in this location is mostly formed of impermeable deposits, which represent cover barrier to thermal water aquifer in this water source, it can be concluded that construction operations and exploitation of the future motorway with applying of all proposed measures for prevention and minimization cannot pose adverse impact on this water source. In favour of this is also the fact that the motorway route is hypsometrically lower than the water source.

There are possible significant adverse impacts on water resources during the construction phase, in all situations where the motorway passes over the watercourse, as well as in the areas where the route is situated along the watercourse banks. This especially relates to interchange locations situated near the watercourses, where large scale construction operations are expected. At all these locations, construction activities can cause particularly increased turbidity of surface watercourses, but also their covering and pollution by harmful materials. The adverse impact on these sensitive areas will be minimized by application of proposed pollution prevention measures.

The motorway route crosses or is situated near 33 sensitive areas classified as aquifers, where significant adverse impacts on ground waters are possible. There is also a problem of inexistence of investigation data on their depth and capacities, thus the assessments of motorway construction impacts, but also impacts of groundwater on the motorway itself, must not be taken with 100% confidence. During the impact assessment the priority was their significance from the aspect of water supply in future, especially having in mind outstanding trend of shortage of quality drinking water, i.e. aspiration to be on the side of safety. In current situation, such practice is completely justified, since potential consequences could be permanent. By applying all proposed pollution prevention measures during construction, the potential impact on these sensitive areas will be minimized. However, the need remains to carry out detailed investigations during the following phases of project designing, having in mind also their potential impact on the motorway. In accordance with this, there is a need to carry out control of our assumed impacts on waters on the basis of data which that will be obtained after finalization of investigation works, i.e. hydro-geological maps and longitudinal profiles of the narrow motorway zone, in more detailed scale (for example 1:5.000).

All characteristic places of the motorway passage over the watercourse along the LOT 2 per sections are given in the Table 5.2.4.1. that follows. Also, the expected impacts on the surface waters are presented.

Table 5.2.4.1. Characteristic places of the motorway passage over the watercourse along the LOT 2 per sections

<table>
<tr><th>Motorway chainage</th><th>Location/
watercourse</th><th>Length and the way of watercourse training/
Bridge on the watercourse</th><th>Expected impact on waters</th></tr>
<tr><td colspan="3">Section 1.
Karuše – Medakovo
Km 0+000 – 4+000</td><td rowspan="5">Pollution of the surface waters due to:
➢ Carrying out the construction works (mining, deep excavations, destroying and removal of the natural cover layer, concrete-work, reinforcing and similar).
➢ Accidental spillages or accidental pouring out the oil and oil derivates, disposal of the motor oil or similar waste.
➢ Usage of the inappropriate materials for construction
➢ Turbid or in other way polluted surface water can be drained in the coastal underground aquifers and pollute them.
➢ Uncontrolled drainage of the sanitary waters and polluted rainwater at the construction sites.
Change of the surface water regime (quantity) due to uncontrolled disposal of excavated material into the watercourse riverbed.</td></tr>
<tr><td>Km 0 +750 to 4+250</td><td>Balnjača Luke Village

Tešanjka River</td><td>River training length L= 3,605 m – riverbed trained with the reno mattresses</td></tr>
<tr><td>Km 0+877.410</td><td>Bridge on Tešanjka River</td><td>Concrete bridge</td></tr>
<tr><td>Km 1+763, 190</td><td>Bridge on Tešanjka River</td><td>Concrete bridge</td></tr>
<tr><td>Km 3+121,860</td><td>Bridge on Tešanjka River</td><td>Concrete bridge</td></tr>
</table>

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters
Section 2. Medakovo – Ozimica Km 4+000 – 24+876,40			Possibility of occurrence of more massive disposing of the deposit, and by that also filling of the riverbed by reducing of its flow capacity what can have the adverse consequences during the passage of the high floodwaters.
Km 4+600 to 4+800	Obrenovac Trebačka River	River training length L= 200 m – riverbed trained with the reno mattresses	
Km 5+000 to 5+200	Obrenovac Trebačka River	River training length L= 180 m – riverbed trained with the reno mattresses	
Km 5+900 to 6+100	Bare Trebačka River	River training length L= 239 m – riverbed trained with the reno mattresses	
Km 6+900 to 7+100	Toplik Trebačka River	River training length L= 215 m – riverbed trained with the reno mattresses	
Km 6+917.00	Bridge on Trebačka River	Concrete bridge	
Km 8+500 to 8+800	Dolac Trebačka River	River training length L= 320 m – riverbed trained with the reno mattresses	
Km 9+150 to 9+350	Luke Trebačka River	River training length L= 215 m – riverbed trained with the reno mattresses	
Km 10+150 to 12+820	Karadaglije Trebačka River	River training length 2890 m - riverbed trained with the reno mattresses	
Km 10+840	Čaglići Trebačka River	Concrete bridge	
Km 11+046	Čaglići Trebačka River	Concrete bridge	

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters
Km 11+611	Zaimovići – Alispahići Trebačka River	Concrete bridge	
Km 12+748	Karadaglije Trebačka River	Concrete bridge	
Km 16+050	Mladoševica – Stupina Strupinski stream	Concrete bridge	
Km 16+730	Mladoševica – Stupina Strupinski stream	Concrete bridge	
Km 17+980 to 18+340	Galovac Strupinski stream	River training length L=373 m - riverbed trained with the reno mattresses	
Km 18+950 to 19+850	Galovac Strupinski stream	River training length L=940 m - riverbed trained with the reno mattresses	
Km 20+150 to 20+250	Ljubatovići Strupinski stream	River training length L=110 m - riverbed trained with the reno mattresses	
Km 21+150 to 21+400	Ljubatovići Strupinski stream	River training length L=230 m - riverbed trained with the reno mattresses	
Km 21+650 – 22+000	Bečkića selišće Strupinski stream	River training length L=390 m - riverbed trained with the reno mattresses	
Km 22+650 to 22+980	Bečkića selišće Strupinski stream	River training length L=350 m - riverbed trained with the reno mattresses	

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters
Km 23+269,90	Ozimica Liješnica River	Concrete bridge	
Km 23+668	Bečkića selišće - Ozimica Strupinski stream	River training length L=348 m - Ozimička petlja and L= 60m Goliješka petlja - riverbed trained with the reno mattresses Concrete bridge	
Section 3 Ozimica – Poprikuše Km 24+876,40 – 37+740			
Km 28+026,440	Tatarbudžak Stream 50	Concrete bridge	
Km 28+676,440	Tatarbudžak Stream 51	Concrete bridge	
Km 28+876,440	Tatarbudžak Stream 52	Concrete bridge	
Km 29+626,440	Vašarište – Bljuva Bljuva Stream	Concrete bridge	
Km 32+026,440	Papratnica Ljubna River	Concrete bridge	
Km 32+526,440	Papratnica Papratnica River	Concrete bridge	
Section 4 Poprikuše – Nemila Km 37+740 – 46+388,80			

Motorway chainage	**Location/ watercourse**	**Length and the way of watercourse training/ Bridge on the watercourse**	**Expected impact on waters**
Km 41+690	Kahriman i Sarevački stream	Concrete bridge	
Km 42+970	Topčić field Stream 63	Concrete bridge	
Km 43+170	Topčić field Kočin stream	Concrete bridge	
Km 46+090	Orahovačko field Krivača River	Concrete bridge	
Section 5. Poprikuše – Nemila Km 46+388,80 – 58+434,60			
Km 46+500	Orahovačko field Stream 71	Concrete bridge	
Km 46+800	Nemila Repeljski stream	Concrete bridge	
Km 47+000	Nemila Selački stream	Concrete bridge	
Km 47+540	Nemila Stream 75	Concrete bridge	
Km 47+670	Nemila Stream 76	Concrete bridge	
Km 56+300	Vranduk Stream 80	Concrete bridge	

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters
Km 56+650	Vranduk Jelovik Stream	Concrete bridge	
Km 57+860	Donja Gračanica Gračanička River	Concrete bridge	
Section 6. **Donja Gračanica – Drivuša** **Km 58+434,60-66+941,10**			
Km 58+537,350	Donja Gračanica Suha River	Concrete bridge	
Km 59+640	Zenica - Dobra voda	Concrete bridge	
Km 61+036	Zenica – Kopilo Babina River	Concrete bridge	
Km 64+540	Zenica – Perin Han Stijenčice Stream	Concrete bridge	
Km 65+580	Zenica – Perin Han Stream 87	Concrete bridge	
Km 65+690	Zenica – Perin Han Đulanova River	Concrete bridge	
Section 7. **Drivuša - Kakanj** **Km 66+941,10 – 82+121,10**			
Km 67+691 to 67+941	Drivuša Bosna River	River training length L= 250 m – riverbed trained with the reno mattresses	

Motorway chainage	Location/ watercourse	Length and the way of watercourse training/ Bridge on the watercourse	Expected impact on waters
Km 68+321,10	Janjići Prihodi Stream	Concrete bridge	
Km 75+537,30	Modrinje Repovački Stream		
Section 8. Blažuj – Tarčin **Km 0+000 – 18+885,40**			
Km 1+770	Vlakovo – crossing Kulićev Stream	Concrete bridge	
Km 4+050	Kobiljača – Rudnik Rakovica River	Concrete bridge	
Km 4+700 – 5+750	Rakovica Kremikovac Stream	River training length L= 850 m – concrete riverbed	
Km 7+400	Azapovići Stream 109	Concrete bridge	
Km 9+300	Kulliješ Stream 113	Concrete bridge	
Km 10+720	Donji Bojakovići Stream 114	Viaduct	
Km 11+120	Solaković Stream 115	Concrete bridge	
Km 11+950	Zabrđe – Mokrine Mlinčići Stream	Viaduct	

Motorway chainage	**Location/ watercourse**	**Length and the way of watercourse training/ Bridge on the watercourse**	**Expected impact on waters**
Km 12+675	Zabrđe – Mokrine Stream 117	Concrete bridge	
Km 13+037.890	Zabrđe Tisovački Stream	Concrete bridge	
Km 18+330	Tarčin Mlavica Stream	Concrete bridge	
Km 18+300 to 18+500	Tarčin Bijela River	River training length L= 230 m – riverbed trained with the reno mattresses	
Km 18+512	Tarčin Korča River	Concrete bridge	

Having in mind that those who were preparing the study had no access to the solutions on the level of Preliminary Design on Watercourse Regulation, and structures within the motorway route, it was possible to make only general assessment of their impact during the construction phase according to practice from literature. More exactly, it can be said that this impact can be **very significant** if there is no use of environmentally friendly practice for river training during the project design. An overview of the necessary measures to prevent/minimize adverse impacts is given in the Annex 6.3.2.

5.2.5. Impacts on Air

Almost the entire mechanisation of motorway construction causes a lot of noise and vibrations. Not only in the area where the works are implemented but also in the pre-fabrication area (stone-crushing, separation, concreting, asphalt base) and on the roads where vehicles move. At the same time, significant emission of harmful materials into the air occurs (CO, sulphur, soot, CO_2), and “raising” of dust when machines and vehicles work.

The Table 5.2.5.1. below gives a review of the estimated quantities of fuel and lubricants by section which can indicate potential contamination of the air (but also of the water in case of accident!)

Table 5.2.5.1. Review of the estimated quantities of fuel and lubricants by section

SECTION:	Fuel and lubricants consumption:
KARUŠE - MEDAKOVO	2.300.000 kg diesel fuel; 69.000 kg oil and lubricants
MEDAKOVO - OZIMICA	7.240.000 kg diesel fuel; 218.000 kg oil and lubricants
OZIMICA - POPRIKUŠE	3.884.000 kg diesel fuel; 117.000 kg oil and lubricants
POPRIKUŠE - NEMILA	2.320.000 kg diesel fuel; 70.000 kg oil and lubricants
NEMILA – D.GRAČANICA	3.460.000 kg diesel fuel; 104.000 kg oil and lubricants
D.GRAČANICA - DRIVUŠA	1.990.000 kg diesel fuel; 60.000 kg oil and lubricants
DRIVUŠA - KAKANJ	2.160.000 kg diesel fuel; 65.000 kg oil and lubricants
BLAŽUJ - LEPENICA	2.840.000 kg diesel fuel; 85.000 kg oil and lubricants
LEPENICA - TARČIN	2.640.000 kg diesel fuel; 80.000 kg oil and lubricants

Explosions for the purpose of excavation in rocks present a special problem and risk for the population – especially in the open (on a section of the road, in stone-pits – borrow sites) and to a smaller degree in tunnels. Besides a threat to life, short and intensive impacts of vibrations, noise and emission of harmful substances also appear – products of explosions and large quantities of stone dust.

5.2.6. Impact on Soil and Agricultural Land

All water sources or underground water have not been detected properly due to insufficient surveys (attention is not paid to that during execution of the works); when the precipitations are intensive these underground water sources are activated and they cause erosion of material in the subsoils, on the embankments or on the edge of cutting slopes – which as a consequence endangers stability of the ground structure, and in parallel with that changes geo-morphological relations.

Inadequately designed inclinations of the slopes on the embankments and at the motorway alignment cuttings (but also in the borrow pits or the material waste areas) in combination with the precipitations and underground water sources cause landslides and slippage of material onto the road. Inadequate blasting techniques leave the risk of postponed slippage of material or stone blocks from the slopes.

Mixing of fertile soil (surface layer – humus) with infertile soil and permanent loss of soil through erosion.

Sedimentation of dust and possibly detritus onto the surrounding agricultural soil reduce its productivity and efficiency.

Soil together with water and air makes the most important segment of the environment, therefore, the following has to be emphasized:

- Soil ageing process is a very slow and long lasting process (a period of almost 1000 years is needed for creation of one centimetre of soil on a hard limestone soil) ,
- Soil is practically an unrecoverable resource and it is permanently lost once it is used for developments,
- In the territory of the FBiH the amount of high quality arable land is very small and its share is constantly reducing.

The facts mentioned above pressurise us to create a clear picture of all negative impacts that the motorway can have on the soil and arable land, in order to undertake all necessary prevention measures and measures for protection of those resources.

Construction stage impacts (direct impacts)
The following processes can be expected during the motorway construction stage:

- Destruction – permanent loss of soil (pedocide),
- Disturbed access to the farms or to the plots of arable land,
- Soil degradation (erosion, aquifers, waste areas, construction sites, storage areas, borrow pits, etc.),
- Soil contamination (spilling of oil, lubricants or fuel),

Soil destruction
Construction of the motorway will cause physical destruction of soil due to construction of the motorway itself as well as the motorway services in the Corridor. Those losses of soil refer to the following:

- Construction of the traffic lanes and the motorway reserves,
- Construction of interchanges and toll plazas,
- Construction of shoulders and verges,
- Construction of drainage systems and the plants for treatment of drain and discharge waters,
- Construction of rest areas and parking lots,
- Construction of petrol stations, hotels and restaurants,
- Construction of prevention and emergency services,
- Construction of maintenance services,
- Other facilities.

Disturbed access to the farms or to the plots of arable land

Some stages of construction will give rise to prevention of adequate usage of agricultural land due to disturbed access to the farms or to the plots of arable land, which as a consequence may cause additional transportation costs to the farmers or inadequate use of agro-technical measures. This will happen during execution of the following works:

- Construction of the motorway, i.e. during cutting of slopes and consruction of the embankments,
- Regulation of river beds or minor water courses,
- Boring of tunnels,
- Construction of bridges and viaducts
- Construction of temporary facilities

Soil degradation

Using the access roads and determining the alignment of the future motorway will cause soil degradation which reflects through:

- Appearance of erosion due to removing vegetation and excavating the soil;
- Appearance of aquifers due to collecting run-off and drained water;
- Constructing the site facilities (accommodation, parking places, storage and storing areas, etc.)
- Establishing storage for the stripped fertile topsoil;
- Using the borrow pits for filling, etc.

Soil contamination

During construction of the motorway due to extensive usage of construction machines and heavy vehicles for transportation of construction materials, as well as due to installation of those materials there is a great possibility of contamination of soil caused by oil, lubricants or fuel spillage, which will reflect through:

- Organic pollutants, presence of various hydrocarbons (light or heavy fractions).

5.2.7. Impacts on Flora and Fauna

An unavoidable consequence of the work execution in the motorway zone is destroying of autochthonous plant complex. But, by careless and negligent relation toward the plants, the contractors often affect and destroy plant zone in scope bigger than designed road zone.

Soil erosion caused by water because of artificial change of relief (cuttings/embankments) additionally endanger flora through baring or depositing of sediments /filling in. Depositing of dust particles and other pollutants (soot, motor oil drops, or drops of some other compound appeared after explosion) directly on plants reduce their physiological functions, endangers process of multiplication, leads to disease and destruction.

All technical activities at the motorway construction mostly endanger fauna, in direct zone of construction as in significantly wider area. Natural habitats of fishes, amphibians, reptiles, insects, birds and game will be physically endangered, and many of individual animals will be destroyed in phase of the work execution (more mobile types will take away on time). Intensive noise, vibrations, emissions of pollutants in area of work execution will lead to moving fauna out.

The zone of the work execution will be physical barrier (and at the same time a danger) for usage of natural corridors of animals' movements over terrain. That is an additional negative effect which interrupts instinctive animals' behavior, decrease quality of their natural living conditions, and also quality in total of ecosystem functions. Many of natural watering and breeding places will be destroyed or endangered by technical activities on the motorway construction, and that has direct impact on fauna. Especially is expressive risk for water animals: if excessive water pollution occurs – their destroying is unavoidable.

Careless work execution (and often intentional) can injure or kill animals (especially fishes, birds and game) in wider zone of work execution. Careless activities on terrain (letting of water or prevention of water leak, creation of mud and swamp terrain) cause suppositions for multiplication and widening of disease carriers (mosquitos etc.).

The food source is being reduced for the aquatic organisms and habitats of water insects disappear by river training of the riverbed due to the removal of the vegetation.

Due to the works that follow the bridge construction the additional covering and filling the riverbeds will occur which will have significant impact on the composition and numerosity of fauna.

This impact reflects in the form of direct stress that will directly and indirectly have impact on reduction of populations or disappearance of the individuals of especially sensitive species.

Removal of coastal vegetation, mining and similar can cause additional losses of microhabitats.

Due to operation of large machines, there is a possibility of discharge of oil or petroleum into the river course and it can lead to change of abiotic conditions that will initiate withdrawal of hydro bionates toward the lower parts of watercourses.

Precise overview of impacts on fauna during motorway construction, for each section, is shown in the following tables.

Table 5.2.7.1. Precise overview of impacts on fauna during motorway construction for each section

SECTION 1. KARUŠE-MEDAKOVO	Site	Penavino hill from the right side of the alignment, 1.5-2 km from the starting point
	Fauna	Rare bird species, squirrels, rabbits
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected
	Site	River Usora 0+207,684
	Fauna	Endemic species of water moth *(Trichoptera)*
	Impact	During removal of bank vegetation, vanishing of this specie can directly be caused, or even its dying.

SECTION 2. MEDAKOVO-OZIIMICE	Site	Part of the alignment with the plant communities Salkovića hill, Križanovo hill, Šiljati vrh (Sharp Peak), Tešanj – Crni vrh (Black Peak)
	Fauna	Birds: wryneck, quail, pheasant, squirrels, rabbits, foxes and wild boars
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected
	Site	River: Trebačka, 2km from the beginning of the section, Strupinska River between the Cakrame village and Ljubatovići
	Fauna	Birds, insects that are water dependant during the larva period
	Impact	Rare bird specimens will move to the more peaceful parts due to the noise created during construction. During cutting of bank willow vegetation, there will be direct impacts on habitats and composition of fauna hydro-bionates, in water ecosystems, which shall lead to its degradation in this part of the watercourse

SECTION 3. OZIMICE-POPRIKUŠE	Site	24+901,587 to 34+000
	Fauna	• Birds: roller, swift, pigeon, quail, pheasant; • mammals: squirrels, rabbits, foxes and wild boars with dense populations
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected
	Site	Žepče surroundings
	Fauna	Birds
	Impact	Due to general degradation of vegetative cover and noise, all species will withdraw to deeper parts of habitats, and this should be performed with the smallest possible losses

SECTION 4. POPRIKUŠE-NEMILA	Site	38+617,44 to 39+618,00
	Fauna	Rare specimens of birds, squirrels, rabbits, foxes
	Impact	Moving or withdrawal of species due to the cutting of forest and loss of habitats, whereby the losses of individuals of certain species are expected
	Site	Jezeračka mountain -Nemila
	Fauna	Birds: type of pigeon *Columbia palumbas* which is protected specie according to the IUCN´s Red List and Bird Directive
	Impact	Because of the construction works there is a possibility of species withdrawal, but also possible vanishing
	Site	Bosna river
	Fauna	Important place within the aquatic fauna belongs to the densely populated colony of cyprinid type of fish, while in the other part of aquatic fauna, the dipterous insects are dominant, sparsely bristled animals, and leech as typical inhabitants of polluted running water
	Impact	Because of the construction works, the excess situations are possible, leakage of lubricants, oil, or sliding of land which will probably condition the losses of aquatic fauna or their movement, which is especially related to ichthyo-populations

SECTION 5. NEMILA-DONJA GRAČANICA	Site	Vranduk 50+000 - 51+000
	Fauna	Birds: gull, pigeon, *Otus scopus* i *Cuculus canorus*. The type of gull registered in this area is one of the protected species according to the European Directive – Annex II – III, rare specimens of small game
	Impact	Due to construction works there is a possibility of losing some species and not having enough space for nests.

SECTION 6. DONJA GRAČANICA-DRIVUŠA	Site	Bosna river bank zone
	Fauna	Rare specimens of birds, ducks Water fauna: well developed cyprind fish fauna, aquatic species of insects, rare specimens of crayfish, leech, snails
	Impact	Because of the motorway construction there is a possibility of bank erosion and covering of sediments, changes in the composition of zoo benthos, which will impact the change in composition and numerosity of ichthyo-populations
	Site	Zenica 60+000 to64+000
	Fauna	Birds: gull, *Pluvialis apricaria, Corcius garrulus i Otus scopus*
	Impact	Withdrawal of birds habitats with smaller losses

SECTION 7. DRIVUŠA-KAKANJ	Site	Kakanj from75+000 to 80+000 – Bosna river bank
	Fauna	Migratory bird types: gull, pigeon, magpie, wryneck, swift
	Impact	Cutting of the flying corridor and its changes
	Site	Vijenac (Okrugla) – Donji Lučani – oak and hornbeam forest
	Fauna	Squirrels, rabbits, quails, pheasants, rare specimens of reptiles
	Impact	Fragmentation of habitats, which will until the adaptation time indicate destruction of a larger number of individuals
	Site	Bosna river with smaller tributaries
	Fauna	Cyprinid fish types, barbel, sparsely bristled animals, leeches, dipterous insects
	Impact	Because of the motorway construction, negative impacts on water ecosystems of Bosna River as well as of the streams flowing into this watercourse are possible, which will initiate movement of aquatic fauna

SECTION 8. BLAŽUJ-TARČIN	Site	Lepenica
	Fauna	Water fauna: Trout, Miller's thumb, water moth, large diversity of water flowers, wheateater, crayfish
	Impact	Because of the degradation of bank vegetation the movement of water insects or their vanishing is possible, and also sliding of land is possible and changes in the composition of zoo benthos, which can cause disappearance of movement of ichthyo-populations.
	Site	River Bijela – crossroads Tarčin-Kreševo
	Fauna	Appearance of crayfish, which is according to the IUCN´s Red List the rare and endangered species
	Impact	Species very sensitive to the anthropogenic impacts and every activity can initiate its vanishing
	Site	Blažuj
	Fauna	Birds flying over this area:eagle-owl, bee-eater
	Impact	Cutting of the flying corridor

5.2.8. Impact on Landscape

There is no significant impact on the landscape during the construction phase if the measures for increase/elimination of impacts which are as a result of technological actions and are properly implemented. Experience shows that the most frequent impacts on landscape occur in cases of unpredicted slippage of excavated material down the slopes if the motorway is in a cut which seriously (and permanently) damages the landscape.

Special visual disturbance for the landscape is caused by placing temporary soil deposits by the road which are very often not removed afterwards.

5.2.9 Impact on Protected Parts of Nature

There is no special conditions.

5.2.10 Impact on Cultural and Historical Heritage

Facilities with cultural and historical significance are situated in the zone of direct impact of the road construction – most of them have been recorded but only in exceptional cases registered. Taking into account all types of direct impacts on the heritage, and in some special cases wider areas with extremely valuable cultural and historical heritage e.g. areas with established space restrictions have been observed and also marked on the wider area of the motorway route.

The impact of construction of a motorway on cultural-historical heritage can be direct and indirect. Direct impact is physical destruction of facilities/sites within the anticipated impact zones. The space of approx. 300 m on the both sides of the route axis has been defined as the boundary for the impact on archaeological sites and individual cultural-historic buildings. Indirect impact is damaging of the integrity of an area which belongs to cultural facilities. The space within 1500 m on the both sides of the route axis has been defined as the boundary for the impact on cultural facilities with space feature.

Indirect impacts refer to construction entities, historic centres and rural areas which are in direct contact with the route; the construction and operation of the motorway will impact upon them in terms of appearance and content (historic centre) of Tešanj, Maglaj, Žepče, rural entity Željezno Polje, Bobovac and Kraljeva Sutjeska, natural-construction entity Ilidža and other entities and individual buildings, including museums, which have been mentioned as legally protected or recorded in the first chapter hereof.

The vicinity of the road may decrease visual values of the wider surroundings of individual sites. If the protection of some cultural-historical heritage facilities is ensured, which has not existed up to now, we can say that a positive impact of the road on heritage has been achieved. Analysis of the impact of the motorway on cultural-historical heritage has been done on the grounds of the existing documentation of the Commission for preservation of national monuments (data on registered, preventively protected and recorded cultural facilities etc.), on the grounds of written and other data (published and unpublished), insight in the Strategy of urban development of the Federation of Bosnia and Herzegovina and Urban plan of Bosnia and Herzegovina. Field trips have not been conducted before development of this phase of study.

Large numbers of protected and recorded sites and buildings, which belong to cultural-historical heritage of Bosnia and Herzegovina, are situated in the impact area of motorway, LOT2. Special attention should be paid to the protection of sites such as historical entities Vranduk and Varošište, Zenica (sector III), the church of St. John the Baptist with tombstones from the Middle

Age within Orthodox graveyard, Bilješevo, Kakanj (sector IV) and archaeological sites in Rakovica, Ilidža, at the beginning of sector V. If it is established, on the basis of detailed maps and field trips, that it is not possible to prescribe sufficiently efficient measures for the mitigation of negative impact of the road on the above mentioned facilities, the designers will be recommended to consider such areas with the highest degree of restrictions, and to avoid such areas in their preliminary designs.

The change of underground flows can have a significant impact on the standing of cultural-historical heritage and thus this aspect will be separately discussed within the heritage impact study, and the same refers to chemical pollution impact which is the consequence of construction and operation of the motorway.

5.2.11. Impact of Noise, Vibrations and Lights

Almost the entire mechanisation of motorway construction causes a lot of noise and vibrations not only in the area where works are implemented but also in the pre-fabrication area (stone-crushing, separation, concreting, asphalt base) and on the roads where vehicles travel. The sources of construction noise are implementation of construction works in the construction sites (heavy machines, possible mining of tunnels on the construction sites) and the noise cased by the movement of the machines used for construction works.

At present, there is no information available about areas where the construction works will take place, equipment or schedule of works, so it is not possible to make projections about noise that will be created on the construction site, nor its impact on residential areas.

A detailed concept of implementation of the construction works is not available, including access routes, and it is not possible to determine levels of movement of vehicles on these roads. However, a general requirement for the contractor concerning mitigation measures will be usage of modern equipment with noise silencers, and respecting the normal working hours during a day (exceptions can be granted for some facilities such as tunnels). However, it is best to use the equipment which complies with the requirements of the European Directive EC/2000/14 about emission of noise made by the equipment which is used in the open e.g. equipment identified by the EU declaration on compliance. It is necessary to limit work with noisy equipment near residential areas as much as possible and/or use screens e.g. putting of equipment behind natural noise barriers, piles, containers etc. that may serve as protection, and putting the equipment far from residential areas.

A special problem is mining for the purpose of excavation in rock – especially in the open (on a section of the road, in stone-pits – borrow sites) and to a smaller degree in tunnels where more intensive but shorter impacts of vibrations occur (special impact can be produced by seismic effect of the explosion because the wave can be transferred to the surroundings through the land).

5.2.12. Impacts on Infrastructure

At locations where the power-transmission lines intersect with the motorway, there is a possibility that some reconstruction works on such power-transmission lines will have to be undertaken, in order to comply with safety regulations and some technical elements.

- **Section 1. / Karuše – Medakovo /**

Power-transmission line 400 kV Tuzla – Banja Luka, intersects the motorway alignment at the location of „Hrastik“ tunnel, therefore, there is no need for any reconstruction works to be undertaken at this section.

Power-transmission line 35kV TS „Jelah“ – the transformer station Matuzići Doboj South at the location of Tešanjka settlement, at km 0+200, bisects the motorway alignment so all necessary reconstruction works will have to be undertaken.

- **Section 2. / Medakovo – Ozimica /**

Power-transmission line 110 kV from the transformer station Misurići Maglaj to the transformer station Bukva, Tešanj, bisects the motorway alignment in the vicinity of Čaglići settlement, at km 6+950 to km 7+000, so that the route of the power-transmission line will have to be realigned. At the location of Ozimica settlement, there are several conflicts of the motorway alignment with the power-transmission lines 110 kV and 35 kV, so that the routes of these power-transmission lines will have to be amended.

- **Section 3. / Ozimica – Poprikuše /**

Power-transmission line 35 kV Zavidovići – Žepče – Maglaj and power-transmission line Maglaj – Zenica bisects the motorway alignment in the close vicinity of the town of Žepča. First location is near the bridge at km 29+810 and the second, over Donje Ravno tunnel, where there is no need for any reconstruction activities.

- **Section 4. / Poprikuše – Nemila /**

At this section there is no conflict between the power-transmission lines and the motorway alignment due to the fact that all power-transmission lines from Zenica pass on the west side of the motorway alignment.

- **Section 5. / Nemila – D. Gračanica /**

Power-transmission line 110 kV , which links the transformer station 220 kV Zenica 2 with the transformer station 110 kV Zenica 1 overlaps with the motorway alignment at several locations starting from km 55+670 until the end of the section, as well as in section 6. At these locations the route of the power-transmission line 110 kV will have to be realigned.

- **Section 6. / D.Gračanica – Drivuša /**

As mentioned above, the power-transmission line 110 kV between the transformer station Zenica 2 and the transformer station Zenica 1 from km 55+670 km to km 64+55 is overlapping with the motorway alignment, so the route of this power-transmission line will have to be harmonized with the motorway alignment.

There will also be a need for changing of the power-transmission line 220 kV route for Tuzla and Kakanj, then of the power-transmission line 110 kV for Zenica 2 – Cement Plant, Zenica 2 – transformer station Sjever, going out of transformer station 220 kV Zenica 2 located in Klopče settlement some 150 metres distance from the motorway alignment.

At Perin Han settlement there are two locations where the power-transmission lines 110 kV and 35 kV intersect with the motorway alignment, where the route of the power lines will have to be reconstructed.

- **Section 7. / Drivuša – Kakanj /**

Power-transmission line 220 kV Zenica 2 – Kakanj, near Modrinje settlement, at km 75 + 744 intersects the motorway alignment, railway line and the River Bosna. There will be no need here to make any amendments to the routes.

Power-transmission lines 110 kV Zenica 1. – Kakanj and Zenice 2. – Cement Plant, also intersect the motorway alignment in Tićići settlement. The motorway alignment on this section follows the alignment of the existing M–17 trunk road. These power-lines have already been adapted according to the safety regulations as they pass above the existing trunk road and the railway line.

- **Section 8 /Blažuj – Tarčin/**

Power-transmission lines 220 kV Kakanj – Jablanica and Kakanj – Konjic intersect the motorway alignment on this section at several locations, but due to the fact that the motorway alignment passes mainly through the tunnels, there will be no need for reconstruction of the power lines. This also refers to the power-transmission line 110 kV Kiseljak – Blažuj, which also intersects with the motorway alignment.

In the area of Zenica Municipality (Section Perin Han - Crkvica), the route of the gas pipeline is interwoven with the motorway alignment. There is a need to make technical solutions of the points of conflict between the gas pipeline and the motorway alignment. The routes of all planned gas pipelines (area of Kiseljak Municipality) have to be brought into accordance with the motorway alignment.

Conflict of the motorway alignment with the existing power transmission lines has to be solved through the detailed design phase. All the conflict points have to be eliminated during the preparation works.

There is a significant conflict of the motorway alignment with existing traffic routes of a higher rank: trunk roads and railway lines (dual track railway line, electrified railway line).

5.3. Impacts During the Exploitation

5.3.1. Social Impacts on Population

Vitality of social and economic communities very much depends on the quality of the implementation of economic and social activities. Ironically, the construction of roads which is the key factor for good functioning of these activities may sometimes result with the decrease of the quality of social and economic activities. Bad planning and designing of new roads are the main elements which hinder these activities. When making the analysis of the impact of the construction of motorways on social and economic activities in the area, the benefits of the motorway are mainly shown as savings in long-distance travel and the savings made in transport of goods, including the price of real estate.
.

Accessibility
Although it is hard to define, accessibility we could say it is related to increased traveling possibility with decreased travel time and/or costs or some other „obstacles“. That's why, the functional definition of accessibility should be: convenience to realize some economic or social activity using a transport system.

There are several methods to assess accessibility: From basic methods, which require a number of resources and limited expertise, to methods which comprise complex techniques. The most important methods are: (1) interviewing of target groups, (2) field researches, (direct observations of the analyzed area), (3) maps and aero-photos are efficient and cheap tool for accessibility assessment, (4) table calculation based on computer's ability to organize data from different origin-destination pairs, and from other specific information (signaling equipment, traffic flow speed, crossings etc.), (5) gravity model measure accessibility effects depending on market activities.

Social Unity
Social unity is used for description of social network structure in an area. Impact of investment in transport infrastructure on social unity could be favorable and unfavorable. Transport projects could separate and/or isolate location, but also bring to economic development, change in property value or separation of inhabitants from social infrastructure.

Interviewing of target groups, field research, aero-photo mapping and statistics are mostly used methods for assessment of impact of investment in transport infrastructure on social unity. Measuring of social unity changes require documentation of existing social network structure (basic case) and estimation of potential decrease or increase in social connection of analyzed area. Social unity impacts are limited. They don't have quantitative nature and they don't overlap with other impact categories (e.g. noise and distribution impacts).

Changes in transport system affects social unity through: direct influence on business and residential locations (adequate social infrastructure of the area - schools, hospitals, kindergartens and so on), direct influence of construction barriers (wide roads and big interchanges could create physical barrier between residential and business activities locations), indirect influence of psychological barriers (traffic noise, dust, traffic safety and so on).

Properties Value
Determination of properties value is much more than simple distinction between the object types and activities related to each parcel. Properties value comprehends range of human activities in built as well as natural environment. Properties value is important regarding of transport because at least three following reasons:

- Activities that use land are generating transport demand;
- Activities are more or less influenced by transport availability;
- Links between transport and activities are important for estimation of transport strategies - especially when it is analyzed if transport system secure accessibility needed for realization of activities.

It is important to recognize that system of properties value is not static and also that transport is just one of factors influencing change of properties use. Influence of transport system on properties value can exceed spatial range of investment. Most of location changes are caused by change of land use and use of existing objects, (either in density or nature, e.g. one business changed with another). If transport investment increase demand for space on a specific location, land price and rent also increase on that location. Changes in properties value are, beside that, influenced by accessibility, safety, traffic noise, visual attractiveness, social unity and business productivity.

Influence of single transport project on properties value could be positive in some areas and negative in others. Variability of influences depends on differences in specific factors: some effects, as availability, could arise in a wider area, while others, as noise, obviously affects smaller areas. Now motorway could change properties value between interchanges because of noise, air pollution etc., while properties value near interchanges increase value because of better accessibility and potential business productivity.

Effects on properties value of a single transport project also depend on land type (residential area / business area). For instance, investment in main city road (arterial) widening could rise value of parcels for commercial use because of better access of location user and at the same time decrease value of parcels for residential use because of noise etc.

Construction of motorway in analyzed area will bring higher speeds of traffic flows, changes in traffic flow and other changes that could affect socio-economic condition of the area. Major changes could be expected along the motorway route and at locations of future interchanges.

Table 5.3.1. Location and shape of intersections on the Corridor Vc - LOT 2

No.	Intersection type	Location	Chainage
1	Diamond	Medakovo	4.km
2	Trumpet (right)	Ozimica	25.km
3	Trumpet (right)	Poprikuše	38.km
4	Trumpet (left)	Nemila	46.km
5	Trumpet (left)	Donja Gračanica	59.km
6	Trumpet (left)	Drivuša	67.km
7	Bretela	Lašva – krak 2	69.km
8	Bretela	Lašva – krak 1	73.km
9	Trumpet (left)	Lepenica	10.km

New motorways may lead to the separation of local communities and cutting off of traditional lines of travel. Alternative routes for local traffic may become longer after the construction of a motorway which has direct impact on the business operations and non-motor traffic. However, the existing traffic flows should be preserved in further development of design documentation in both urban and rural areas.

In rural areas, pedestrian bridges, underpasses, and overpasses should be designed to ensure normal connections between villages and farms that might be cut off.

The 10th chapter of Backgrounds for planning documentation - LOT 2 gives guidelines for prevention and/or mitigation of afore stated potential conflicts. Interchanges positioning, spatial conflicts and need for traffic connection was also analyzed in the document.

A relatively big number of water course regulations and dislocations of local roads have been analyzed, as well as construction of a number of unleveled passes for connection of local population with regional roads and arable land. An overview of specific locations on adopted route of Corridor Vc motorway - LOT 2 follows:

Due to the technical route solution in the borderline part of the settlement Nemila, made up of continuant tunnels, it is not possible to form junctions on this part of the route. Positions of neighboring junctions in D. Gračanica, Zenica and Golubinja additionally support this choice.

Section 5 is bypass of regional center Zenica (which is also administrative center of Zenica-doboj Canton), so there are a lot of individual residential objects located near the adopted motorway route.

Due to the conceptual revision of the preliminary design of solution for connecting the motorway route to the existing highway Drivuša, there was a justifiable questioning of the need for the sub-junction construction in settlement Janjići.

The route adopted through Conceptual design has been changed, after request of Kiseljak municipality, because of elementary school vicinity.

Due to the presence of a cemetery in the urban area Toplice (municipality of Kiseljak), instead of by deep cutting, proposed by the conceptual design, passing of the route at this location should be realized through a short tunnel.

Interchanges Ozimica and Donja Gračanica are positioned so to disturb social unity of settlements and a number of individual residential objects. Change of micro location for those two interchanges should be considered.

5.3.2 Impact on Microclimate

The microclimate of some areas in Bosnia and Herzegovina is very complex. This also refers to some areas along the motorway route. Although the route mostly goes along river valleys, the microclimate of individual hill-encircled valleys, river mouths and canyons differs significantly. This is the reason why the impact on microclimate is complex.

Impact on temperature reflects on the increase of asphalt surface which is in general a good receptor of sunshine and the surface temperature increases (in the immediate area). This reflects in a decrease of the value of the relative humidity in the area and evapotranspiration. Because of this, in the circumstances of high temperature above the road, a specific trembling of air occurs and this creates the effect of mirage and may decrease visibility during the ride.

Intensified heating also impacts vertical flow of air above the road which may have influence on the precipitation regime, including intensified local turbulences of air. Besides this, temperature is influenced by the shape and setting of facilities on the motorway (tunnels, viaducts, larger buildings along the road etc.).

In principle, these effects are limited to the immediate area around the road. Having in mind the complex climate of Bosnia and Herzegovina, and the lack of experience in this sort of road, and also the lack of suitable measures, we recommend that automatic monitoring of meteorological parameters and air pollution parameters along the entire motorway route is introduced as soon as possible in the preparation phase and during the construction and operation. On the section from Doboj to Tarčin it is necessary to put automatic weather reporting stations in at least 20 locations, and at least 5 of them should measure all relevant meteorological parameters.

We emphasise that the above mentioned negative impacts on the microclimate can be considerably mitigated by growing green belt in the immediate area of the motorway.

5.3.3. Impact on Water

During exploitation and maintenance of the motorway there are permanent pollutions of the motorway and the belt along it, which have adverse impact on water quality and they are related to the following:

- Pollution of the stormwater runoff due to:
    - Spills and releases from the driving and lubricating systems (gasoline, oil, motor oils, cooling and braking liquids, etc.),
    - Remains of tires and asphalt wearing layer (remains of asphalt and bitumen),
    - Emissions of products from burning of motor fuels (lead and lead compounds, unburned hydrocarbons, nitrogen oxide, soot and tar). These polluting materials can be transported by storm water runoff, and get to surface and ground waters.
- Accidental pollutions caused by traffic accidents. Accidental situations can cause spills and releases of harmful and dangerous materials. The most frequent are those which cause releases of oil derivatives, with great capability of filtration into surrounding terrain and underground. Because of complexity of water flow regime and retention in underground, pollution by oil derivatives can be characterized as long term one. The pollutions can be activated under different hydro-geological conditions.

It can be emphasized that pollution loads in water which comes from the motorway are in direct relation to the number of vehicles that use this motorway. Having in mind the estimated average annual daily traffic of 20.000 vehicles, it is possible to expect significant impacts on ground and surface waters.

Having in mind that water **sources, which belong to public water supply system** of Zenica, Žepče, Kakanj, Maglaj and Kiseljak, are significantly distanced from the motorway route, **the adverse impact on them is not expected**.

As it is case during motorway construction, also during the motorway exploitation the most significant adverse impact is expected on the local (village) water sources. This adverse impact is assessed as significant and in accordance to this adequate measures for prevention /minimization have been proposed.

The adverse impacts during motorway exploitation, similarly as during the construction phase, are most pronounced with the following water sources:

- Water source of the local water supply system Tešanjka (Municipality of Tešanj)
- Water sources: "Kilavi Dolovi", "Šume" and "Grab" (Municipality of Doboj – Jug)
- Water sources on the area of MZ "Novi Šeher" (Municipality of Maglaj)
- Water sources: "Jezera", "Studenac", "Trnčić", "Orašje", "Sojtovača", "Ivićeva voda", "Hasanbegova voda", "Skakavac", "Grab", "Markova voda", "Matina voda", "Maline", "Krmare", "Torovi", "Vučijak", "Jurjevac", "Brezik", "Dolina", "Šuma" (Municipality of Žepče)
- Water source "Klopče" (Općina Zenica)
- Group of water sources of thermal, mineral and thermo-mineral water in the area of Tičići, group of water sources within MZ "Hrasnica", group of water sources within MZ "Slivnica", group of water sources within MZ "Dumanac", group of drinking water sources within MZ "Tičići", water source "Lokvač", water source "Dumanac", "Crvena voda" (Municipality of Kakanj)
- Water sources "Laze", "Gaj", "Vukuše" (Municipality of Kiseljak, MZ "Lepenica")

At all places where motorway route is situated near to ground water sources of temporary or permanent character, whose position is established by analyzing hydro-geological structures of the terrain, significant impacts on water quality are possible.

At all places where the motorway passes over the watercourse, as well as at locations where the route is situated along the watercourses banks, significant adverse impacts on water quality, during motorway exploitation, are possible.

Sensitive areas classified as aquifers can also be significantly endangered during the motorway exploitation.

All expected adverse impacts on above mentioned water sources can be mitigated or minimized by applying measures proposed under chapter 6.3.2 of this study.

The main characteristics of water pollution sources

The polluting process, according to its time characteristics can be permanent, seasonal and accidental.

The permanent (systematic) pollutions are mainly related to scope, structure and characteristics of traffic flow, characteristics of motorway and climate conditions. The consequence of the traffic flow is permanent deposition of harmful materials on the road surface as well as on the accompanying elements of vertical profile, which are washed out during precipitations. It is mainly about depositing of exhausted gases, oils and lubricants, wearing of tires and asphalts, wearing of vehicles bodies, etc.

Seasonal pollutions are mainly related to certain period of the year. Typical example of this type of pollutions is use of salt for motorway maintenance during winter or use of pesticides for green belt maintenance during vegetation period. This kind of pollution is specific because in very short time there are very huge concentrations of harmful materials.

Accidental pollutions are mainly caused by traffic accidents. Accidental situations cause releases and spills of dangerous and harmful materials. It is mainly about oil and its derivatives, although it is not rare that these accidents involve vehicles which are transporting harmful chemical products. In such case, the main problem is the fact that very high concentrations are created, which cannot be predicted in time and space. The main consequence of that, from environmental point of view, is the need to protect very broad areas.

Types, form of presence and quantity of polluting materials

Stormwater runoff from road surface contains large amount of harmful substances in concentrations that are frequently above the allowed limits for discharge into watercourses. These are mainly compounds of fuel such as hydrocarbon, organic and inorganic carbon, nitrogen compounds (nitrates, nitrites, and ammonia), sulphates, chlorides, etc. Particular group of elements is presented by heavy metals such as lead (fuel additive), cadmium, copper, zinc, mercury, iron and nickel.

The very important parts are solid materials with different structures and characteristics, which appear in the form of suspended or soluble particles. Additionally, it is possible to register substances which are consequences of use of anti-corrosion substances. Special group of very cancerous substances is presented by polyaromatic hydrocarbons (benzopyren) which are products of incomplete fuel burning.

The way to establish indicators which would serve for assessment of motorway impacts, implies primarily estimation of appropriate concentrations of polluting substances in waters coming from the motorway, and appropriate flow rates within the water runoff systems. Based on this, it is possible to estimate the total quantity of polluting substances that can reach receiving waters.

In accordance with mentioned attitudes, and on the basis of certain number of practical experiences from foreign countries, using interpolation procedure for different traffic loads, the assessment of the quantities of polluting substances in the stormwater runoff has been made. At this analysis level, it is possible to establish certain relations only with global parameters (traffic load, traffic structure, etc.). The expected values of polluting substances in the storm water runoff from the motorway, for LOT-2, have been shown in Table 5.3.3.1.

Table 5.3.3.1. The expected values of polluting substances in the storm water runoff from the motorway

Substances	Unit	Section Karuše-Medakovo – Blažuj-Tarčin
Suspended substances	mg/l	100-150
Chlorides	mg/l	50-80
Sulphates	mg/l	0.04-0.07
Total phosphor	mg/l	0.4-0.8
Motor fuel	mg/l	0.005-0.008
Mineral oils	mg/l	0.004-0.007
Cadmium	mg/l	0.002-0.005
Chromium	mg/l	0.004-0.008
Copper	mg/l	0.03-0.07
Iron	mg/l	0.1-0.3
Lead	mg/l	0.07-0.1
Zinc	mg/l	0.1-0.2

It is of special concern to examine total concentrations of polluting substances in motorway runoff. The main attitudes which are of special significance for estimation of polluting substances can be systematized in the form of following conclusions:

- The highest concentrations of polluting substances are registered in the motorway runoff during winter seasons, when the use of salt is most intensive.
- The concentrations of the most polluting substances are in direct relation to duration of dry seasons, before the rain and traffic load. The highest concentrations are in the first 5-10 minutes of the precipitation, and then they abruptly decrease.
- The concentrations of suspended particles are proportional to intensity of precipitation and the highest concentrations are during the highest water flows.
- Water losses, because of sprinkling during passing of vehicles do not exceed 10% of total losses.
- Dispersion of material from motorway during dry periods, caused by air circulation during passing of vehicles, does not have significant impact on decrease of concentrations.
- Surface water contamination caused by motorway runoff can be very significant. In accordance with that, there is a need to carry out detailed analysis and define the need for possible mitigation measures.
- The pollutions caused by traffic accidents present the specific problem and they are not included in previously mentioned opinions. The relations to these phenomena are analyzed separately within the chapter on possible accidents.

Impacts on waters in the case of accidents

In case of traffic accidents, especially those involving vehicles which are transporting harmful materials, there is possibility of spillage and releases of harmful and dangerous materials along the motorway, and possibly in the surroundings if there is no buffer fence or concrete blocks (New Jersey) in order to physically prevent vehicles from turning over. The most frequent are the accidents that cause spillage of oil and its derivatives, which have the large capability of diffusion into the surrounding terrain and underground. The probability of these impacts is small, however, if they happen, the consequences would be very heavy and lengthy. This impact is especially present on the locations where the motorway is passing through aquifers, near local water sources impact zones, and the edge of water protection zones, as well as on the locations where motorway crosses open streams.

Having in mind heavy consequences in case of accident, besides application of prevention measures, there is a need to develop emergency plan for both phase of construction and phase of exploitation.

5.3.4. Air Quality

Definitions and legislative framework
Talking about air pollution from a new transport infrastructure (in this case motorway), there is difference between:

- Air pollution in construction phase: building mechanization and asphalt base operation, dusting during transportation on provisional roads and building material manipulation. Air pollution limitation during construction is obligation of building company.
- Air pollution in operational phase: work of internal combustion engine and fuel evaporation. Main products of fossil fuel in internal combustion engines are carbon dioxide[30] and water. However, the engine inefficacy and high temperatures produce many other substances. Most important air pollutants – nus products of internal combustion engine are nitrogen oxides (NO_x), hydrocarbons, carbon monoxide (CO), sulphur dioxide (SO_2), soot and PM, lead[31], aldehydes and other secondary pollutants. This air pollution segment have time dimension so it will be subject of further analysis in this chapter.

A three-part process describes air pollutants (induced by traffic) movement in nature:

I Emission, determined by the following factors:

For a single vehicle:
- Type and power of engine;
- Fuel composition;
- Combustion efficiency;
- Emission control equipment;
- Driving habits

For total traffic:
- Number of vehicles;

[30] That is way the vehicles operated by the internal combustion engine have large impact on air pollution in general, more exactly cause the grenhouse effect .
[31] From 01. 01. 2010. will not be allowed sale of leaded gasoline at the territory of the Federation B&H (article 22 of the Federal Law on Air Quality)

- Vehicles structure (type and age);
- Driving conditions;
- Road geometry.

II Dispersion is dictated by:
- Prevailing wind direction;
- Weather conditions;
- Roadside vegetation;
- Topography
- Distance from road.

III Reception – impacts on human health, flora, fauna and buildings.

Concentration of air pollutants along the route depending mostly on emission values (by traffic and from „background“ sources), meteorological parameters and relief.

The biggest negative influence could be expected on the motorway sections which are designed through settlements (especially on sections with big AADT values), on sections with high vertical grade and near tunnel openings and intersections. In March 2005 Rulebook on marginal values of air quality[32] was enforced. This rulebook regulate marginal values of air quality for protection of human health on territory of Federation of B&H. The Rulebook is prepared according to instructions from European Commission and World Health Organization (WHO). Article 4 of the Rulebook define air quality as concentration of pollutant in the air, expressed in micrograms per cubic meter (for 293 Kelvin temperature and 101,3 kPa atmospheric pressure).

According to Article 5 of the Rulebook, air quality samples (during period of monitoring random statistical values) should be determined with at least two following parameters:
1. Annual average – arithmetic mean value of air quality on certain location, with regularly taken samples in a year period - presents parameter of long-term activity during total exposure of receptors to polluted air; and
2. Statistical parameter representing high concentration of pollutants during a year - parameter of short-term activity of high values that could cause acutely impact on human health.

Marginal values of air quality for protection of human health are presented in next table:

Table 5.3.4.1. Marginal values of air quality in FB&H – protection of human health

Pollutant	*Sampling Period*	*Average Annual Value (µg/m³)*	*High Value (µg/m³)*
SO_2	*1 hour*	*90*	*500 a)*
SO_2	*24 hours*	*90*	*240 b)*
NO_2	*1 hour*	*60*	*300 c)*
NO_2	*24 hours*	*60*	*140 b)*
PM 10	*24 hours*	*50*	*100 b)*
UPM	*24 hours*	*150*	*350 b)*
Smoke	*24 hours*	*30*	*60 b)*
CO	*8 hours*		*10000*
O_3	*8 hours*		*150 d)*

a) Must not be exceeded more then 24 times in a year.
b) Must not be exceeded more then 7 times in a year (98th percentile).
c) Must not be exceeded more then 18 times in a year.
d) Must not be exceeded more then 24 times in a year.

[32] Official Gazette of Federation of B&H 12/05 from 03/03/2005.

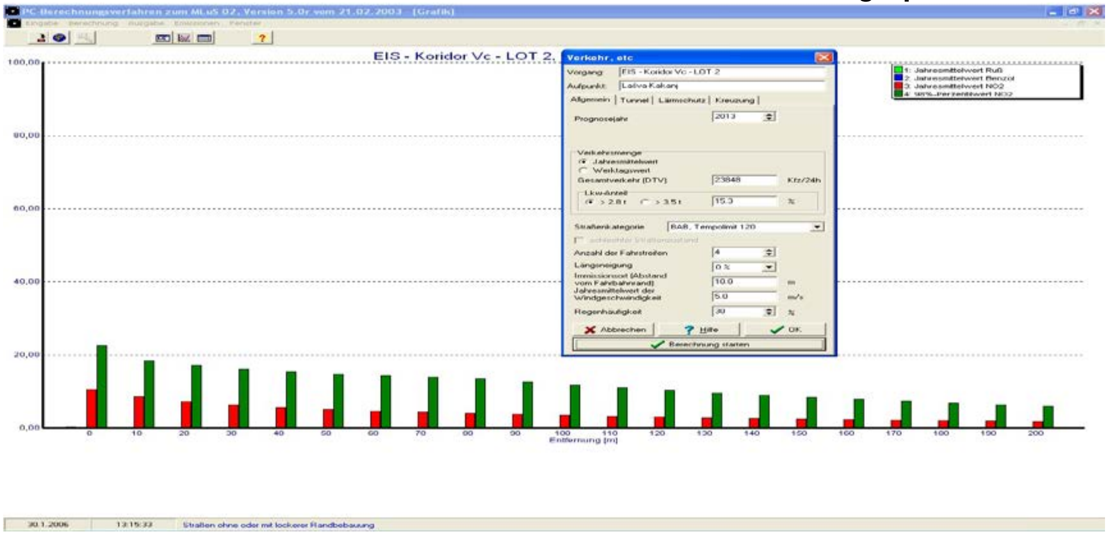
Methodology for air pollution calculation and MLuS 02 results

Concentration of pollutants in atmosphere could be determined by calculation, measuring or combining two methods. Measuring method is based on air quality sampling (minimum of 52 samples, taken in different week days), analysis and statistical processing (calculation of average and 98th percentile value). Calculation method is based on forecast model application.

There is still no efficient system of air quality monitoring stations on territory of Federation of B&H, which could provide reliable results. Number of measuring stations in FB&H is insufficient at the moment. Network of existing stations should be improved and extended to cover all major urban areas and endangered areas in vicinity of major emission sources, so reliable results of background concentration could be collected.

There are many different forecast models, classified as follows: (1) models based on differential equations of diffusion with coefficients of turbulent diffusions from atmosphere stability, (determined on the basis of meteorological synopsis or climate parameters). (2) models based on integral solution of differential equations for presumed conditions of configuration and meteorological conditions (atmosphere stability classes), (3) statistical models, etc. The best solution is application of model calibrated with measuring results.
MLUS 02 software is chosen for calculation of air pollutants concentration for purpose of this Study (Figure 5.3.4.1.) MLuS 02 is software for estimation of air pollutants emissions an calculation near roads[33], calibrated in Germany. Software calculation inputs are specific emission of vehicles, depending on vehicle type (for reference year of production), engine type, fuel, traffic flow and road geometry data.
Section with biggest AADT value and a relatively inhabited location near tunnel opening[34] are chosen for the estimation process. Since there were no reliable and/ore representative indicators of air quality available for the estimation area, software default values for high pollution rural area, are taken for background concentration value. Adopted scenario of background concentration and assuming specific emission values of vehicle fleet for year 2008[35], could be regarded as pessimistic.

Illustration 5.3.4.1. SoftwareMLuS 02 – graph



[33] In adition, there are moduls for calculation of air pollution near tunnel openings and in case of noise protection walls design as well as for pollution analyses near intersections.
[34] Concentration near tunnel openings is higher, because emission acumulate inside tunnels.
[35] Assumption is that vehicle fleet structure on the Corridor Vc motorway in 2013. will be the same as on German motorways in 2008.

All other inputs (road category, AADT, percentage of heavy vehicles, road gradient, technical characteristics of tunnel and climate data) were taken from relevant planning-study documentation prepared for „Motorway on Corridor Vc“ Project.

Results of calculation for section Lašva krak 1 - Kakanj (km 72+236,528 - km 82+559,500) are as follows:

Table 5.3.4.2. Estimated annual emission for 2013 (in tones)

CO	NOx	Pb	SO_2	Ćađ	Benzol	LČ10
97,03	67,48	0,00	0,64	1,26	0,24	39,09

Table 5.3.4.3. Average values of pollutants concentration (estimation for 2013)

x (meters)	Pollutant (μg/m^3)							
	CO	NO	NO2	Pb	SO2	Soot	Benzene	PM10
0	683	30,7	38,1	0,06	12,5	4,08	2,71	58,31
10	650	17,9	34,8	0,06	12,3	3,65	2,62	45,05
20	641	14,6	33,7	0,06	12,3	3,53	2,6	41,47
30	636	12,7	32,9	0,06	12,2	3,46	2,59	39,32
40	632	11,3	32,4	0,06	12,2	3,41	2,58	37,77
50	629	10,3	31,9	0,06	12,2	3,37	2,57	36,57
60	626	9,4	31,5	0,06	12,2	3,34	2,57	35,58
70	624	8,7	31,1	0,06	12,2	3,31	2,56	34,74
80	622	8,1	30,8	0,06	12,1	3,29	2,56	34,01
90	621	7,6	31,5	0,06	12,1	3,27	2,55	33,37
100	619	7,1	30,2	0,06	12,1	3,25	2,55	32,79

Table 5.3.4.4. 98-th percentile (estimation for 2013)

x (meters)	Pollutant (μg/m3)							
	CO	NO	NO2	Pb	SO2	Soot	Benzene	PM10
0	2077	106,4	75,2	0,18	50,5	11,16	6,19	143,08
10	2045	60,5	71,4	0,18	50,3	10,64	6,11	106,87
20	2037	48,6	70,2	0,18	50,2	10,51	6,09	98,65
30	2032	41,6	69,5	0,18	50,2	10,44	6,08	94,19
40	2028	36,8	68,9	0,18	50,2	10,39	6,07	91,24
50	2026	33,1	68,5	0,18	50,2	10,35	6,06	89,1
60	2023	30,2	68,1	0,18	50,2	10,32	6,06	87,45
70	2021	27,8	67,7	0,18	50,1	10,29	6,05	86,14
80	2020	25,9	67,4	0,18	50,1	10,27	6,05	85,05
90	2018	24,2	67,2	0,18	50,1	10,25	6,05	84,14
100	2017	22,8	66,9	0,18	50,1	10,23	6,04	83,35

Results (for average annual values, and for short-term indicators) are fully in line with marginal values of air quality for human health protection.

Having in mind that analyzed section is one with the biggest AADT value, presented scenario could present pessimistic air quality for 2013 (year of putting in operation motorway on Corridor Vc) near the motorway. So it is concluded that there is no need for further calculation for the motorway sections.
The results of calculation for location Donja Gračanica (km 57+783.770), 250 meters away from tunnel opening (tunnel „Pecelj"; L=370 m) are as follows:

Illustration 5.3.4.2. Average Annual values and 98th percentile

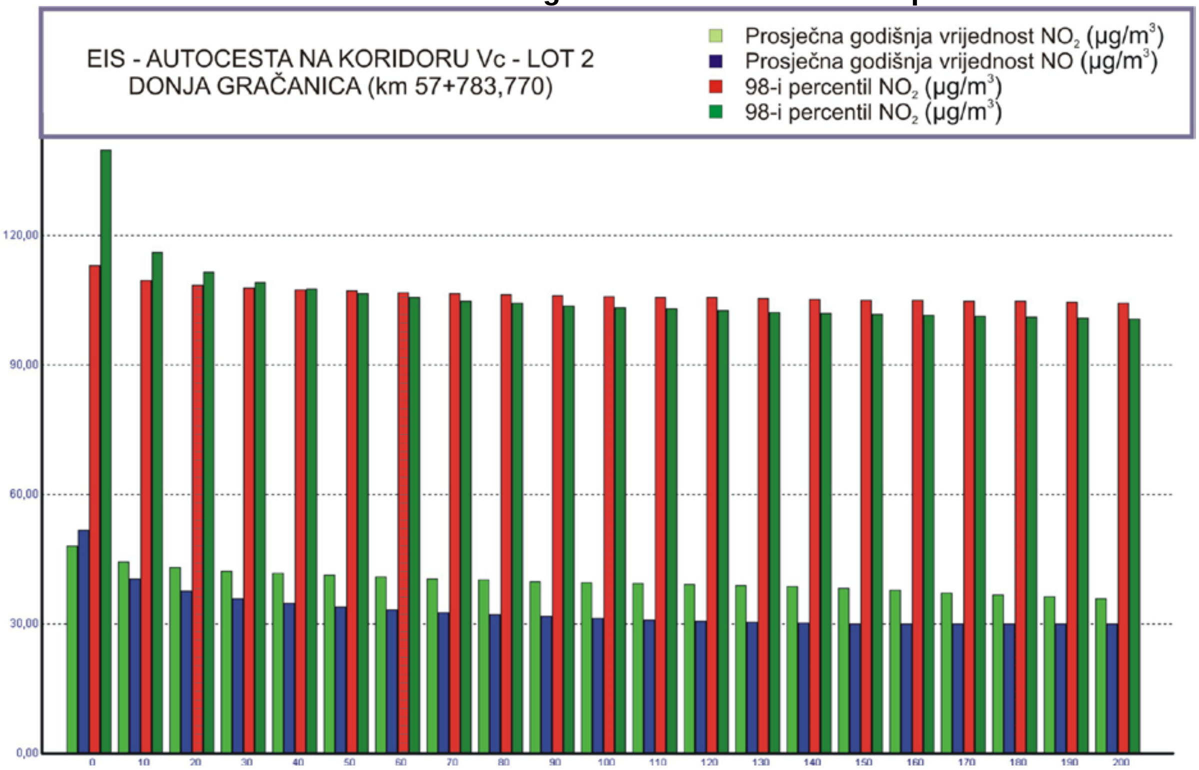


Table 5.3.4.5. Average values of pollutants concentration (estimation for 2013)

x (meters)	Pollutants (µg/m3)							
	CO	NO	NO2	Pb	SO2	Soot	Benzene	PM10
0	1077	51,7	48,0	0,10	15,5	5,46	3,18	58,85
10	1045	40,5	44,3	0,10	15,3	5,07	3,11	47,28
20	1036	37,6	43,0	0,10	15,2	4,96	3,09	44,13
30	1031	35,9	42,3	0,10	15,2	4,9	3,08	42,26
40	1027	34,7	41,7	0,10	15,2	4,85	3,07	40,93
50	1025	33,9	41,2	0,10	15,2	4,82	3,06	39,89
60	1023	33,2	40,8	0,10	15,1	4,79	3,06	39,05
70	1021	32,6	40,5	0,10	15,1	4,77	3,05	38,33
80	1019	32,1	40,2	0,10	15,1	4,75	3,05	37,71
90	1018	31,7	39,9	0,10	15,1	4,73	3,04	37,16
100	1017	31,3	39,6	0,10	15,1	4,72	3,04	36,67

Results of calculation for Donja Gračanica location are fully in line with marginal values of air quality for human health protection, except for short-term indicator of PM 10 concentrations[36].

[36] Main reason for this is high value of background pollution (90 µg/m³).

Table 5.3.4.6 98th percentile (estimation for 2013)

x (metara)	Zagađujuća materija (µg/m3)							
	CO	NO	NO2	Pb	SO2	Čađ	Benzol	LČ10
0	3069	139,8	113,1	0,50	70,4	15,93	9,16	140,24
10	3040	116,1	109,6	0,50	70,3	15,53	9,10	113,17
20	3032	111,5	108,5	0,50	70,2	15,42	9,08	107,33
30	3027	109,1	107,8	0,50	70,2	15,36	9,07	104,25
40	3024	107,6	107,4	0,50	70,2	15,32	9,06	102,23
50	3022	106,4	107,1	0,50	70,1	15,29	9,05	100,76
60	3020	105,6	106,8	0,50	70,1	15,26	9,05	99,62
70	3018	104,9	106,5	0,50	70,1	15,24	9,05	98,69
80	3017	104,3	106,3	0,50	70,1	15,22	9,04	97,91
90	3016	103,8	106,1	0,50	70,1	15,21	9,04	97,25
100	3015	103,3	105,9	0,50	70,1	15,19	9,04	96,67

After presented results of air quality calculation for the section Lašva krak1-Kakanj and for Donja Gračanica location, it can be concluded that:

- There is no need for further calculation, because the standards are fulfilled for the section with the biggest AADT value and for location near tunnel (in area of high concentration of air pollutants). Consequently, standards should be fulfilled for whole analyzed area (close to the future motorway on Corridor Vc – LOT 2) route.

- Traffic on the future motorway on Corridor Vc – LOT 2 should not increase concentration of air pollutants near the route, and so have negative impact on human health in analyzed area.

- Short –term indicators of marginal values of air quality for protection of human health could be overdrawn for PM10 and NO_2, but only in areas with high “background” concentration close to the future motorway, especially near tunnel openings. Individual objects should then be protected with noise protection walls decreasing diffusion of emitted pollutants and vertical ventilation should be designed in tunnels.

- Short –term indicators of marginal values of air quality for protection of ecosystems could be overdrawn for NOx. However, this standard could not be applied for areas close to motorway analyzed in this occasion..

5.3.5. Impact on Soil and Agricultural Land

During the operation phase of the motorway there will be the following process:

- contamination of soils;

Soil contamination:

During the operation phase of the motorway due to participation of an increased number of vehicles and their increased speeds, the soil will become more contaminated due to exhaust gases, wearing of tyres and road maintenance activities. The consequence is pollution of the soil by:

- organic pollutants (light and heavy hydrocarbons),
- heavy metals (lead, zinc and cadmium)
- sodium chloride (used in winter period to prevent ice on the pavement).

The process of soil pollution during the motorway operational phase is going to be more intensive and will last for a longer time period, which can lead to contamination of vegetation and crops. It will especially affect agricultural products such as fruits and vegetables (salad, spinach, onions and similar).

5.3.6. Impact on Flora

Impact on the flora will be present in all stages, that is construction, maintenance, and use of highway. The most important negative impacts during the construction phase is cutting of the forest vegetation and potential soil erosion, particularlly in the sections wher soil is shallow, such is in serpentine complex in the vicinity of Žepče, then destruction or degradation of biological resources or ecosystems which should be protected. The most pronounced effects during the use of highway will be pollution by motor oils and fossil fuel combution in the environment, as well as deposition of waste in the natural ecosystems. Direct impacts include habitat loss, that is conversion of the land and loss of natural habitats, which is unavoidable process during the construction of the highway, and fragmentaion of habitats, since in the locations where highway cuts natural ecosystem sum of two parts created after cutting has lower value than it had deteriorated location, even habita loss is not calculated. Ecosystems are distinguished by the complex relationships between living organisms and their physical environment, and therefore the integrity of ecosystem depends on the maintenance of these interactions.

Through habitat fragmentation, highway has negative impact on the stability and maintenace of the structure of ecoystems. The highway has tendency to fragmentate given ecosystems to the weaker ecological subunits, making in this way the compley more succeptible to the invasions by new species and to degradation. However, the highway and natural ecosystem could coegsist if their mutual relationships are based on the carefull planning. This is present in all sections in the zone of LOT 2, and particularlly in the protected area near Žepče.

Introduction of new plant species along the highway could appear at any stage of construction and use of the highway, which could disbalance dynamic equillibrium which exists in the natural ecosystems. Natural species are faced with competition for resources due to the new species, andtherefore changes in the relationships between predator and prey could appear as the results of these activities. Non native species could gaincompetitive advantages due to the lack of natural control and become dominant. The result is simplification of the ecosystem which becomes too much sensitive on the future disturbances.

- **Section 1. Karuše – Medakovo (chainage km 0+000 to 4+000)**

Zone of the impact

The most important plant communities are located just by the proposed alignment and thereore in the process of the construction works they could be seriouslly endangered and their structure degraded. This is case particularlly in the zones that include communities of white willow (Salix alba). This zone includes banks of the river Tešanjka.
In the zone of the highway construction, loss of the vegetation and habitats of plant species and their respective communities distinguished by the high conservation values will be unavoidable. This is particularlly case with riparian vegetation which is included in Annex I of the Habitat Directive (communities of white willow and sticky elder). The significant impact will be at

locations by the banks of waterways since there will be partial or complete degradation of riparian communities of willow and sticke elder that have important conservation significance, both international (Habitat Directive), and local. Beside they play a key role in the flood protection, these communities repesent important habitats for the fauna, and particularlly for the birds. This is particularlly pronounced in the area of the town Hadžići, where is planned more intensive construction of infrastructure.

Forest cutting
Construction of the highway will unavoidably lead to the clearing of the forests and particularlly of the communities of white willow by the river Tešanjka, and communities of hop hornbeam and pubescent oak at Penavino brdo on the right side of the alignment, at the distance of 1 km from the starting point, then Matanovićevo brto on the right side of the alignment at the distance of 1.5 – 2.0 km from the starting point. All trees should be cut to the standard lenght, and cleared from all branches. Trees suitable for selling are all trees that could be used for production of timber or logs. All cutted trees, branches, and roots should be removed in accordance with existing legal provisions, rules and regulatives.

- **Section 2. Medakovo - Ozimica (km 4+000 do 24+901,587)**

Forest cutting
Construction of the highway will lead to the cutting of hygrophylle forests in the riparian zone of the river Trebačka at the distance of 2 km from the starting poin in the form of interrupted belt between willages Čakrama and Ljubatovići. Very small fragments of this vegetation type are located by the river Ozimica and brook Sarajlića just at the end of this section. Riparian vegetation which is degraded during the construction stage should be restored. Particular attention should be paid to the preservation of the riparian vegetation in the impact zone of the highway which could be egradaed by various human impacts
The construction of the highway will have significant direct impact on pine forests which belong to the order Erico-Pinetalia and alliance Orno-Ericion are developed in the zone of Šiljati vrh on the left side of the alignment and just by the alignment, at the distance from 10.0 to 12.0 km from the beginning of this section. Since alignment passes through this section, construction will cause loss of cca. 30 ha of high quality pine forests. All trees should be cut to the standard lenght, and cleared from all branches. Trees suitable for selling are all trees that could be used for production of timber or logs. All cutted trees, branches, and roots should be removed in accordance with existing legal provisions, rules and regulatives.

- **Section 3. Ozimica – Poprikuše (km 24+901,587 to 38+617,434)**

Habitat disturbance

Indirect impacts could even be more dangerous than direct ones, and their effects could have broader rane. On the locations where highway enables approach to the zones that have been relativelly undisturbed by human impacts, such is the zone near Žepče (wider area by the brook Paparatnica), this could have long term impacts and cause to the significant degradation of the quality of natural ecosystems.

- **Section 4. Poprikuše – Nemila (km 38+617,434 to 46+289,378)**

Forest cutting
Highway construction will unavoidably lead to the forest cutting at zone Saravački brook – Kočin brook, by the right bank of the river Bosna, where are developed communities of hornbeam and oak Carpino betuli – Quercetum roboris, which represent the most productive forests in this area.

- **Section 5. Nemila – Donja Gračanica (km 46+289,378 to 58+434,599)**

Since in this setion is planned construction of tunnels there will be no significant impacts on the vegetation, except in the vicinity of entrance and exist of the tunnel.

- **Section 6. Donja Gračanica – Drivuša (km 58+434,599 to 66+959,592)**

Forest cutting
Highway construction will unavoidably lead to the cutting of forest of hornbeam and pubescent oak from the setllement Donja Gračanica, via Ričica, Kopila, Klopče, to Perin han, at terrain slopes of cca. 10° to 30°, at the SW and NE aspects.

- **Section 7. Drivuša – Kakanj (km 66+959,59 to 82+595,000)**

Forest cutting
Highway construction will unavoidably lead to the cutting of the forest communities of English oak and hornbeam developed on the alluvial soils in two segments: from Drivuša to settlement Klanci, and from Gornji Lučani to Kakanj, in the form of the fragments on the flat terrains by the river Bosna and its tributaries Tišina, Prihodi, Sopotnica, Klanji brook, Desetnički brook, and Ribnica.

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

Forest cutting
Highway construction will unavoidably lead to the forest cutting of oak – hornbeam forests which represent climatogenous vegetation in the hilly belt of the central part of Bosnia and Herzegovina. Typical stands are located in the zone of the waterways Trnava, Vitovac, Rakovica, Kremikovac, Krmeljevac, and Mlinčići, and the river Bijela and the river Klašnica. In the area of the alignment these communities are linked with the communities of hornbeam and oak Carpino betuli – Quercetum roboris, and theye represent the most productive forests in this area.

5.3.7. Impact on Landscape

The motorway construction has direct and indirect influence on the environment and on the change in environment usage. These effects can be positive and negative.

Positive effects of the project on the environment:

- settlement unburdening from pollutants and noise
- increase of traffic security in general
- possibility of joining to the attractive spaces within the landscape (parks, forests, picnic areas, etc.)
- increase of recreational areas by constructing many places for rest

Negative effects of the project on the environment:

- diminishing the existing green surfaces (landscapes)
- green areas cutting
- burdening the surroundings with pollutants
- degradation of flora and fauna
- change of the visual image of the area
- increase of noise in the area of natural surroundings

Regarding the basic ecological influences, the influence zone can be expected from both sides of the motorway route in a radius of 300 m. In general, the longest zone can be viewed as land pollution, and the widest as a big influence on water and air.

The construction of the motorway represents a source of degradation of the physical surroundings, because of the presence of people, machines, technology and organized work performance. This is specifically regarding the phase of performance works. It is necessary to take care of permanent and season pollution while performing works (such as: oil spills, gas spills, grease spills, deposits of gasses, depositing of organic and inorganic waste, use of salt, use of pesticide, etc.), which can cause serious degradation of the environment.

5.3.8. Impact on the Protected Parts of Nature

Construction of the highway in the zone of the protected nature leasds to the conversion of significant parts in other forms of land use. The only one protected area situated in the zone of LOT 2 is serpentine complex near Žepče which is protected by the provision of the responsible municipal bodies from the municipality Žepče. Serpentines are prone to the erosion and degradation. This process is particularlly intensive at the location where forest was cleared, which will also happened during the construction of the highway. For these reasons, on this sites there are frequently a very large areas of sceletone soils, that is barren rocky and rocky meadows. Here are developed plant species which are the most important form the serpentine flora. Construction of the highway will also put under the treat rare plants and plant communities developed in this area.

5.3.9. Impact on Cultural and Historical Heritage

The presence of the road in the close vicinity can reduce visual values of the wider surroundings at certain locations. If during construction of the motorway, preservation of certain localities or objects of cultural and historical heritage is secured, then it can be said that a positive impact of the motorway on the cultural and historical heritage has been achieved.

5.3.10. Impact on Hunting

- **Section 1. Karuše – Medakovo (km 0+000 to 4+000)**

Main feature is the presence of small hunting animals which could be vounded by the highway construction, which is also important for large hunting animals, but planned solution with bridges and tunnels mitigates significantlly these impacts.

- **Section 2. Medakovo - Ozimica (km 4+000 to 24+901,587)**

Impact on the free migration of game, system of solutions with tunnels in the very beginning will creat chaos among wild animals populations, and therefore in this section will be necessary to provide a place for an artificial corridor for migrations (Fig. 1. in Annex 12.2.).

- **Section 3. Ozimica – Poprikuše (km 24+901,587 to 38+617,434)**

Species loss or decrease of the populations in migrations over the highway, and impact of the construction site and noise will lead to the disturbance and retrieving of the animals in the deeper parts of habitats which could additionally increase biodiversity loss.

- **Section 4. Section Poprikuše – Nemila (km 38+617,434 to 46+289,378)**

Similar or almost similar impacts as in the previous sections.

- **Section 5. Nemila – Tonja Gračanica (km 46+289,378 to 58+434,599)**

Loss of of species sensibile for hunting and fauna by their migrations to highway or at construction sites. Also, construction works will have significant impact on reproduction which will in the certain period of adaptation or recovery of species put in the danger some sensible species (e.g. roe deer)

- **Section 6. Tonja Gračanica – Drivuša (km 58+434,599 to 66+959,592)**

In intersection of migration of both small and large animals, and treats for extinction or some excess situations which will lead to the decrease of the number of their populations.

- **Section 7. Drivuša – Kakanj (km 66+959,59 to 82+595,000)**

In the part of Lašva it would be possible to disrupt corridor for migration of small and large forest animals. Besides, there is a possibility for spatial isolation of microhabitats whih will cause reproductive isolation of less viable species.

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

Appereance of wolf or brown bear which are to certain extent hot tempered animals will be dcreased dur to the noise or construction sites.Due to the crossing of the highway certain negative impacts in the forms of the permanent loss of these remarkable animals are possible. For this part of the alignment it is important a more dense setllement of atractive bird species (pheasant, quail, etc) and thier survival is quetionable due to the active work in this part of the highway. Fishery and fishing is a part of hunting, and therefore impacts on the populations of brook trout caused by the devastation of the river bed of the river Lepenica could not be avoided.

5.3.11. Impact of Noise and Vibrations

Noise caused by traffic on the roads affects the surrounding area through which that road passes, contributes to degradation of quality of living and affects wild animals also. By exposure to noise the quality of life is affected both psychologically and physiologically. Constant exposure to noise can cause nausea, creates communication problems and leads to increased stress which as a final outcome has serious impacts on human health. Constant noise can lead to disorder of the hearing organs with either temporary or permanent loss of sense of hearing, sleeping disruption or reduction of the learning capacity of the children. Vibrations caused by the traffic resonance can have negative consequences on the buildings located in the vicinity of the road. Many objects of cultural and historical heritage have not been designed to stand such impacts. Even the wild animals are disturbed because they are frightened to cross the road under traffic. Therefore, such roads become barriers to regular migrations of the wild animals from one area to another.

5.3.12. Impacts on Infrastructure

As a background documentation for motorway impact assessment on water supply and sewerage infrastructure, “Layouts for Planning Documentation – LOT 2” October 2005, were used, which were prepared by the B&H Urban Institute, as part of the entire documentation prepared for the project “Development of Study Planning Documentation – Corridor Vc Motorway”. Graphic interpretation, which was within the “Layouts for Planning Documentation – LOT 2” prepared for water infrastructure, is attached to this study in form of a map of limitations related to the infrastructure – Annex 12.3.11.

Water Supply Infrastructure

On several locations, planned motorway passes over the route of existing, as well as across planned water supply system lines. Therefore, there is a need for an adequate technical solution at every location where the motorway route is passing over the existing water supply infrastructure. Technical solutions for locations where motorway route on LOT 2 is in conflict with the existing water supply infrastructure should be provided within the Project design, which is elaborated during preparation of this Study.

Route of the planned motorway is passing over the existing pipelines of water supply system, specifically:

1. Primary pipelines of water supply system of town Zenica.
2. Primary pipelines of water supply system of town Žepče.
3. Secondary pipelines of water supply system of local community Lepenica.
4. Secondary pipelines of water supply system of contact area of Žepče and Maglaj municipalities.
5. Primary pipelines of water supply system Tešanjka.

Route of the planned motorway is also passing over the planned pipelines of water supply system, which were determined in planning documents of municipalities that are located along the LOT 2 section, specifically:

1. Main pipeline for water supply of Žepče municipality (planned within the Long-term solution for water supply problem of municipalities Usora, Tešanj, Maglaj and Žepče through the regional water supply system with intake on a planned water reservoir Krajinići on river Krivaja),
2. Main pipeline planned within the “Long-term solution of water supply problem through the planned water reservoir Toplice on river Lepenica,
3. Main pipeline in the area of Zenica municipality (which is planned within intake on planned water reservoir Ribnica – an alternative of initiated realization of the regional Water Utility Company “Plava voda”, with the objective to form a complete system for water supply of Zenica municipality and west part of Kakanj municipality).

During the phase of motorway construction, planned works will be conducted according to the project which provides technical solutions for locations of conflict between the motorway route and existing water supply infrastructure, in a way that eliminates all negative impacts on the infrastructure.
For the planned pipelines, technical solution needs to be in accordance with the project solutions provided within the entire motorway project.
During motorway exploitation, negative impacts on this infrastructure are not expected.

Sewerage Infrastructure

Generally, on locations where motorway route is passing over sewerage pipelines, we can say that significant impact on them is expected. On the LOT-2 section, through analysis of a Map of Limitations prepared by Urban Institute, these types of crossings were not registered, when the existing sewerage pipelines are in question.

However, motorway route is passing over the planned main collector in the area of Tarčin. For the planned pipeline, a technical solution should be in accordance with the project solutions provided within the entire motorway project.

If wastewater from locations of auxiliary structures along the motorway are planned to be discharged into the existing public sewerage systems, it is necessary to follow the limitations regarding effluent limit values during their discharge into the existing system. Considering that there are no bylaws in FB&H which define conditions for discharge of wastewaters into the existing sewage systems, a guideline could be an existing "Rulebook on Conditions of Wastewater Discharge to Public Sewerage System," Official Gazette RS, no. 44/01".

Therefore, during motorway construction and exploitation phases, negative impacts on existing sewerage infrastructure are not expected.

6. DESCRIPTION OF MEASURES FOR MITIGATION OF THE ENVIRONMENTAL IMPACTS

6.1. General Measures for Mitigating the Negative Effects on Environment

The measures for mitigation of the environmental impacts can be technical and organizational. They relate to environmental influences that have through previous analysis been accepted (location, capacity) and which are inevitable, and are resolved through spatial and urban planning (previously adopted plan or plan that will be adopted post festum). As to technical measures in the case of motorways, the project of ventilation of tunnels, projects of overpasses and underpasses, project of protective walls (protection of the motorway from snow or wind, or protection of buildings outside of the motorway from appearances on the motorway (noise, lights, air pollution). Organisational measures are those that relate to organisation of activity (traffic safety, organisation of construction site, etc.).

Both organisational and technical measures can be divided into measures that are implemented during the construction of a motorway and measures that relate to usage and maintenance of the motorway.

6.2. Mitigation Measures During Construction

During the construction of a motorway, the participants are obliged – in terms of influences and measures of reduction of effects on the environment – to complete their activities in accordance with the following laws:

- Law on construction land of the Federation of Bosnia and Herzegovina; Official gazette of F BiH 25/03, June 12, 2003
- Law on spatial planning and use of land on the level of the Federation of Bosnia and Herzegovina; Official gazette of F BiH, no. 2/2006 from January 18, 2006
- Law on protection of air; Official gazette of F BiH 33/03, July 19, 2003
- Law on waters; Official gazette of F BiH 18/98-454
- Law on protection of waters; Official gazette of F BiH 33/03, July 19, 2003
- Law on changes and additions of the Law on protection of waters; Official gazette of F BiH 54/04, October 16, 2004
- Law on protection of environment; Official gazette of F BiH 19/04
- Rulebook on plants and factories for which it is obligatory to evaluate the influence on the environment and plants and factories that can be built and work only if they have an environment license; Official gazette of F BiH 33/03, July 19, 2003
- Law on protection of nature; Official gazette of F BiH 33/03, July 19, 2003
- Law on agricultural land; Official gazette of F BiH 2/98
- Law on waste management; Official gazette of F BiH 33/03, July 19, 2003

As opposed to other activities with a stationary character of production, legal regulation (so called environment laws) does not assume explicit / direct obligation of a construction company that is completing the work to subject its spatial time changing and dynamic production process to the requirements and criteria of avoiding, limiting and reducing the influences on the environment. The existing legal obligation that 'for exceptionally important construction objects of interest to the state' (such as a motorway, etc.) an evaluation must be done, that is a study of influences on the environment, is addressed to the investor – the carrier of the project (that is the user) and it general defines the problem (sets up a diagnosis) and recommendations are given for the reduction of influence of the project on the environment and its life cycle. However, during the transferring of authorities of the investor (user) in the phase of construction onto the construction contractor, almost always it is forgotten to transfer the obligations for care of the environment. In such circumstances, the construction contractor sporadically and non-systematically (mostly under external forces: inspection, accidents, etc.) deals with issues of the environment, and the study of influence of the project on the environment in the phase of construction stays a 'dead letter on paper'.

Therefore there is a great need that this legal insufficiency is regulated by a contract on construction, as an obligatory form of law, which will ensure that the construction contractor – on behalf of the investor – implements the complete and systematic care of the environment during the phase of construction. This also means that the investor should in advance implement the measure of selection of contractor and request from him detailed documentation for construction – Project of technology and organization of construction and regulation of the construction site, with a report on implementation of measures of prevention / removal and reduction of influences on the environment during the phase of constructing the object. Especially, the contractor should be imposed with the obligation to ask for urban approval from the competent (municipal) authority for his temporary locations that will be used for housing and production capacities, for workshops and warehouses, for temporary traffic access roads and parking lots, for borrow pits and deposit areas, for temporary installations, scaffolds, etc., and then to develop a final project of technology and organisation of construction, report on regulation of the construction site and programme of environmental measures in order to get approval for construction!

On the other side, state institutions should continue to enforce the responsibility of maintaining and protection of the environment, and the most effective way is conditioning the issuance of:

- urban approval (in phase I based on the project concept) – by existence of a high quality study of influence on the environment; and
- approval for construction (in phase II, based on the main project) – by existence of a special project of technology and organisation of completion of work and report / project of regulation of the site which will explicitly define the measures for avoiding / removal and reduction of influences on the environment during the phase of construction.

Obligations of the contractor for execution of construction works

The contractor for execution of the construction works – as the bearer of all activities involved in the construction of a motorway – must minimise the influences on the environment through two groups of measures: organisational and technical.

I Organisational measures

The construction company (individually or through a consultation group) must introduce a system of environmental management, as part of a general system of management, which ensures a systematic relationship of organisation towards the environment, environmentally responsible management, production and behaviour, in accordance with the international standard ISO 14000.

The main parts of the system of environmental management of organisation are:

- own environmental policy of organisation based on standards;
- identification of environmental aspects based on production activities of the organisation with ranking of influence by importance;
- identification of relevant legal and regulatory requirements;
- establishment of priorities of action – completion of adequate operational tasks from recorded frame environmental tasks;
- programmes and organisational structure for implementation of policy and operational tasks;
- implementation, monitoring, recording and applying corrective measures;
- records, periodic evaluation and review of activities;
- informing the public of achieved progress.

• Environmental policy

That is a guide for implementation and improvement of the system of environmental approach to management of a given organisation, so that it can maintain and improve its environmental performances. It expresses the obligation of the highest management of the company for respecting the laws dealing with the environment and constant improvement of that activity.

• Identification of environmental aspects

An organisation that does not have a system of environmental approach, as a first step, should determine its present position, through review – preliminary analysis. The review includes four key areas:

a) legal and regulatory requests
b) identification of significant environmental aspects (emissions into the air, discharge into water, waste management, contamination of land, use of raw materials and natural resources, other environmental issues towards the community)
c) examination of existing actions and procedures from the aspect of environmental management
d) review of data – results of research of previous incidents

• Legal and other requirements

Beside the relevant laws dealing with the environment, the organisation must also take into consideration other requirements, such as: industrial regulations, agreements with public government, non-obligatory directives.

- General and operational tasks

General tasks should be stated generally, and operational should be specific (measurable). It is recommended to use the best available technologies – if that is economically sustainable and cost effective.

- Programmes and structure of environmental management

The programme should describe how the general and operational tasks of organisation will be realised, that is how will the objectives of the organisation be achieved, including the time dimension and staff responsible for implementation of the environmental policy. In terms of product, the programme can deal with projecting, materials, production processes, use and final disposal.

As far as practice in construction companies is concerned, it is necessary that the existing PROJECTS of

Technology and organisation and economics of construction (abbreviated construction project)

are expanded with elements of environmental management. The usual contents of the construction project include:

a) technological loans, resources and means ('technology of construction')
b) human resources, organisation, planning of completion of tasks, management system, regulation of site, project of protection at work ('organisation of construction')
c) analysis of expenses and evaluation of economy of project ('economy of construction')

A new component of the construction project should be the programme of environmental management that should present the main elements of the system of environmental management (information on process, organisational diagrams, internal regulations and work procedures, and plans for unexpected events), and to separately define WHO, WHAT, WHEN and HOW will be done regarding the environment.

- Implementation, monitoring, enabling, overcoming

It is especially important that in the company bearers of responsibility are selected in the system of management for implementation of environmental management: from the highest management of the company (executive director), through the level of construction site (head-director of site) and manager of sector (head of part/sub-part) to the manager on the work location. Also, special means (monetary, material, technical) should be ensured for the implementation of the system of environmental management. It is especially significant to establish a system of training / enabling the employees to complete operational tasks, as well as establishment and maintenance of adequate documentation.

- Records, periodic review and evaluation

The company must establish procedures for recoding, documenting, transfer/receipt and response of important information and requests of parties involved in the system of environmental management. Environment records can include the following:

a) information on applied environment legal regulation or other requests;
b) records on complaints;
c) records on training;
d) information on production procedure;
e) information on products;
f) records on review, maintenance and calibration;
g) information on adequate suppliers and contractors.

Assessment (audit) of the system of environmental management includes: description of activities and areas that will be evaluated, frequency of evaluation, responsibility regarding records of evaluation, connection of result of grade, authority of evaluator, how will the grades be implemented.

Organisational management also needs to periodically consider and evaluate the system of environmental approach to management, in accordance with the following items: result of evaluation (audit), scope in which the general objectives are fulfilled, maintenance of adequacy of the system of environmental management in relationship to variable conditions, relationship between interested parties.

- Informing the public

A very important element of the system of environmental management is informing of all interested parties (investor, state, population) on the results and achieved progress. In that way the company gets the desirable social verification of its efforts in terms of environmentally responsible management.

II Technical measures

Based on the accepted evaluation of influence on the environment, here is provided an overview of environmental aspects and influences on the environment important for construction of the motorway with a comment and recommendation of technical measures for removal or reduction of those influences. This overview has a general character and should serve as a sample for orientation and a base for companies – future construction contractors so that they can themselves more easily identify the influences – general environment tasks, determine their scope and significance, and establish priorities and an action plan, methods, means, executors and system of responsibility.

Beside that, for each part of the motorway within LOT 2, a general concept of construction is recommended (‘organisation of site’ / ‘technology and organisation of construction’) in specific natural circumstances, with emphasis on the aspects with especially present influences on the environment and an instruction for the future contractor as to how to act. It is important that the proposed technical measures of avoiding / reducing the influences on the environment are adapted and built into adequate parts of the construction project (especially technical and technological procedures and organisational solutions of work places, sites, plants, warehouses, transport, etc.).

6.2.1. Population

On all construction machines and vehicles used during the construction of a motorway it is obligatory to build in sound protection / isolation of the motor and other parts that produce or contribute to the production of noise. Also, on exhaust pipes of all machines and vehicles with diesel motors build in filters for separation of soot. By regular (planned periodic) and extra technical examinations of machines and vehicles, ensure maximum regularity and functioning of the system of combustion of motor oil, use (and control regularly) oil of guaranteed standard quality. Prevent dust which is always present on temporary construction traffic access roads by moistening-sprinkling of road and operational areas.

In the case of use of mining for digging in rock massif, select the type of explosives that have the least damaging influences on the environment: use the technique of millisecond activating of mine charging with directed action of explosion, in order to reduce the effect of superposition of dynamic thrusts (vibration, seismic), noise and emission of dust. Alternatively, use the technique of digging out by use of hydraulic hammers or mechanical excavation by milling machines, boring machines - ‘moles’, etc.

Relocation of the population due to physical endangerment from danger during the completion of works is desirable although an unpleasant measure; still, it is proposed to use a systematic approach to relocation, where the endangered population would receive adequate replacement locations with complete infrastructure, so that they could take the relocation without encountering damages for their social and economic status.

As part of resolving the complete integration of the new motorway in the area, looking from the aspect of construction, it is necessary to primarily establish / build ‘deviations’ of the existing or build a new traffic infrastructure that is adequate for the needs and habits of local population. It may not be allowed that the population – out of necessity – uses the zone of construction work as ‘its’ traffic route, because that is doubly disturbing and dangerous. Zones of interference between existing and construction traffic routes are to be visibly marked by application of: traffic signs, side markings, boards of caution, signal lanes, light signals, and if necessary also have a service of regulation of traffic (alternating flows of traffic by direction).

By a report on expropriation, precisely and realistically determine the economic use of land and through an investment programme ensure funds for fair compensation, that is for ensuring replacement locations for completion of agricultural activity of the population during the phase of completion of the works (therefore, without loss of a single agriculture season).

During the construction works, through a project of technology and organisation of construction, predict, build and maintain side crossings/passages for local population travelling to work or for other needs.

Workers’ settlement – camp, must be formed through the project of regulation of construction site so that it has all necessary life, social, hygienic and health contents, so that the employees of the construction contractor can be kept – living there. A special programme of social work with employees (animation, cultural, entertainment and educational contents) should eliminate socially deviant behaviour and immorality that could possibly be transferred to the local population. At the same time also apply disciplinary measures for the violators.

In continuation the most significant measures of reduction of social and other influences are given, by characteristic parts, based on identified and valorised influences:

1. SECTION: KARUŠE-MEDAKOVO	Proposal of measures for avoiding / mitigating influences	Optimum setting of temporary traffic routes, removal of fertile land from the route of the motorway and depositing for later use; phase moving and regulation of the channel of river Tešanjka; establishment of a system of collecting and cleaning of waste waters, oils and grease from the construction site Medakovo
	Extraordinary conditions:	Ensuring the zone of work and surrounding agricultural land during flooding seasons
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and locations of borrow pits / deposit areas.

2. SECTION: MEDAKOVO - OZIMICA	Proposal of measures for avoiding / mitigating influences	Optimum setting of temporary traffic routes, maintenance of new forests, removal of fertile land from the route of the motorway and depositing for later use; constant care of maintaining the natural status of water flow of Trebačka river and Strupin brook, establishment of a system of collecting and cleaning of waste waters from the construction site and work area.
	Extraordinary conditions:	Discharge of dangerous materials in water flows; accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and locations of borrow pits / deposit areas.
	General notes:	1. Instead of using the excavated material from the tunnel for embankment, depending on the mineralogical and petrographic content of the rock, it is possible to use it for making stone aggregate for concrete and asphalt. 2.The investor and contractor should jointly plan the construction and use of temporary objects and infrastructure, in order to retain their use after construction with the function of maintaining the motorway or for other (commercial and recreational) purposes.

3. SECTION: MEDAKOVO - OZIMICA	Proposal of measures for avoiding / mitigating influences	Optimum planning and construction of temporary traffic routes and necessary areas for construction sites, work areas and deposit areas. Construct deposit areas as a measure of temporary regulation of the shores of river Bosna (it is desirable to plan and complete foundations-legs for shores). In construction of foundations and columns for bridges over the river Bosna avoid covering/filling in of the channel : complete works from the shores, from temporary scaffolds-bridges or from floating means! Every construction site (and work area) must have a system for receipt and cleaning of waste waters and a service for collection and disposal of hard waste at the local sanitary disposal site. It is obligatory to use traffic signalisation and necessary protective barriers for works on the roads, and for the railway and electricity supply network it is obligatory to do protective construction for physical separation from the zone of construction.
	Extraordinary conditions:	Emission of dangerous materials in water flows, accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas and locations of borrow pits / deposit areas.

4. SECTION: POPRIKUŠE - NEMILA	Proposal of measures for avoiding / mitigating influences	Optimum planning and construction of temporary traffic routes and necessary areas for construction sites, work areas and deposit areas. Construct deposit areas as a measure of temporary regulation of the shores of river Bosna (it is desirable to plan and complete foundations-legs for shores). In construction of foundations and columns for bridges over the river Bosna forbid (any) filling in of the channel: complete works from the shores, from temporary scaffolds-bridges or from floating means! Every construction site (and work area) must have a system for receipt and cleaning of waste waters and a service for collection and disposal of hard waste at the local sanitary disposal site. It is obligatory to use traffic signalisation and necessary protection barriers for jobs on roads, and for railroad and electricity supply network it is obligatory to make protective constructions for physical separation from the zone of construction.
	Extraordinary conditions:	Emission of dangerous materials in water flows, accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and locations of borrow pits / deposit areas.

5. SECTION: NEMILA – D. GRAČANICA	Proposal of measures for avoiding / mitigating influences	Optimum planning and completion of construction traffic routes and necessary areas for construction sites and individual work areas, with a special concern for avoiding the destruction and protection of forests along the section of the motorway. Construction traffic routes should be constructed so that they can be used for commercial purposes after construction (care and raising of forest). During construction of foundations and columns for bridges over the river Bosna forbid (any) filling in of the channel: complete works from the shores, from temporary scaffolds-bridges or from floating means! Every construction site (and work area) must have a system for receipt and cleaning of waste waters and a service for collection and disposal of hard waste at the local sanitary disposal site. It is obligatory to use traffic signalisation and necessary protective barriers in works on roads and for railway and electricity supply network it is obligatory to use protective constructions for physical separation from the zone of construction.
	Extraordinary conditions:	Emission of dangerous materials in water flows, accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and locations of deposit areas and temporary construction of traffic routes.

6. SECTION: D. GRAČANICA – DRIVUŠA	Proposal of measures for avoiding / mitigating influences	Optimum planning and completion of construction traffic routes and necessary areas for construction sites and individual work areas should to the maximum maintain the existing status of the environment. During construction of foundations and columns for bridges over the river Bosna forbid (any) filling in of the channel: Every construction site (and work area) must have a system for receipt and cleaning of waste waters and a service for collection and disposal of hard waste at the local sanitary disposal site. It is obligatory to use traffic signalisation and necessary protective barriers when working on the existing roads for physical separation from the construction zone (especially in the settlement Drivuša).
	Extraordinary conditions:	Emission of dangerous materials in water flows, accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and locations of deposit areas and temporary construction of traffic routes.

7. SECTION: DRIVUŠA – KAKANJ	Proposal of measures for avoiding / mitigating influences	Optimum planning and completion of construction traffic routes and necessary areas for construction sites and individual work areas should to the maximum maintain the existing status of the environment. The top layer of agricultural land through which the section is passing should be taken off in full thickness, removed and deposited for later use for the purpose of re-cultivation. During construction of foundations and columns for bridges over the river Bosna forbid (any) filling in of the channel. Every construction site (and work area) must have a system for receipt and cleaning of waste waters and a service for collection and disposal of hard waste at the local sanitary disposal site. During the completion of works with existing traffic routes it is obligatory to use traffic signalisation and necessary protective barriers. Transit traffic should be directed to alternative roads, or build additional parallel traffic routes that will serve as both transit and construction traffic routes.
	Monitoring during the construction phase:	Water flow of river Bosna. It is necessary to have constant presence of an archaeologist during the completion of land works and on the section and bridges.
	Extraordinary conditions:	Emission of dangerous materials in water flows, accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and location of borrow pits, as well as temporary construction traffic routes. Oblige construction contractors to regularly maintain existing local roads that they use as traffic routes.

8a. SECTION: BLAŽUJ – LEPENICA	Proposal of measures for avoiding / mitigating influences	Optimum planning and completion of construction traffic routes and necessary areas for construction sites and individual work areas should to the maximum maintain the existing status of the environment. The top layer of agricultural land through which the section is passing should be taken off in full thickness, removed and deposited for later use for the purpose of re-cultivation. Every construction site (and work area) must have a system for receipt and cleaning of waste waters and a service for collection and disposal of hard waste at the local sanitary disposal site.
	Monitoring during the construction phase:	It is necessary to have constant presence of an archaeologist during the completion of land works and on the section and bridges.
	Extraordinary conditions:	Emission of dangerous materials in water flows, accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and location of borrow pits, as well as temporary construction traffic routes. Oblige construction contractors to regularly maintain existing local roads that they use as traffic routes.

8b. SECTION: LEPENICA – TARČIN	Proposal of measures for avoiding / mitigating influences	Optimum planning and completion of construction traffic routes and necessary areas for construction sites and individual work areas should to the maximum maintain the existing status of the environment. The top layer of agricultural land through which the section is passing should be taken off in full thickness, removed and deposited for later use for the purpose of re-cultivation. Every construction site (and work area) must have a system for receipt and cleaning of waste waters and a service for collection and disposal of hard waste at the local sanitary disposal site. During completion of works in the zone of water flow prevent filling in of the channel and destruction of life inside it. Existing traffic routes at the end of the section should be technically insured from possible endangerment during the completion of works, and also insure work areas from traffic.
	Monitoring during the construction phase:	River Lepenica, Bijela river. It is necessary to have constant presence of an archaeologist during the completion of land works and on the section and bridges.
	Extraordinary conditions:	Emission of dangerous materials in water flows, accidents in tunnels (in case of work with explosives)
	Recommendation for state institution / investor / contractor:	Obligatory issuance of urban approval for location and technological and technical contents of all construction sites and work areas (for tunnels and bridges) and location of borrow pits, as well as temporary construction traffic routes. Oblige construction contractors to regularly maintain existing local roads that they use as traffic routes.

6.2.2. Waters

By the Plan of the work execution, and detailed development of technological activities, it should avoid completely a possibility of partial and especially of complete riverbed filling in. In work organization project and site plan, it should foresee measures of planning and safe collecting of all unnecessary materials (waste), their transport and disposal at sanitary land field. At the same time, it should sanction by discipline measures law breakers. Used waters should be collected by safe collector system, collect in suitable reservoirs and treat on regulated way (at the place, or on distant location), before letting into water courses.

By usage of technical measures – construction of underground water drainages – to conduct interrupted underground water courses under the motorway structure/ motorway zone.

In all variants of work construction technologies, it should keep stable/natural hydrological regime of swamps and puddles, by preventing water leakage / draining.

General measures of prevention:

- Within organisation responsible for use and maintenance of motorway, it is necessary to establish a Department for environmental protection that will be responsible for:
- Monitoring and control of all activities related to environmental protection,
- Monitoring of drainage system functioning and regular control of treated effluent from polluted water treatment units,

- Organization of execution of self-monitoring programme,
- Saving and analysis of measurement data and taking of corrective actions in case of increased emissions,
- Delivering of monitoring reports to relevant authorities and informing of the public on state of environment,
- Educating of all employees on environmental protection measures,
- Development of environmental management plan.

Mitigation and prevention measures for impact on waters during preparation and construction of motorway

a) During later phases of project design development

During the later phases of project design development, it is necessary to prepare a Final Design of water drainage system for water from road surface and adjacent surface waters, with detailed hydrological and hydraulic calculations, as well as design of structures for collection, transport and disposal.

Water drainage project should contain at least the following:

- In general, units for treatment of wastewaters from road surface, can be located inside the areas defined as sensitive, but their final location should be decided upon detailed hydrogeological maps in scale 1:5000 of narrow area around motorway. It is necessary to pay attention that structures are not positioned in aquifer zones where high water tables are observed, in order not to cause disruptions in groundwater hydraulic flow regime, recharging of wells, etc.
- In the water discharge project, at least closed discharge system should be foreseen with oil and grease separator. If necessary, additional treatment should also be included in order to reach water quality as prescribed by relevant rulebooks (as a guideline “Rulebook on conditions for wastewater discharge to surface waters”, or “Rulebook on Conditions of Wastewater Discharge to Public Sewerage System” should be used, published in Official Gazette RS, no. 44/01).
- Construction of foreseen structures for treatment of waters from road surface must guarantee water tightness, meaning that wastewater must not be allowed to drain into ground.
- Access to structures of inner discharge, i.e. separators and lagoons should be efficiently resolved so that a car (such as cistern for wastewater transport) access is enabled.
- To design a water tightness trenchs (the outside drainage) on the parts where the motorway route goes accross very sensitive areas (water sources protected zones)
- To design and impement the watertight protection of slope on the parts where the motorway route goes accross very sensitive areas (water sources protected zones).
- To design the watertight pipe of indoor drainage system. Inevitable to provide normal control of inbuilt pipe.
- To design a green barriers at water tightness trenchs on the parts where the motorway route goes accross very sensitive areas (water sources protected zones)
- The approaching to the indoor drainage objects to determine on an effective method with option access to these objects.

In later phases of project design it is necessary to prepare Final Design of sewerage and rainwater discharge for all accompanying structures.

The Final design of sewerage and rainwater discharge for all accompanying structures should ensure:

- For all adjacent and servicing structures it is necessary to resolve issue of wastewater discharge and treatment. On locations where this is possible, wastewater should be conveyed to existing sewerage systems in nearby settlements. On locations where it is not possible, sewage from adjacent servicing structures should be discharged to their own sewerage system connected to suitable treatment device prior to discharge into recipient or on land. Rainwater from these structures should be treated in the same way as water from road surface. Limit values for wastewater discharge surface waters or sewage system should be respected and should correspond to the relevant rulebooks. As a guideline “Rulebook on Conditions of Wastewater Discharge to Surface Waters”, or “Rulebook on Conditions of Wastewater Discharge to Public Sewerage System” should be used, published in Official Gazette RS, no. 44/01).

In later phases of project design development it is necessary to prepare Project of organisation of construction site and technology and dynamics of construction for each subsection of LOT 2.

The project should contain the following:

- Borders of construction site that should be given based on technical criteria for organisation of construction site, need for protection of zones sensitive to erosion, disposal of waste and soil material, discharge of oil and similar liquids (surface waters, wells, agricultural land and other natural values identified in this study).
- Most suitable locations for borrow pits and material disposal. During selection of location it is necessary to avoid sensitive areas.
- Methods for rehabilitation and replanting of borrow pits and disposal sites.
- Most suitable locations for workshops, mechanisation base, asphalt base, fuel and lubricants storage. Zones of unacceptable and high risk for waters, defined based on hydrogeological and other investigation works, should be avoided.
- Transport routes.
- Planned system of wastewater and rain water discharge from the construction site.
- Plan of construction works and detailed development of technological works should enable to avoid partial or full cover of river bed (all water streams cut by motorway or located in the vicinity described in detail within hydrographic network).
- Rehabilitation plan.
- Plan of landscape rehabilitation.
- Plan of intervention in case of accidents.
- On all locations where motorway crosses water streams, or is located near river banks, as well as near water sanitary protection zones, thermal water sources or aquifers, it is necessary to design bumper fences or concrete blocks (New Jersey) for physical prevention of car turnovers.
- In the phase of project design it is necessary to avoid all possible collisions with existing water management structures along motorway Vc. Where it is not possible to avoid this collision, it is necessary to provide adequate technical solutions on identified locations.
- Project of river training should foresee environmentally acceptable constructions, that is, the criteria should be to avoid natural riverbed or design culvert through motorway body where conditions are appropriate.
- In project of river bed displacement use environmentally acceptable practices.

b) During construction phase

- Use the special manner of the mining in the way not to disturb the directions of the ground flows (in stretches where the route passes in the vicinity of the sensitive zones on the groundwater) and of the recharge of surface watercourse. Apply the good management practice of the construction site and of the traffic in order to avoid the watercourse pollution.
- Do not carry out the disposal in the riverbed and near the banks of the watercourses, or in the zones of sanitary protection zones as well as in the zones which are defined as sensitive. In the case that these locations are located in the water asset or in the public water asset, it is necessary to ask for water management authorization.
- All excavated material, which will not immediately be used in construction activities must be disposed in locations foreseen for that in accordance with the Design of the construction site organization (dumping sites of the material surplus) protected from the erosions, as well as outside of the defined sensitive zones.
- Protect the vegetation cover in most possible extent, i.e. leave the buffer zones formed from vegetation cover between the road and watercourse.
- Use only clean material for dyke in the vicinity of watercourse, such as gravel, without earth or other impurities.
- Protect coastal areas sensitive to erosion by means of stabilization and plants that prevent erosion.
- Prohibit any temporary or permanent disposal of waste material on the surrounding soil, except on the locations foreseen for that by design of the construction site organization, as well as insure watertight containers for waste.
- Supervise processes of formation of deposits, and organize clening of the bottom and slopes of the riverbeds from the surplus material.
- Carry out frequent and controlled storage of the municipal and hazardous waste in prescribed manner.
- Establish continuous supervision during the works carrying out with the presence of environment protection specialist.
- Apply disciplinary measures against violators of the determined rules of behaviour.
- Water used at the construction site should be collected in the adequate sewerage system, in waterproof tanks, and treated in the prescribed way (either at the site, or at some distanced location), before it is discharged into recipient or urban sewage system.
- At construction sites, for the needs of workers, it is obligatory to construct ecological toilettes.
- Provide space with waterproof surface ground layer for storage and maintenance of the construction mechanisation, outside of the defined sensitive zones.
- Oily precipitation water from the construction site area should be collected in waterproof tanks and treated in the prescribed way (either at the site or at some distanced location), before it is discharged into the recipient or urban sewerage system.
- Forbid repairing of construction machines and changing of oil in the defined sensitive zones.
- All construction areas and other impact zones should be rehabilitated during construction, in accordance with the Rehabilitation Plan, or, depending on the future use of that space, restored to its original state.
- For locations of the construction bases, maintenance centres, asphalt plants, borrow pits and other structures, in the following design phase a request should be made to get special water conditions.
- During construction in the sensitive zones, put notices (on bulletin boards) for workers at the construction site with warnings that works are being performed in such zones.

- In case of accidents, leaking of petrol or lubricants into the environment, an emergency intervention is necessary in accordance with the Emergency Intervention Plan in Case of Accidents.
- In case of negative impacts on water sources used for water supply, it is necessary to provide alternative water supply for the population in the endangered area in the shortest period possible.
- Use special methods of mining not to disrupt groundwater flows in locations where road passes near sensitive zones, that is, zones of unacceptable and high risk to ground water.
- All digging material that will not be immediately used up in construction works should be disposed on previously determined locations, in accordance with the Construction site organisation project (disposal of excess materials), protected from erosion and located out of identified sensitive zones or zones of unacceptable and high risk to ground waters.
- Protect the vegetation cover, i.e. leave green buffer zones in between road and water bodies,
- Near the water streams use only pure material for embankments, such as gravel, clean of soil and other impurities.
- Disposal should be prohibited in river bed and on the river banks, or near sanitary protection zones and zones identified as aquifers. In case that these sites are located on water asset or public asset it is necessary to ask for water management authorisation.
- Protect erosion sensitive zones with means of stabilisation and using plants that prevent erosion.
- Carry out frequent and controlled adequate solid waste management, i.e. forbid temporary or permanent disposal of waste material on surrounding land, except on locations that are designated for that purpose by Project of construction site organisation, and ensure impermeable waste disposal bins. At the same time use disciplinary measures for those not obeying established measures. It can be expected that workers will during construction find out several previously identified or unidentified (wild) disposal sites of various waste. All these locations should be rehabilitated, depending on the type of waste, according to the appropriately designed projects.
- Used water from construction site should be collected in safe sewerage systems, corresponding tanks and treated in adequate way (on-site or on remote location), prior to discharge to surface water. On construction sites, it is obligation to install ecological toilets for workers use.
- Ensure location with water-tight foundation for locating and servicing mechanical equipment, outside zones defined as zones of unacceptable and high risk to groundwater. Oily rainwater from these locations should be collected and treated in grit removal chamber and oil and grease separator prior to discharge to recipient.
- Prohibit fixing machines and changing of oil in zones of unacceptable and high risk to groundwater.
- All areas related to construction site and other areas of temporary impact should be rehabilitated in accordance with Rehabilitation Plan, and depending on future land use, returned to initial condition.
- For location of construction bases, asphalt bases, borrow pits and other structures ask for water management conditions.
- In case of negative impacts on water supply well, in shortest possible period ensure alternative water supply for people living in area under impact.
- Put warning signs for trespassing through zone of pollution risk, i.e. zone of unacceptable and high risk to groundwater, as well as signs with speed limitation. For vehicles carrying dangerous or harmful substances to water, put signs forbidding temporary stopping in these zones.

- In case of accident, oil or lubricant spillage, it is necessary to undertake urgent measures in accordance with the Intervention Plan in case of accidents.

Measures of the mitigation of negative impact in the use phase

These measures relate to the manner and scope of maintenance of the highway drainage system, selection of appropriate localities of the maintenance service facilities, and selection of material used in this way:

- passing regulations stipulating the scope and time intervals of control procedures, cleaning, and if necessary repairs of facilities for drainage of downfall waters as well as facilities for their filtering,
- selection of appropriate locations and methods of storing chemicals used during the highway maintenance and maintenance of the surrounding ambiance (salt, fertilizers, pesticides etc.),
- organization of the service of regular control and maintenance of the highway and related facilities,
- use the salt for melting and other chemicals, to the smallest possible degree.

It is important to make the operational plan of procedures for possible accident situations as early as during the stage of building of the highway, and at the level of the municipality of cantons organize and equip the appropriate intervention service.

Special water protection measures

Considering all conclusions drawn by analysing impacts, and in sense of implementation of adequate protection measures, it is necessary to define certain actions that must be implemented in the phase of project use. These measures are:
At the level of municipality or canton, it is necessary to organise and equip corresponding intervention team, equipped adequately to quickly ensure rehabilitation of damage caused by accidents and prevent large-scale accidents.
Organisation/company/body that will be responsible for motorway management, use and maintenance must have Plan of intervention in case of accidents.

The Plan should contain at least the following elements:

- In case of accident caused by vehicles transporting harmful powder or granular material, traffic should be stopped and specialised team called to remove harmful matter and rehabilitate road surface. Dispersed powder or granular material must be removed from road surface using only mechanical means (return in new appropriate packaging, cleaning, vacuum cleaning) without water use.
- In case of accident caused by vehicle transporting harmful liquids, stop the traffic immediately and engage special teams for removal of potential problems. Spillage should be removed from road surface with special adsorbents. In case when spillage has moved outside of profile, and when it contaminated the soil, rehabilitation in this case means soil removal. All materials collected should be treated using special regeneration methods or should be disposed in location suitable for such materials.
- • Planned motorway should be equipped with corresponding horizontal and vertical signalisation that includes all types of restrictions and information. Traffic signalisation is necessary to influence drivers that transport harmful substances to decrease speed, prevent overtaking of trucks, increase level of attention and prohibit car stopping on the road.

Administrative water protection measures

Administrative protection measures include number of activities related to administrative regulation of certain issues that, if not regulated, can have negative consequences that are very difficult afterwards to reduce to acceptable level.

These water protection measures include:

- Within authorisations obtained from relevant institutions (relevant ministries, water management companies), require exercising permanent control that would serve to eliminate future possible impacts on waters.
- Within contracting documents that developer will jointly sign with contactors, strictly require that water protection measures defined in Environmental Impact Study are executed and water quality monitoring programme implemented. Beside, contractors are obliged to follow regulations on water protection
-

Within tender documents for construction works, ask from bidders to prove that in their company they have department for environmental protection that will ensure that environmental protection measures prescribed in environmental permit are implemented.

6.2.3. Air

On the exhaust pipes of all machines and vehicles with Diesel engines separating filters shall be built-in. Maximum correctness and functionality of the system for driving fuel combustion to be assured by regular (periodical, planned) and special technical overview of the machines and vehicles. Fuel with guaranteed quality standard shall be used (and regularly controlled).

Dust which regularly accompanies the construction of temporary traffic lanes should be prevented by casual watering – spraying the carriageway and operative surfaces. In the case of applying mining for excavations in rock massif, the type of explosive to be used must have the least possible harmful impacts on the environment.

6.2.4. Soil and Agricultural Land

Permanent monitoring and observation of hydrology conditions in zone of work execution should be a special task/directive to direct managers of works. In case of noticing some new moments, it should undertake urgent investigation activities and rehabilitation works for avoiding destructive affect on earth structures.

By usage of the method 'test sections' at every characteristic geological-enginering area of the motorway route, it should chack correctness of designed slopes, and then start earthen works.

A technic of contour mining should be in application (previously tested at 'test section'). Alternatively, it should apply additional mechanical processing of cutting slopes with dredges.

Surface layer of fertile land ('humus') which is located in the working zone, should be excavated completely in whole depth and deposit out of the working zone because of later usage for re-cultivation (slopes of cuttings and embankments) and other surfaces (mines, cleared land of forest etc). Temporary dump cannot be placed at location which will endanger natural soil.

The agricultural land should be protected against dust by biological covers (reed, doormat, straw). Sedimentation of water deposits should be prevented at the place where erosion occurs, by previously mentioned measures of controlled collection and conducting of rainfall and underground waters. The system of measures on prevention of consequences of negative impacts on soil and agricultural land includes:

- Prevention measures,
- Mitigation measures,
- Rehabilitation measures.

Prevention measures
The prevention measures have for goal prevention of negative consequences of different impacts on soil and agricultural land, and on agricultural production itself:

- Prohibition of leaded fuels,
- Obligatory usage of catalysts in vehicles,
- Regulation of driving speds at critical points and zones of intensive agricultural production (Agro-zone-I).
- Prohibition for growing of agricultural raisings in zone of the motorway corridor, which accumulate harmful and dangerous matters in edible parts as salade, spinach, onion, mangel etc.
- Usage of agricultural production through growing of raisings under controlled conditions in direct vicinity of the motorway, as plastic or glass greenhouses production of garden flowers and decorative herbs, production of industrial plants at open space and plowmas raisings (grains and potatoes), and on bigger distances from the road, fruits and vegetables.

All these measures should be introduced by passing adequate law regulations, in accordance with the principles of sustainable development and international standards.

Mitigation measures
Mitigation measures are related to activities that should be undertaken in construction phase, with the goal of prevention of unwanted effects on the soil and plants, more exactly, on agricultural production itself, and they are :

- Removal and dumping of fertile layers of soil,
- Provision of passability and accessability to agricultural lots,
- Remediation of degaraded land,
- Decontamination of contaminated land,
- Growing of vegetation zones.

Removal and dumping of fertile layers of soil
Taking into account the fact that absolute measures of land protection do not exist and that it was not possible to avoid occupation of valuable bonity categories of agricultural land (Agro-zone-I), and to do not lose fertile soil, it is necessary to remove it and dump it on suitable location.

- **Section-1 Karuše – Medakovo**

The following bonity categories of agricultural land are present at this section:

- II	106.000 m^2 x 0,45 m =	47.700 m^3
- III	20.000 m^2 x 0,35 m =	7.000 m^3
- IVa	3.000 m^2 x 0,30 m =	900 m^3

- IVb 12.000 m^2 x 0,25 m = 3.000 m^3
Total = 58.600 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 58.600 m^3 of fertile soil.

- **Section-2 Medakovo – Ozimice**
The following bonity categories of agricultural land are present at this section:
- II 407.000 m^2 x 0,45 m = 183.150 m^3
- III 138.000 m^2 x 0,35 m = 48.300 m^3
- IVa 18.000 m^2 x 0,30 m = 5.400 m^3
- IVb 44.000 m^2 x 0,25 m = 11.000 m^3
Total = 247.850 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 247.850 m^3 of fertile soil.

- **Section-3 Ozimice - Poprikuše**
The following bonity categories of agricultural land are present at this section:
- II 32.000 m^2 x 0,45 m = 14.400 m^3
- III 35.000 m^2 x 0,35 m = 12.250 m^3
- IVa 8.000 m^2 x 0,30 m = 2.400 m^3
- IVb 60.000 m^2 x 0,25 m = 15,000 m^3
Total = 44.050 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 44.050 m^3 of fertile soil.

- **Section-4 Poprikuše - Nemila**

The following bonity categories of agricultural land are present at this section:
- II 10.000 m^2 x 0,45 m = 4.500 m^3
- III 2.000 m^2 x 0,35 m = 700 m^3
- IVa 4.000 m^2 x 0,30 m = 1.200 m^3
- IVb 13.000 m^2 x 0,25 m = 3.250 m^3
Total = 9.650 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 9.650 m^3 of fertile soil.

- **Section-5 Nemila - Donja Gračanica**

The following bonity categories of agricultural land are present at this section:
- II 1.000 m^2 x 0,45 m = 450 m^3
- III 2.000 m^2 x 0,35 m = 700 m^3
- IVa 3.000 m^2 x 0,30 m = 900 m^3
- IVb 36.000 m^2 x 0,25 m = 9.000 m^3
Total = 11.050 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 11.050 m^3 of fertile soil.

- **Section-6 Donja Gračanica - Drivuša**

The following bonity categories of agricultural land are present at this section:
- II 35.000 m^2 x 0,45 m = 15.750 m^3
- III 26.000 m^2 x 0,35 m = 9.100 m^3
- IVa 5.000 m^2 x 0,30 m = 1.500 m^3
- IVb 92.000 m^2 x 0,25 m = 23.000 m^3
Total = 49.350 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 49.350 m^3 of fertile soil.

- **Section-7 Drivuša - Kakanj**

The following bonity categories of agricultural land are present at this section:

- II	206.000 m^2 x 0,45 m =	92.700 m^3
- III	54.000 m^2 x 0,35 m =	18.900 m^3
- IVa	15.000 m^2 x 0,30 m =	4.500 m^3
- IVb	28.000 m^2 x 0,25 m =	7.000 m^3
Total		= 123.100 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 123.100 m^3 of fertile soil.

- **Section-8a Blažuj - Lepenica**

The following bonity categories of agricultural land are present at this section:

- II	21.000 m^2 x 0,45 m =	9.450 m^3
- III	98.000 m^2 x 0,35 m =	34.300 m^3
- IVa	5.000 m^2 x 0,30 m =	1.500 m^3
- IVb	121.000 m^2 x 0,25 m =	30.250 m^3
Total	=	75.500 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 75.500 m^3 of fertile soil.

- **Section-8b Lepenica - Tarčin**

The following bonity categories of agricultural land are present at this section:

- II	72.000 m^2 x 0,45 m =	32.400 m^3
- III	109.000 m^2 x 0,35 m =	38.150 m^3
- IVb	6.000 m^2 x 0,25 m =	1.500 m^3
Total	=	72.050 m^3

Concerning the bonity categories of agricultural land at this section, it is necessary to remove 72.050 m^3 of fertile soil.

- **Whole route**

The following bonity categories of agricultural land are present at motorway Corridor Vc for LOT-2 in zone of 50 m, is:

- II	890.000 m^2 x 0,45 m =	400.500 m^3
- III	483.000 m^2 x 0,35 m =	169.050 m^3
- IVa	61.000 m^2 x 0,30 m =	18.300 m^3
- IVb	412.000 m^2 x 0,25 m =	103.000 m^3
Total	= 690.850 m^3	

Concerning the bonity categories of agricultural land at whole motorway route, it is necessary to remove 690.850 m^3 of fertile soil.

Provision of passability and accessability to agricultural lots

In phase of the motorway route construction and situations when the works are ongoing or in cases where because of watercourses regulations it is not possible to approach to the lots, It is necessary to undertake some actions by which the access will be enabled to all lots in order to do not disturb usage of the lots. In these actions are included:

- Construction of accesss roads,
- Construction of bridges,
- Construction of passages.

Above mentioned measures will be undertaken according to situation, individually or in combination.

Remediation of degraded land

During the motorway route construction, it will be necessary to rehabilitate land on which occure some processes of erosion and flood, where the buildings for needs of the site have been built (setllments, parkings, warehouses and other rooms), dumps for stockpiling of removed fertile soil layers placed and open borrow pits for embankment material located.

In this purpose, it is necessary to make a program of remediation and recultivation of land in accordance to valid law regulations as the Law on agricultural land (Off. Gazette FB&H 2/98).

Decontamination of contaminated land

In all situations where it comes to spilling and leakage of fuel, lubricants, tar masses and etc., it is necessary to undertake suitable decontamination measures.

These measures understand sprinkling of sawdust on places of leakages and burning of sawdust, then removal and dumping of soil layers that were polluted.

Growing of vegetation zones

In order to prevent contamination of high- valuable agricultural land (I and II bonity category) It is necessary to get up vegetation protective zone high around 2,5-3,0 m.

- **Section-1 Karuše – Medakovo**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	0+500 - 0+930	0+650 - 0+930
2	1+150 - 1+400	1+100 - 1+370
3	1+900 - 3+200	1+900 - 3+300
4	3+400 - 4+000	3+400 - 4+000
Total	2.580 m	2.550 m

In relation to bonity categories of agricultural land, at this section, from the right side of the route, it is necessary to grow 2.580 m, and from left side to grow 2.550 m of protective vegetation zone, in total 5.130 m.

- **Section-2 Medakovo – Ozimice**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	4+000 - 6+500	4+000 - 6+500
2	7+240 - 7+340	7+500 - 7+630
3	7+500 - 7+620	7+700 - 8+400
4	7+750 - 8+430	8+720 - 9+200
5	8+650 - 9+200	9+350 - 9+450
6	9+350 - 9+450	9+700 - 9+950
7	9+700 - 10+000	10+280 - 10+620
8	10+280 - 10+620	10+800 - 11+000
9	10+800 - 11+000	11+050 - 11+120
10	11+050 - 11+120	11+180 - 12+370
11	11+180 - 12+000	12+800 - 12+870
12	12+200 - 12+320	18+350 - 18+450

13	12+800 - 12+870	18+940 - 19+070
14	18+350 - 18+450	19+100 - 19+450
15	18+940 - 19+060	20+320 - 20+500
16	19+100 - 19+300	20+670 - 20+760
17	20+320 - 20+500	20+820 - 21+420
18	20+670 - 20+760	21+750 - 21+900
19	20+820 - 21+420	22+220 - 23+650
20	21+700 - 21+850	23+700 - 23+920
21	22+220 - 22+560	24+380 - 24+600
22	22+600 - 22+800	24+750 - 24+880
23	22+940 - 23+650	
24	23+700 - 23+920	
25	24+400 - 24+600	
26	24+750 - 24+880	
Total	9.210 m	9.630 m

In relation to bonity categories of agricultural land at this section, it is necessary to grow, from right side of the route 9.210 m and from the left side 9.630 m of protective vegetation zone, in total 18.840 m of zone.

- **Section-3 Ozimice - Poprikuše**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	24+880 - 25+200	24+880 - 25+200
2	25+300 - 25+330	25+300 - 25+330
3	25+400 - 25+500	25+400 - 25+500
4	25+550 - 25+600	25+550 - 25+600
5	32+950 - 33+020	32+950 - 33+020
6	35+320 - 35+400	35+320 - 35+400
7		37+420 - 37+500
Total	650 m	730 m

In relation to bonity categories of agricultural land, at this section, from the right side of the route, it is necessary to grow 650 m, and from left side to grow 730 m of protective vegetation zone, in total 1.380 m.

- **Section-4 Poprikuše - Nemila**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	42+500 - 42+540	42+500 - 42+540
Total	40 m	40 m

In relation to bonity categories of agricultural land, at this section, from the right side of the route, it is necessary to grow 40 m, and from left side to grow 40 m of protective vegetation zone, in total 80 m.

- **Section -5 Nemila - Donja Gračanica**

Concerning the presence of high-valuable bonity categories of agricultural land, it is not necessary to grow vegetation protective zones at this section.

- **Section -6 Donja Gračanica - Drivuša**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	62+800 - 62+920	62+800 - 62+920
2	65+870 - 66+050	65+880 - 66+050
3	66+200 - 66+240	66+200 - 66+240
4	66+290 - 66+430	66+300 - 66+430
5	66+460 - 66+650	66+460 - 66+650
Total	670 m	650 m

In relation to bonity categories of agricultural land, at this section, from the right side of the route, it is necessary to grow 670 m, and from left side to grow 650 m of protective vegetation zone, in total 1.320 m.

- **Section -7 Drivuša - Kakanj**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	67+100 - 67+620	67+100 - 67+620
2	68+000 - 68+400	68+000 - 68+400
3	68+580 - 68+720	68+580 - 68+720
4	72+400 - 72+900	72+400 - 72+900
5	73+280 - 73+500	73+280 - 73+500
6	73+720 - 74+280	73+720 - 74+280
7	74+650 - 75+530	74+650 - 75+530
8	77+620 - 79+200	77+620 - 79+200
9	79+300 - 80+630	81+300 - 81+600
10	81+180 - 81+600	
Total	6.550 m	5.100 m

In relation to bonity categories of agricultural land, at this section, from the right side of the route, it is necessary to grow 6.550 m, and from left side to grow 5.100 m of protective vegetation zone, in total 11.650 m.

- **Section -8a Blažuj - Lepenica**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	7+380 - 7+680	7+380 - 7+680
2	7+930 - 8+000	7+930 - 8+000
3	8+040 - 8+120	8+040 - 8+120
Total	450 m	450 m

In relation to bonity categories of agricultural land, at this section, from the right side of the route, it is necessary to grow 450 m, and from left side to grow 450 m of protective vegetation zone, in total 900 m.

- **Section -8b Lepenica - Tarčin**

Concerning the presence of high-valuable bonity categories of agricultural land, it is necessary to grow vegetation protective zones at the following chainages at this section:

Chainage	Right side of the route	Left side of the route
1	9+600 - 9+700	9+600 - 9+700
2	10+370 - 10+720	10+370 - 10+650
3	11+130 - 11+200	12+200 - 12+270
4	12+150 - 12+300	12+450 - 12+650
5	12+450 - 12+650	12+900 - 13+200
6	12+900 - 13+200	12+230 - 13+480
7	13+230 - 13+480	13+810 - 13+960
8	13+810 - 13+960	
Total	1.570 m	1.350 m

In relation to bonity categories of agricultural land, at this section, from the right side of the route, it is necessary to grow 1.570 m, and from left side to grow 1.350 m of protective vegetation zone, in total 2.920 m.

- **Whole route**

In relation to the bonity categories of agricultural land, at whole motorway route, it is necessary to grow 21.720 m from the right side of the route, and from left side to grow 20.500 m of protective vegetation zone, in total 42.220 m.

6.2.5. Flora

In the framework of the Work Organization Project and Site Organization it should plan very carefully and precisely the optimal routes of temporary roads and other operative surfaces (depots, warehouses, parking, workshops etc.), and during the work execution, it should be limited strictly on usage of planned surfaces. Furthermore, technological actions and order of works should be so planned that devastation of flora would be reduced at minimum (prevention against uncontrolled crashing down of material or intentional pulling down from the hillside; forming of depots and borrow pits according to the plan). Special obligation of the contractor will be to protect technically some valuable samples (or groups) of plants/especially trees/ that can be endangered by the work execution.

By the Project of the work technology, the contractor has to foresee temporary technical measures for protection against erosion caused by water (carrying out the edge channels; covering of artificial slopes by waterproof foils /or application of sprayed concrete, adequate transversal slopes of the foundation, carrying out temporary collecting pits – wells and sedimentation tanks, which will be cleaned regularly under control and according to the plan).

Measures for mitigation of solid particles emission, dust and pollutants that have been mentioned for impact on the air, can be applied here. The corrective measure, which designer should apply here obligatory, is to restore autochtonous vegetation on all surfaces that have been temporary used in purpose of the motorway construction, more precisely, re-cultivation of zones for borrowing pits, in other words, all surfaces of the formed depots, through planting and afforest by adequate plant sorts.

There is no effective protection measure for above mentioned impact. But, it is useful to undertake some measures on time, as gradual preparation of animals for phased removal from the endangered zones, by limited and discrete technical activities. At the same time, it should create (according to the plan) suppositions for animal existence of better quality in surrounding areas, through construction and permanent maintenance of breeding and watering places, – and prohibition of hunting and any other form of persecution on behalf of the people.

In the Plan and order of work execution in space ('attacking' places and directions of the work progress) it shoud leave the intact zones, long as much as possible, which are identified as natural corridors of animals moving over terrain. Through special technical solutions (motorway in tunnel or overground crossings for animals) and effective organization of the execution, it should make permanent solutions which enable crossing to animals over the motorway zone – along with maximal preservation of natural ambient at these crossings.

Construction and maintenance of alternative breeding and watering places should proceed to the motorway construction, in order to create reflex habits at animals for their usage. Besides that, environment of water animals will be preserved through application of special water protective measures. Through development of actions and establishing of work execution order, special attention should be paid to the aspect of preservation of the lives of animals that would be found in wider area of work execution. Careless human actions which lead to endangering of lives of animals will be sanctioned by discipline measures in contractor organization, intentional injuring and killing of animals will- besides discipline responsibility – be under jurisdiction of Tort/Criminal Law. Through all technical activities undertaken, it should avoid presence of factors which are favorable for creation of conditions in which carriers of diseases can multiply – by adequate drainage during the work execution, drainage of muddy terrain etc.

Construction of the highway includes numerous activities in the space that will lead to the permanent loss of vegetation cover and habitats. Degradation or complete destruction of rare, endemic, or endangered plant species and their communities is significant problem. That complete removal of vegetation will along all the alignment in the average width of 30-35 m which physically covers this linear object, and in the predicted protective belt by the highway. A loss in the places where service objects are predicted this width will be wider and it will depend on the type of planned service object.
It will be necessary to carry out the quantification of these amounts in all phases of the project preparation when will be precisely known all positions for both service and infrastructure objects along the highway.

In phase of motorway construction, it would be necessary to cut all trees to the standard length, and clear them from all branches. Trees suitable for selling are all trees that could be used for production of timber or logs. It would be necessary to obtain permit for fires in accordance with legislative and law regulations. All cut trees, branches, and roots should be removed in accordance with existing legal provisions, rules and regulative.
Estimated number of cut trees within all sections of the LOT 2 and costs of the wood mass that needs to be removed is given in the table 6.2.5.1. below.

Table 6.2.5.1. Estimated number of cut trees within all sections of the LOT 2 and costs of the wood mass that needs to be removed

NO.	SECTION	OWNER -SHIP	PLANT ASSOCIATION	WOOD CATEGORY	STOCK VOLUME (M^3/HA)	PRICE PER M^3 (KM)	SECTION LENGTH (M)	TOTAL (KM)	REMARKS
1.	**Karuše – Medakovo (km 0+000 to 4+000)**	ROAD ROUTE GOES TROUGH AGRICULTRAL LAND ALONG ITS ENTIRE LENGTH							
2.	**Medakovo - Ozimica (km 4+000 to 24+901,587)**	Private property	Degraded coppice Oak forests	Fuel wood	50	30	25	375	Enlarged 2 times because of access roads
			Degraded coppice Oak forests	Fuel wood	50	30	200	3.000	Enlarged 2 times because of access roads
			Degraded coppice Beech forests	Fuel wood	100	30	640	19.200	Enlarged 2 times because of access roads
			Degraded coppice Oak forests	Fuel wood	100	30	400	12.000	Enlarged 2 times because of access roads
			Degraded coppice Oak forests	Fuel wood	100	30	200/2	6.000	Access roads not required
			Total private	*1.352,5 m^3 relates to 5 sections whose total length is 1.465 m*				***40.575***	
		State property	Artificial Locust forest (cultures)	Artificial forests			200	6.000	Size of artificial forest is 1 ha.
			Artificial forest (culture) of Scotch and Austrian pine	Technical round wood	150	140	100 x 50	10.500	Access roads not required
			Artificial forest (culture) of Scotch and Austrian pine	Technical round wood	150	140	300 x 50	31.500	Access roads not required
			Total state	300 m^3 relates to 3 sections whose total length is 600 m				***48.000***	
		Total section No. 2		*1.652,5 m^3 relates to 8 sections whose total length is 2.065 m*				***88.575***	Plus 1 ha of Locust Artificial forest
3.	**Ozimica–Poprikuše (km 24+901,587 to 38+617,434).**	State property	Degraded coppice Oak forests	Fuel wood	100	30	1.000 + 200	***18.000***	Enlarged for 20% because of access roads
4.	**Poprikuše–Nemila (km 38+617,434 to 46+289,378)**	State property	Artificial Austrian pine forest	Technical round wood	150	140	200 + 40	***25.200***	Enlarged for 20% because of access roads
5.	**Nemila–Donja Gračanica (km 46+289,378 to 58+434,599)**	State property	Degraded coppice Oak forests	Fuel wood	80	30	75+15	1.080	Enlarged for 20% because of access roads
			Degraded coppice Oak forests	Fuel wood	80	30	220+44	3.168	Enlarged for 20% because of access roads
			Degraded coppice Oak forests	Fuel wood	80	30	90+18	1.296	Enlarged for 20% because of access roads
			Degraded coppice Oak forests	Fuel wood	80	30	1100+ 220	15.840	Enlarged for 20% because of access roads
			Degraded coppice Oak forests	Fuel wood	80	30	180+36	2.592	Enlarged for 20% because of access roads
			Degraded coppice Oak forests	Fuel wood	80	30	25+ 5	360	Enlarged for 20% because of access roads

NO.	SECTION	OWNER -SHIP	PLANT ASSOCIATION	WOOD CATEGORY	STOCK VOLUME (M^3/HA)	PRICE PER M^3 (KM)	SECTION LENGTH (M)	TOTAL (KM)	REMARKS
			Degraded coppice Oak forests	Fuel wood	80	30	600+ 120	8.640	Enlarged for 20% because of access roads
			Degraded coppice Beech forests	Fuel wood	80	30	90+18	1.296	Enlarged for 20% because of access roads
			Degraded coppice Beech forests	Fuel wood	80	30	200+40	2.880	Enlarged for 20% because of access roads
			Degraded coppice Oak forests	Fuel wood	80	30	70+14	1.080	Enlarged for 20% because of access roads
			Total state	*1.272 m^3 relates to 10 sections whose total length is 2.650 m*				***38.232***	
		Total section No. 5						***38.232***	
6.	**Donja Gračanica – Drivuša (km 58+434,599 to 66+959,592)**	ROAD ROUTE GOES TROUGH AGRICULTRAL LAND ALONG ITS ENTIRE LENGTH							
7.	**Drivuša – Kakanj (km 66+959,59 to 82+595,000)**	ROAD ROUTE GOES TROUGH AGRICULTRAL LAND ALONG ITS ENTIRE LENGTH							
8.	**Blažuj – Tarčin (km 0+000 do 19+100)**	State property	Degraded coppice Beech forests	Fuel wood	80	30	2000+ 400	28.800	Enlarged for 20% because of access roads
		Total section No. 8		*960 m^3 relates to 1 section whose total length is 2.000 m*				***28.800***	
Total for the whole LOT 2			***4.664,5 m^3 relates to 8 sections whose total length is 7.915 m***				***198.807 KM***		

Remark:
The prices per m^3 of wood mass are calculated in accordance with "compensation price list" which is formed by adding 50% to the normal price (e.g. if the price of fuel wood is 20 KM/m^3, the price according to "compensation price list" would be 30KM). Above-mentioned information are obtained from employees of Forestry Enterprises ZDK and J.P. „Sarajevo šume"Ltd.

6.2.6. Fauna

Measures for mitigation of loss or revitalisation of animals on the sections of the highway that will be endangerd or under the treat due to the exploitation of this area are general to the certain extent to all ections, and they are:

- The control of the oil and petroleum discharge which must not be poured out into the watercources. During construction it would be necessary to purify water from construction sites using sand filters and accepotrs of oils, and then leave to enter waterways.
- Cutting of riparian forest vegetation should be carried out during winter season in order to mitigate to the certain extent total impact on the fauna on the land and in the water.
- One of the preventive measures is fencing of construction site which will limit the belt of negative impacts, using 2 m height fence.
- It would be necessary to provide construction of bird houses for nesting birds which will mitigate loss of ornitofauna (Section: 1, 2, 3,4, 5, 6, 7 i 8).
- Provide easy passage for fish species (rare) regulated with smaller paths and similar
- Impact on aquatic or water fauna could be mitigate to the great extent through implementation of measures of monitoring of the state (zero state) before the construction and at the beginning of the construction. Monitoring should be implemented on numerous waterways situated in the alignment (details in the section 10.0).

- In all sections (and particularlly at Section 2: Medakovo-Ozimiace) there are numerous smaller waterways which considering their ecological characterisation have high level of biodiversity of lower plants and animals. Constructio stage and construction itself will cause changes in these waterways which belong to the river Bosna basin. In order to mitgitae these impacts it would be necessary to implement precautionary principles in the construction sites, movement of heavy machinery should be carried out far from these sites, all deposits should be removed, and filling in with deposits should be strictly controlled, etc.

- **Section 3. Ozimica – Poprikuše (chainage km 24+901,587 to 38+617,434)**

At distance from 25+240 to 26+000.00 km network for prevention of exit of small animals on highway (Fig. 3. in Annex 12.2.).

- **Section 5. Nemila – Tonja Gračanica (chainage km 46+289,378 to 58+434,599)**

Part of the alignment separates a part of the habitat and prevents or disrupts contacts and migrations of animal populations. Construction either smaller underpass or fence which will prevent losses, until poplations get adapted to this form of the impact 46+388.800 km to 49 +122.716 where it is necessary to predict passages for fauna or fence (Fig. 4. in Annex 12.2.).

- **Section 7. Drivuša – Kakanj (chainage km 66+959,59 to 82+595,000)**

In the parts toward Kakanj after cutting of the trees or other forms of removal, it would be necessary to build bird houses for nesting birds that will contribute to the quality of the landscape in this part of the alignment.

- **Section 8. Blažuj – Tarčin (chainage km 0+000 to 19+100)**

At 19+100.00 km it would be necessary to construct a fence to prevent enter of large and smaller animals to highway (Fig. 5. in the Annex). Protective measures for water fauna of the river Bijela and the river Lepenica will be considered in the section about monitoring.

6.2.7. Landscape

By appropriate technological procedures and organising the working place uncontrolled slippage of material from the hillsides should be completely avoided.

Temporary waste areas may exist only during the phase of preliminary earth works: after that, any temporary waste areas shall be systematically removed, and the terrain on which they had been made, shall be reactivated to their previous function.

Illustration 6.2.6.1. SECTION 2: Village Karadaglije, view in direction of future tunnel «Crni vrh»

Illustration 6.2.6.2. SECTION 4: View on the hillside where the motorway will pass in zone of settlement Nemila

6.2.8. Protected Parts of Nature

Protected area in the surroundings of Žepče is mainly designated for preservation of serpentine complex which is distinguished by the high viodiversity level with the high level of endemic plant species. Construction of the highway will lead to the increas of the number of visitors to this area which come to understand and learn about values of this protected area and to gain certain personal benefits. Tourism in the protected area depends on the preservation of the ecosystem quality. This has significant importance for maintenance of economy and life quality. Threfore it is necessary to very carefull plan, manage, and monitor all tourist operations in the protected area in order to ensure its long-term sustainability. Othervise, there will be negative impacts and tourism will deteriorate the quality of protected area insted to contribute to its preservation.

6.2.9. Cultural and Historical Heritage

General measures for archaeological areas or possibly new findings require permanent archaeological – conservation supervision during the performance of the works on the whole road section. In the case of discovery of archaeological finds, the research procedure and location documenting shall be obligatorily conducted.

Depending on the nature of the finds, the possibilities and methods of its protection and conservation shall be considered including application of the following measures:

- Conservation of finds by backfilling,
- relocation of finds,
- relocation of parts of the finds while conserving the remaining part of the locality by backfilling,

Aiming to reduce negative indirect motorway impact on the heritage, and to achieve positive impact as far as possible it is important while designing the landscape, accompanying contents and visual communications to take into account appropriate presentation of the heritage, visual compliance with the cultural landscape in its environment, as well as on assuring the protection the planted belts or protection structures for reducing soil vibrations, changes of underground water flows and chemical contaminations indirectly jeopardizing the monuments.

6.2.10. Hunting Game

Measures for protection of hunting animals in various sections rich in hunting animals (Medakovo-Ozimice, Poprikuše-Nemila, Nemila - D.Gračanica, D.Gračanica-Drivuša, Drivuša-Kakanj) are facilitated by the construction of numerous tunnels, viaducts, and bridges. General mitigation measures include:

- Avoiding higher level of noise which could disturb animals;
- Light on construction sites should be decreased to the minimum during the night since this also could have a negative impact on the hunting animals;
- In the case of findings of cubs or nests with eggs it would be necessary to relocate them to the preserved parts of habitats;
- To the bashful animals should be handled with caere and move them to distant parts far from the alignment or construction sites;
- All implemented measures will not prevent higher losses due to the presence of heavy machimery, noise during the construction, but in the communication with municipal hunting associations it would be necessary to have permanent insight into control and monitoring in order to after construction of the highway through introduction of species of hunting animals influence to the revitalisation of this very important biological factors in maintenance of general ecological balance.

Concreate measures are predited for each sector:

- **Section 2. Medakovo - Ozimica (km 4+000 to 24+901,587)**

At 6+072.546 – 7+166.544 construction of passage for animals as underway or «green bridge» (Fig. 1. in Annex 12.2.).
At 17+465.017 – 18+304.836 km construction of passage for animals (Fig. 2. in Annex 12.2.).

- **Section 3. Ozimica – Poprikuše (km 24+901,587 to 38+617,434)**

At 25+240.114-26+000.00 km fence for prevention of enter of smaller animals to the alignment (Fig. 3. in the Annex 12.2.).

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

At 19+100.00 km fence from the upper side towards Tarčin and from the left side of the highway to prevent enter of animals to the alignment (Fig. 5. in the Annex).

At 13+182.00 – 13+275.3 km from Zabrđe to Toplice construction of animal passage (underway of «green bridge») – Fig. 6. in the Annex 12.2.

6.2.11. Noise, Vibrations and Lights

All construction machinery and vehicles used while constructing the motorway shall have built-in noise protection/isolation of the driving engine and other assemblies producing or otherwise contributing to noise development.

In the case of mining application for excavations in a rock massif, the type of explosive to be used must have the least possible harmful impacts on the environment; technique of millisecond activating of mine filling with directed action of explosion shall be applied so that the effect of superposition of dynamic thrusts (vibrations, seismic), noise and dust emitting would be reduced. Alternatively, the technique of excavation by applying hydraulic hammers or mechanical digging by milling machines, by boring "moles" and similar, can be used.

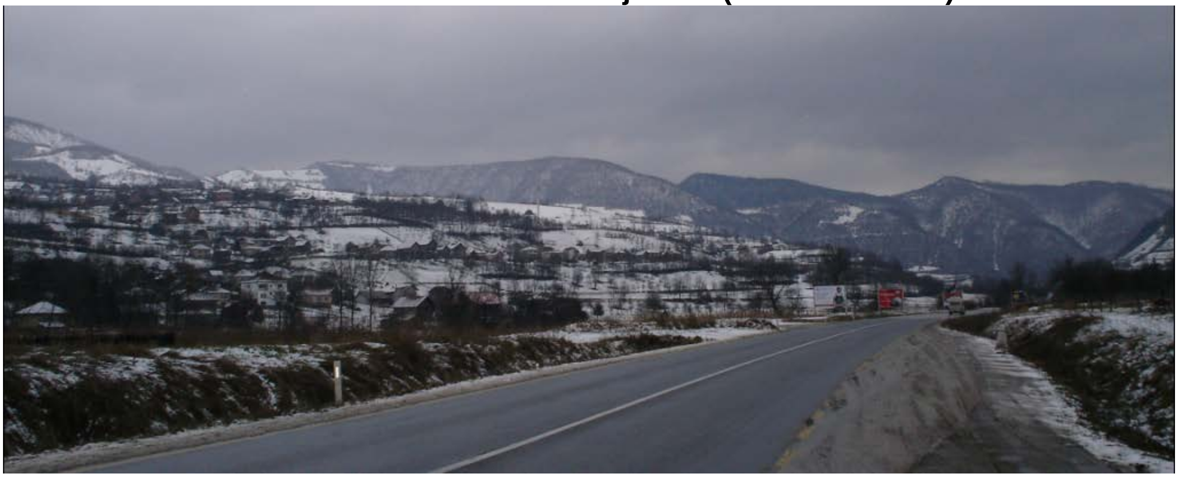
6.2.12 Infrastructure

At the intersection points with the existing current installations (power transmission lines), the lines should be realigned through the preceding works; and/or separated /protected /isolated by technical measures.

At the intersection points with the existing traffic routes of higher rank: highways and railway track (double-gauge, electric powered) necessary temporary protective structures should be built for separating the traffic lanes from the work zone; any prescribed traffic signalling shall be applied and if necessary, traffic police patrols shall be provided.

Illustration 6.2.111. SECTION 3: Location of the motorway crossing over the main road M17, railroad and Bosna River (Papratnice)

Illustration 6.2.11.2. SECTION 6: Location of the interchange «Drivuša» with the view in direction of future tunnel «Vijenac» (at the section 7)



6.3. Mitigation Measures During the Motorway Exploitation

6.3.1. Population

It is expected that the construction of the motorway will be the strongest driving force for economic activities and that will enable B&H to join main European traffic flows and common European economic system.

Construction of the motorway will connect B&H area with the neighboring countries and regions in a rational way, and will have stability and development effects on the country. Improved transport conditions will improve quality of life, to be manifested in the following:

- Decrease of the length of travel of goods and passengers;
- Decrease of the costs of transport of goods and passengers;
- Increase of employment;
- Valorization of geo-transport situation of B&H;
- Increase of the competitiveness of the industry situated in the gravitating area of the corridor;
- Starting of the new projects and increase of private investments in the regional economy;
- Improved access to the markets for the goods transported by the future motorway Vc;
- Improved access to work and possibilities of employment;
- Decrease of the number of accidents which involve pedestrians and related social and economic costs as the result of lightening the mix of transit and local traffic on the existing road scheme;
- Positive effect on houses and business operations along the existing route due to improved access and diversion of the most of the existing traffic which causes traffic jams;

- Business opportunities for local companies in road contraction industry, transport industry, exploitation and processing of raw materials (stone, gravel, cement, asphalt, etc.); the construction works will provide short but far-reaching work opportunities in the period of several years.

However, the project will have some negative local effects on social and economic aspects along the route, both for individuals and businesses:

- Loss of houses and property;
- Possible decrease of the value of residential property / rent due to the vicinity of the motorway which is a common thing when new and large facilities are built;
- Influence on business operations / industry due to the conflict with the route;
- Limitations regarding the usage of land and forest;
- Losses in agricultural production (loss of smaller property and land parcels may influence the subsistence of individuals/families).

6.3.2 Waters

These measures relates to the way and scope of motorway maintenance, especially relates to the system of the motorway drainage, selection of suitable localities for the structures of maintenance department, and selection of the material which will be used in that purpose. The measures include:

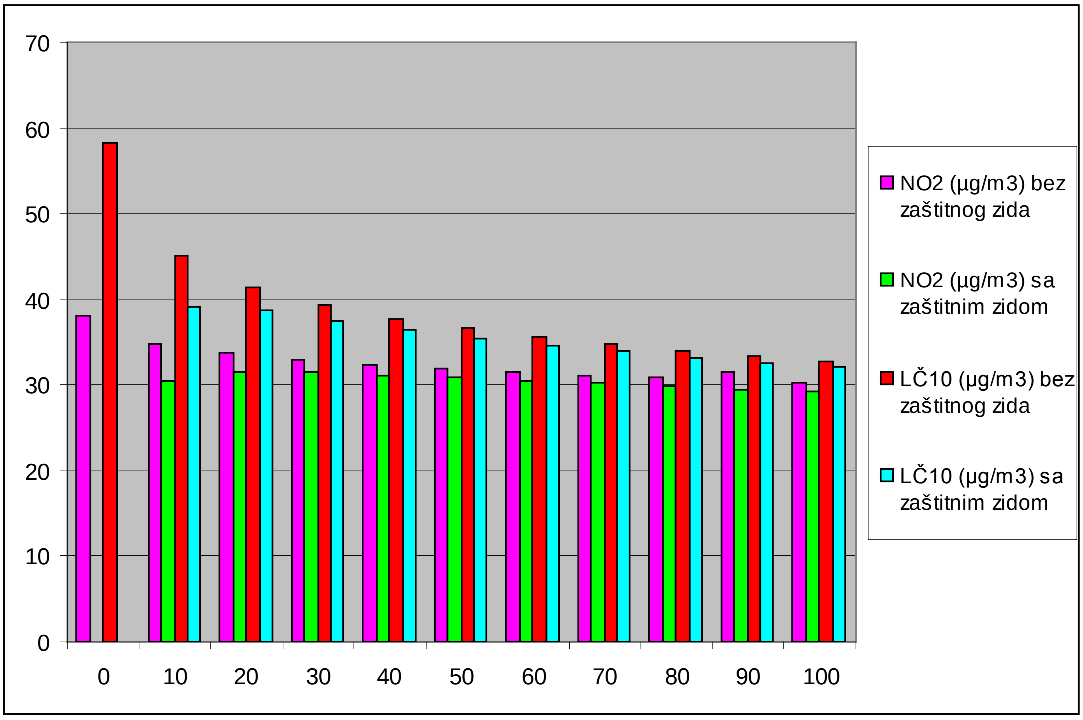
- Protection of surfaces sensitive on erosion by stabilization means and plants that can stop erosion.
- Preparation of the Operational plan for regular and exceptional maintenance of the drainage system. By this plan will be regulated the scope and time interval for actions in relation to control, cleaning, and according to the needs, repair of structures for drainage of storm waters and facilities for their treatment. By this plan, the way of taking care of material produced as result of cleaning and maintenance of drainage system and its treatment shall be regulated in accordance with the Law on waste. Preparation of the Plan and its application is under competence of the Service for environmental protection.
- Preparation of the Operational plan for the actions of winter maintenance (usage of salts and other means for unfreezing), taking into account protection of waters and soils, and problems of environmental protection in general. The Plan has to include:
  - Defining of suitable locations and the way of storage of the chemicals that are going to be used for maintenance of the motorway and surrounding ambient (salt, fertilizers, pesticides etc.), which have to be out of sensitive areas.
  - Usage of means shall be reduced at the minimum, by correct assessment of the state of pavement.

6.3.3. Air Quality

In cases when design phase could not include measures to reduce influence of vehicles on air quality[37], i.e. road sections/locations where the impact is inevitable, following measures should be applied:

- Usage of designed noise protection walls, which also reduce diffusion of emitted air pollutants;

Illustration 6.3.3.1. Comparison of estimated average annual values (for 2013) for NO_2 and PM 10 with and without noise protection wall on Section Lašva krak1 - Kakanj



- Design of vertical ventilation tubes in tunnels to decrease concentration of air pollutants near tunnel openings;
- Design of local speed limitation in areas with high background concentration of air pollutants;
- Planting tall, leafy, and dense vegetation between roads and human settlements to filter pollutants.

Locations for consideration regarding above stated measures are presented in table 6.3.3.1.

[37] Providing sufficient capacity to avoid traffic congestion and driving pattern, avoiding placement of busy intersections, and tunnel vents and openings near housing, schools or workplaces etc.

Table 6.3.3.1. Locations for consideration regarding stated mitigation measures[38]

Section	Chainage	Location
1: Karuše - Medakovo	0+450 do 1+200	Tešanjka
	2+250 do 2+800	Luke
	3+525	petlja Medakovo
2: Medakovo - Ozimica	4+000 do 5+070	Obrenovac
	11+300 do 12+880	Koprivci
		Karadaglije
	23+300 do 24+400	Ozimica
3: Ozimica - Poprikuše	28+600 do 29+700	Tatarbudžak
	31+770 do 32+120	Rosulje
	32+350 do 32+600	
	37+200 do 37+810	Poprikuše
4: Poprikuše - Nemila	41+390 do 43+560	Topčić Polje
	45+450 do 45+610	Nemila
	46+040 do 46+120	
	46+200 do 46+390	
5: Nemila - Donja Gračanica	46+390 do 47+070	Nemila
	47+130 do 47+800	
	51+200 do 51+850	Vranduk
	52+150 do 52+600	Ponirak
	57+630 do 58+540	Donja Gračanica
6: Donja Gračanica - Drivuša	58+530 do 58+830	Donja Gračanica
	59+150 do 59+920	
	62+900 do 63+420	Krčevine
	63+730 do 67+060	
		Drivuša
7: Drivuša - Kakanj	67+060 do 67+600	Drivuša
	68+450 do 69+370	Janjići
	72+650 do 74+350	Lučani
		Bilješevo
	77+700 do 79+400	Krivače
	79+400 do 80+950	Dumanac
	80+950 do 82+260	Karaulsko Polje
		Slivnice
8: Blažuj (Vlakovo) - Tarčin	1+500 do 5+750	Šamin Gaj
		Rakovica
	9+060 do 9+570	Homolj
		petlja Lepenica
	11+200 do 13+500	Bojakovići
		Solakovići
		Bukovica
		Zabrđe
	13+800 do 14+230	Toplica
	18+240 do 18+710	Tarčin

38 Those locations should be compared with noise protection walls design locations.

Air Quality Monitoring
AADT growth of 3,2 to 5,6% annually is predicted for period 2013 - 2042. Under the assumptions of further development of car engine production technology and growing need for alternative fuels, having in mind emission standards for new internal combustion engine vehicles[39], it could be claimed that air pollutants concentration should grow slower then AADT.

Anyway, monitoring of air pollutants concentration is proposed as the basic measure of protection during the Corridor Vc motorway operation period. Monitoring should be carried out in line with Rulebook on monitoring, at locations where the motorway passes through settlements, on sections with high grade and bigger AADT, as well as near tunnel openings.

For LOT 2 area, locations from table 6.3.3.1 could be considered for monitoring. Concentration of PM 10 and NO_2 depends on dispersion, i.e. wind direction and strength[40], so for final decision of monitoring locations the settlement position and wind direction for specific area (near the future motorway alignment) should be taken in account.

6.3.4. Impact on Soil and Agricultural Land

Rehabilitation measures
During the road exploitation, it is necessary to undertake appropriate measures in aim of the rehabilitation of soil and agricultural raising damages and infrastructure (contamination and accidents) through:

- Establishing of monitoring,
- Soil decontamination measures,

Establishing of monitoring
In order to control the state of the motorway impact on agricultural land, it is necessary to establish a system of monitoring which can make possible measuring of heavy metal concentrations, organic pollutants and salts, and based on these measurings proposition of rehabilitation measures.
More details about monitoring system are given in chapter 10.6.

Soil decontamination measures

In the phase of the road operation, the process of soil contamination will be expressed to a higher extent. This process will be expressed in the vicinity of the traffic route, at distances from 0 to 200 m on the left and right side of the road. Soil contamination may be rehabilitated and/or alleviated by eliminating adverse effects occurred by pollutant presence in the soil. Measures for rehabilitation of the contaminated soil may be as follows:

- technical
- chemical
- fito - melioration.

T e c h n i c a l m e a s u r e s of soil rehabilitation, shall be foreseen in cases of high contents of pollutants in the soil. This measure consists of setting non-contaminated layer of soil of ca. 25-30 cm above the contaminated earth.

C h e m i c a l measures of rehabilitation include bringing into soil lime materials (measure known as calcization). This measure is especially effective in acidic soils. Bringing of $CaCO_3$ or

[39] EURO 3,4 and 5.
[40] Unlike SO_2 or soot.

$CaCO_3MgCO_3$ (dolomite) leads to inactivation of heavy metals and their transition to insoluble state. By these processes of inactivation plants cannot use heavy metals.

F i t o – m e l i o r a t i o n measures, include cultivation of special plants on contaminated areas which can absorb from the soil larger quantities of pollutants. By cultivating such plants, the contents of pollutants in the contaminated soil is reduced so that the used plants are cut, then burnt, and their ash is covered by earth in specially prepared pits.

6.3.5. Flora

In the stage of exploitation of the highway there is a need for implementation of all below mentioned measures by sections.

- **Section 1. Karuše – Medakovo (km 0+000 to 4+000)**

Loss of forest stands could be compnsated through reforestation in the ratio 1:3 (loss of 1 ha of natural forest stands should be replaced with 3 ha of forested stands). In the part of this Secion it would be necessary on the basis of this estimation to plant new 2 ha of riparian forests of white willow with native species typical for the given site, not longer than one year after completion of all works, as well as 2 ha with species typical for communities of hornbeam. In order to avoid los of seedlings, it would be necessary to febce all this area during fiirst several years.

- **Section 2. Medakovo - Ozimica (km 4+000 to 24+901,587)**

Loss of forest stands should be compensated through reforestation in ratio 1:3 (loss of 1 ha of natural stands should be replaced with 3 ha of forested areas). In this Section it would be necessary on th basis of this estimations to plant new 90 ha of white pine forests. In order to avoid loss of seedlings, it would be necessary to febce all this area during fiirst several years.

- **Section 3. Ozimica – Poprikuše (km 24+901,587 to 38+617,434)**

Plant species planted at the edges of protective belt should be resistant to the wind and assist in protection from erosion. Planting should be carried out using native species, whenever it is possible, since they will probably demand less care and they will be useful in the maintenance of the ecosystem integrity. For stabilsation of the slopes in this area it would be necessary to use geotextile membranes which ontain mixture of seeds of plants that should stabilise nd revegetate slopes. This is particularlly important in the cuttings.

These measures include mitigation of disturbances caused by the intenisve traffic, such as noise and air pollution. Noise could be mitigated by planting of protective row of greenery, which is less efficient during winter season if broadleaved species are used. Advantage of protective greenery is that these species by their green area could absorb air pollutants. Slopes in cuttings should be protected by mulch in order to prevent erosion until appereance of the vegetation. It would be necessary to carry out erosion control until recovery of vegetation.
Hygrophylle forests of white willow Salicion albae are developed in this Section in the form of discontinuated belt from Brezovo polje to Golubinje. It mainly forms a narrow belt which is more-less interrupted due to the strong human impact. Plant communities of hygrophylle forests and shrubs of sticky elder are situated by the river Bosna and its tributaries in the zone between Brezovo polje and Golubinje. Riparian vegetation which is degraded during construction should be restored by planting of native species. A particular attention should be paid to the preservation of riparian vegetation in the impact zone of the highway that should be under human impact.

- **Section 4. Section Poprikuše – Nemila (km 38+617,434 to 46+289,378)**

Loss of forest stands should be compensated throug reforestation in ratio 1:3 (loss of 1 ha of natural stands should be replaced with 3 ha of forested areas). In this Section it would be necessary on th basis of this estimations to plant new 3 ha of riparian forests of white willow with native species typical for the given site, not longer than one year after completion of all works, as well as with 2 ha with species typical for communities of hornbeam. In order to avoid loss of seedlings, it would be necessary to febce all this area during fiirst several years.

- **Section 5. Nemila – Tonja Gračanica (km 46+289,378 to 58+434,599)**

Since the tunnel construction is planned in this part of the Section, this would not have any significant impacts on the flora, besides locations in the vicinity of tunnel.

- **Section 6. Tonja Gračanica – Drivuša (km 58+434,599 to 66+959,592)**

Loss of forest stands should be compensated throug reforestation in ratio 1:3 (loss of 1 ha of natural stands should be replaced with 3 ha of forested areas). In this Section it would be necessary on th basis of this estimations to plant new 2 ha of riparian forests of white willow with native species typical for the given site, not longer than one year after completion of all works, as well as with 2 ha with species typical for communities of hornbeam. In order to avoid loss of seedlings, it would be necessary to febce all this area during fiirst several years.

- **Section 7. Drivuša – Kakanj (km 66+959,59 to 82+595,000)**

Loss of forest stands should be compensated throug reforestation in ratio 1:3 (loss of 1 ha of natural stands should be replaced with 3 ha of forested areas). In this Section it would be necessary on th basis of this estimations to plant new 5 ha with species typical for the communities of oak and hornbeam. In order to avoid loss of seedlings, it would be necessary to febce all this area during fiirst several years.

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

Loss of forest stands should be compensated throug reforestation in ratio 1:3 (loss of 1 ha of natural stands should be replaced with 3 ha of forested areas). In this Section it would be necessary on th basis of this estimations to plant new 2 ha of forest stands. In order to avoid loss of seedlings, it would be necessary to febce all this area during fiirst several years.

6.3.6. Fauna

Measures for mitigation of loss or revitalisation of animals on the sections of the highway that will be endangerd or under the treat due to the exploitation of this area are general to the certain extent to all ections, and they are:

- Cutting of riparian forest vegetation ishould be carried out during winter season in order to mitigate to the certain extent total impact on the fauna on the land and in the water.
- It would be necessary to provide construction of bird houses for nesting birds which will mitigate loss of ornitofauna (Section: 1, 2, 3,4, 5, 6, 7 i 8).

- In the parts of the corridor distinguished by a very rich fauna (smaller animals) it would be necessary to build protective fences (nets) by the highway in order to decrease occurance of accidences on the road.
- Impact on aquatic or water fauna could be mitigate to the great extent through implementation of measures of monitoring of the state (zero state) before the construction, at the beginning of the construction, and during the use. Monitoring should

be implemented on numerous waterways situated in the alignment (details in the section 10.0).

- In all sections (and particularlly at Section 2: Medakovo-Ozimiace) there are numerous smaller waterways which considering their ecological characterisation have high level of biodiversity of lower plants and animals.

- **Section 3. Ozimica – Poprikuše (chainage km 24+901,587 to 38+617,434)**

At distance from 25+240 to 26+000.00 km network for prevention of exit of small animals on highway (Fig. 3. in Annex 12.2.).

- **Section 5. Nemila – Tonja Gračanica (chainage km 46+289,378 to 58+434,599)**

Part of the alignment separates a part of the habitat and prevents or disrupts contacts and migrations of animal populations. Construction either smaller underpass or fence which will prevent losses, until poplations get adapted to this form of the impact 46+388.800 km to 49 +122.716 where it is necessary to predict passages for fauna or fence (Fig. 4. in Annex 12.2.).

- **Section 7. Drivuša – Kakanj (chainage km 66+959,59 to 82+595,000)**

In the parts toward Kakanj after cutting of the trees or other forms of removal, it would be necessary to build bird houses for nesting birds that will contribute to the quality of the landscape in this part of the alignment.

- **Section 8. Blažuj – Tarčin (chainage km 0+000 to 19+100)**

At 19+100.00 km it would be necessary to construct a fence to prevent enter of large and smaller animals to highway (Fig. 5. in the Annex). Protective measures for water fauna of the river Bijela and the river Lepenica will be considered in the section about monitoring (point 10.2).

6.3.7. Landscape

By using moderation measures of the negative effects on the environment and landscape architecture, biological and eco-functional integration of the motorway into the landscape is achieved:

- landscape modeling and elements of protection against erosion, embankment and notch,
- hygienic–reparation motorway separation by raising protective barriers from noise, gasses, visual protection, etc.

These measures are required for motorway integration into the natural environment and for the highest possible traffic security. The needs of traffic participants, residents and persons on recreation should be considered.

The goals of moderation measures of the negative effects on the environment can be summed in:

- adaptation of the motorway to the natural landscape
- visual protection of the residents in the immediate vicinity of the motorway
- visual protection of drivers from reflection during driving
- protection of settlements from noise, dust, wind and snow-drifts

- reparation of the eroded terrain

6.3.7.1. Protection measures of the landscape

The strategy of landscape protection for preservation and supported usage of the total biological and landscape diversity requires proper and professional usage of the precaution measures. Considering this, it is necessary to determine the reasons and the level of biological diversity endangerment in the stage of preparation for the intervention on the motorway construction, in the stage of construction and after the construction, and, according to this, determine the measures of protection with priorities.

6.3.7.1.1. Measures of protection of the landscape in the stage of preparation for the intervention

Measures of protection in the stage of preparation for the intervention need to be applied to protect settlements, agricultural lands and existing forest elements.
Settlements, agricultural lands and forest elements require protection from harmful effects of the motorway by forming protection belts (for diminishing the effects of strong winds, pollutants and snow).
Green belts are formed in zones of expropriation by choosing the species which meet the required demands, with their morphological and habitation properties.

These measures can be:

1. Long-term measures:
    - Landscape modeling of the forest edge with newly designed species for protection of the forest terrain, forest elements and individual trees.

2. Middle-term measures:
    - Providing of tree and bush planting material, according to the specifications given by the concept design (one year before planting).

3. Short-term measures:
    - Flora and fauna protection by protection fences
    - Preventing of erosion processes on slopes, using the appropriate bio-technical, agro-technical and technical measures and creation of a vital vegetation cover.
    - Protection of valuable vegetation groups from physical destruction and harmful effects from the motorway.
    - Protection of individual species with high biological and esthetic qualities, and their possible replanting.
    - The landscape surfaces which have diminished or have been destroyed by the effects of motorway construction are necessary to return to their original state by utilizing methods of extensive greening.
    - Planning of measures, to form protection belts from noise (by a combination of trees and bushes for a more efficient reduction of noise effects), wind and air pollution, while taking care of their integration into the existing landscape ambient.

6.3. 7.1.2. Landscape protection measures during construction

- Forming of a depot for terrain (excavation) disposal with a goal of further use for bio-technical slant re-cultivation. This depot should be protected from machines, vehicles and stomping and should be located as close as possible to the location of the excavation, according to the standards and criteria of this region. Determining the appropriate time for waste removal is necessary, to reduce the negative effects on the environment.
- The landscape modeling of the embankment, notch, meaning the security of terrain stability, according to the existing landscape.
- Protection of agricultural surfaces from toxic agents from the motorway by forming protection belts.
- Protection measures for preventing erosion by grass sowing, soding and moss adding.
- Reparation of the separation belt and the inter-belt at the tunnel entrance by adding grass or by planting short bushes with horizontal branching for a better traffic overview.
- Forest protection from damage during construction works by forming fences.
- Removal of damaged or uprooted trees to prevent them from becoming a source of disease.
- Filling of the formed forest edge by planting, using protection from possible damage.
- Landscape modeling of the space in the limits of expropriation, according to the project.

All spaces that are in the expropriation zone need to be modeled by plant material, according to the concept design.

6.3.7.1.3. Landscape protection measures after the construction

- Areas that had separation facilities, concrete bases and concrete plants are necessary to return to their original state by biological repair. Returning to the original state should be performed in a way that all artificial materials from those areas are removed and, by doing that, to enable natural biological succession.
- Plant species which will be planted need to be autochthonous and compatible with the surrounding area.
- After the construction, it is necessary to check the performance efficiency of the applied protection measures by terrain analysis and by checking the state that the surfaces, which have been sown and planted on, are in.
- Including the monitoring of the state of terrain and newly planted plants, with the necessary measures of maintenance (to fully satisfy function which are expected from them: reparation, hygienic, protective and esthetically decorative). In the necessary measures of maintenance, the following is included: grass mowing (affects the grass thickness), improvement of terrain preservation and esthetic attributes. Mowing should be performed according to the agronomical practice and often enough to enable growth and balance of different types of grass which make the grass lawn. This includes the grass mowing at 1 meter from the edge and under it. It is important to remove the grass which has rooted. The grass should be mowed in short intervals to keep its growth from 30 – 55 cm. The entire surface of the slant is mowed whether or not it is on

embankments or notches; which means the part at the top and at the base of the slant, as well as the steep parts and channels, from the base to the fence. Grass mowing is applied on the resting spaces, CP-s and loops, with necessary removal of the mowed grass.

- Planted trees and bushes during development phase should be treated with appropriate measures of nourishment and protection:
  Cropping is implemented when vegetation reach certain height, which decrease visibility, or when plants become too dense, that causes lower part to lose leafs and become nonresistant to illnesses and vermin. For plants used within covers and as fixtures of slants cropping is focused on removal of branches and leaves that decrease visibility on motorway. However for plants placed to fulfill just aesthetic functions cropping is targeted on periodical sprout shortening and damaged and sick branches removal. Best way to make cropping is after ending of winter period.
  Earth up is done when the soil is dry, when within is not enough air and when it is covered with weed.
  Fertilizing and additional plants feeding is used to provide their proper growth and development. Usage of organic fertilizers is recommended when plants are planted for fires time, and mineral fertilizers afterwards. It is necessary to implement protection from illnesses and vermin by using of appropriate means for plant protection.

6.3.7.2. Protection measures and interventions planning

Measures for protection of landscape arrangement of embankments, cuttings and flat surfaces provide terrain stabilization next to motorway route before erosion occurrence, in order to enable landscape arrangement and embedding in ambient entirety, which enclose route and all space around it.

6.3.7.2.1. Biotechnical measures

Terrain protection - greening with grass

Slant terrains (1:1,5), and steeper are usually treated with grass seed and fertilizer spraying using water and air jet. To enable best possible contact of grass seed and fertilizer with soil, materials for efficient joining must be added (bitumen).

Content of grass mixture depends on type of the soil and terrain exposition. Grass mixture is composed from different types of grass depending on local, environmental, botanical and trophic factors. Actually, during optimal mix of grasses design it is necessary to have in mind environmental factors (climate, morphological, topographical and geographical) and botanical factors. When selecting grass mixture attention must dedicated to prevent ascendancy of one cultivar in plantation growth, and in the same time provide continual growth of plants during whole year.

For obtaining quality protection from erosion, grass cover should have roots that are not too deep, and that individual roots are formed in groups. During selection of grasses, types with tendency of horizontal root spreading should be appropriated, due to better impact on soil stabilization. This is the way to build grass cover, which is able to absorb certain quantity of water and in the same time protect soil from ablution. In practice best results are achieved with grass mixture containing 5 - 8 types of grass.

Mechanical and manual grass mowing can be used on rest platforms, stopping lines, loops and other ancillary objects on the route.

Natural greening

On flat or slightly slant surfaces, covered with layer of humus, the most efficient way is to leave greening to nature, without artificial sowing.
Annual flowers, also can contribute to slant fixing, but only for short period, because of their annual life cycle. This natural look of terrain emphasizes richness and diversity of local vegetation.

Sowing on slants using grasses and pulses

On slant terrains good results appear with sowing of combination grasses and pulses, which have ability of fast growth and linkage of soil that provide accelerated forming of rich ground texture.

Very good results were achieved with following grass and pulse types: Cynedon, Dactylon, Bermuda grass and Trifolium repens, or White cloower, etc.

Sowing of grass with prepared undercoats

Grass sowing with undercoat in combination with bitumen and water emulsion (biotorket) is also used for greening of slants.
Undercoat consists of seed, straw, milled bark and other organic materials.

Sowing of grass with plant pulp

Grass sowing with plant pulp is done similar to water sowing, except that to mixture of grass seed, water and fertilizer is added pulverized cover and small-grain humus.

Slant fixing using sods (sod transplantation)

Sod transplantation is common way of greening with pieces of grass sods (dimensions 20x20 do 40x40cm and thickness 7-10 cm), which are placed from bottom-up in lines, horizontally or askew. This method is used for very abrupt slants in case that their heights are not over 1,5m.

There are several ways of sod placement:

- sod placement on fertile soil,
- sod placement without undercoat,
- sod placement on undercoat with grass and flowers,
- sod placement on road metal (crushed stone).

Sod placing provides very fast way of reaching aesthetic visage and protection of slanted and flat surfaces.

Soil protection with sowing and planting bushes and trees

On surfaces along the motorway, where botanical and geo-pedology factors tolerate it, we can plant bushes aiming to provide perennial erosion protection.

During selection of bushes and trees for erosion protection, from ecology stand point, priority should be given to autochthon breeds that are resistant to local conditions and have strong emerging ability and fast adventives rooting. After that should be used varieties, which best thrives on particular soil and is resistant to bad biotic and non-biotic influences.

For undisturbed growth of bushes and trees on slant terrains is necessary to prepare surface ground layer and clear it from weed and stones. For bushes planting necessary depth of soil substrate is 30 - 40 cm, and for trees 50 - 80 cm, depending on height of plant.

Planting of rooted plant material – forestation, can be done in prepared holes, ditches, notches and nests, depending on soil conditions. On smooth slants is planting 3-5 plants per m2, and on very abrupt 1 plant per m2, which on the end depends on plant growth. Except mentioned, bushes and trees plants can be planted with bales. Best results in practice were achieved with container planting of trees and bushes.

During planting of trees on embankments, slant base is leaved free. In case of planting in notches, trees are moved aside 2,5 m from the road and 4,5 m from each other.
Except planting on very abrupt surfaces, trees and bushes can be also sowed that is more simple, because no holes for plants are needed, which often can cause endangering of slant construction stability.

To provide continuous and deep consolidation of areas pervious to soil dispersal, on slanted parts, in notches and on the beginning and end of tunnels, it is necessary to implement forestation technique for soil stabilization and getting land physiognomy in state before impact of construction works.

Measures for protection of existing vegetation

Concept design identified surfaces under existing vegetation in comprehended zone wide to 300m, aiming to provide preventive protection from eventual damages and destruction, during road construction and exploitation.

Basic traditional forest formations are decreasing – deforestation samples and it can be bounded to clearing of land for its usage in other purposes (agricultural production, condominium building, and road construction). Destruction of habitat results with loss of biological diversity, which has long-term consequences for ecology and economy. Supplement in planted trees and bushes are to compensate lack of existing forest resources and enriching with new plant breeds.

In this comprehended zone is necessary to prepare protection measures that enclose placing of fences beneath tree tops to protect trees during motorway construction works from earth covering or laying bare of top soil layers, which have long-term consequences for plant formations. Forest edge should be formatted as a compact texture in order to protect its content from harmful impact from close motorway presence.

6.3.7.2.2. Agro-technical measures

Agro-technical measures enclose:

- selection of appropriate pants for terrains exposed to erosion,
- proper soil treatment,
- existing lawn renewal,
- adding moss.

Moss used for slants with decline (1:1) that also has favorable influence on microclimate conditions.
Organic mosses are degrading and produce humus layer that in contact with soil ameliorate earth ventilation in heavy soils and in the same time enrich light soils. Favorable moss attribute is shown in prevention of vaporization and excessive soil water-drainage, as well as erosion in winter period.
Surfaces should be protected from frost and icing, which on the other hand has favorable impact on decrease of extreme temperature variations and heat losses.

For more efficient moss connecting is used bitumen-water emulsion, partially-hydrolyzed polyvinyl acetate and water solution of cellulose. These materials acting as colloids that successfully bind moss, grass seed and soil particles.

In case of terrain placed on high ground much over sea level usage of bitumen is not recommended. Before moss adding is necessary to remove all surface water on upper part of slant. Mentioned vegetation cover is protective in case of direct precipitations only. Even six months can pass until rich and compact vegetation cover is completely formed, what we can avoid by sowing of fast-growing grasses.

6.3.7.2.3. Technical measures

Technical jobs usually should be done before implementation of biotechnical measures, because they are prerequisite for its success.

1. Slant preparation

During slant treatment is necessary to take care of upper edges of excavated hill-sides. For prevention of erosion reflow, dispersal and excavate material dropping in, as well as unfavorable impact of high trees and freezing, on upper excavation edge, hill-side must be formed in round shape with minimal curve radius of 5 m.
Trees are planted minimally at 5m from rounded edge to prevent unfavorable impact on mechanical hill-side's compactness as result of their swinging caused by strong wind.

On hill-side parts where trees hewing down is necessary, it is advisable to keep logs in place because its capacity for soil connecting. In the same time logs are used as ground for vegetation reproduction.

Next step in process of proper professional biotechnical fortification and protection of slants on motorway, on embankments as well as on excavations, is arrangement of water regime on hill-sides.

Under arrangement of water regime on hill-sides is understood removal of causes for deep erosion, namely, concentration of surface water flows. It should accomplish best possible dispersion of surface water flows that, in the same time enable more steady soil humidity, which is desirable for vegetation growth.
For those purposes are often implemented combinations of differently limited technical works (terrace, gradon, shelve, wattle, etc.).

2. Dikes (infiltration terrace)

Dikes represent modern forms for arrangement of incline terrains on which, between built objects (mainly of channel type) are usually left minor or large free spaces.
They are used for trapping and removal of water surplus from hill-sides in regions with significant humidity, or water retention on slant terrains in arid regions.
They are implemented on terrains with minor inclination where is possible to intensively use inter-dike spaces.

3. Terraces

Terraces are implemented on hill-sides with significant slants, which by their use are converted into stepwise disposed surface. Usually height of terrace not exceeds 2 m. On terraces can be planted "dendro" vegetation. In practice building of terraces has shown it's most favorable facilities, especially for forestation of hill-sides on arid terrains. Their impact is convenient for water regime, soil humidity and micro-exposition.

4. Gradons

Gradons are form of modified Algerian dikes adjusted to terrain inclination > 35%. They are used for forestation of very abrupt terrains. Bottom can be made in counter-slant or flat, but it is usually in counter-slant and in that case it is accustomed to make stabilization using wattle or forest plants from lower side.

Gradons are very economic tool for arrangement. They are with small dimensions with little excavation and pretty god stability, due to counter-slant and down-stream reinforcement. They are usually placed on terrain contour lines, and depending on slant, on distance of several meters and width of 0,8 - 1 m only.

5. Wattles

Wattles are made of stack battens and braided osiers, or similar sticks. Battens are with diameter of 5 cm, 80 cm long on distance of 50 cm. Wattles field can be square or rhombus shape, in which is added fertile soil and plant material.

6. Cordon planting

Cordon planting is very simple and functional operation, which joint technical and biotechnical works.
Routed bushes grafts are planted in trench deep 10 cm dig in hill-side. Trenches are slanted towards slope with its vertical excavated part. Planting is done bottom-up.

7. Live brushes

Live brushes are cheaper from wattles, fast in reacting and fast routing. It is combined method of technical and biotechnical works. They are very suitable fro sterile and poor grounds.

For planting is used 80 - 120 cm long battens, which are placed athwart on distance 1,5 - 2,5 m one from the other. For building of live brushes are used ferules and branches from breed able to regenerate like willow, poplar or pea-tree.

8. Nets

Hill-sides are often protected from erosion using nets with various origins, and can be from:

- galvanized wire
- plastic fibers
- jute or cocoa fibers

Advantage of cocoa fiber wattles over plastic and metal nets lay in fact that they consisting of natural materials and not looks like foreign element within ambient. Wattles made of natural fibers are not causing animal injuries and are disintegrable, therefore are completely acceptable regarding preservation of nature and environment.

Protective of wattles enable faster seed intergrowth on lower temperatures, and on high temperatures prevents excessive vaporization and keep moister within soil. Their capacity of protection against erosion during motorway construction is significant.

6.3.7.3. Protection belts building

For all kind of traffic stopping spots (rest places, vehicle stopping lines, loops, fuel stations, motels and parking places), most frequent protection measure is building of green belt, with consideration of technical-technological requests for clearness from infrastructure systems.

Protection belts are used for establishment of physical and graphical balance within nature environment disturbed with violent interventions. Visual dominants, which draw road flow trough space, directly impact on: driver's perception, decreasing lights reflection, sound intensity, and abate impact of pollutants and wind.

- Noise protection

  Traffic noise spreads on close and distant surrounding. In any case best effects are provided from green belts in which trees and bushes are interchangeable placed, because it is the efficient way to decrease noise. On places of notches with slants noise reflects from road itself.

  In cuttings with abrupt stone sides and supporting walls noise can be reduced with:

  Covering with organic soil, or

  - Slants greening with trees and bushes that throttle and absorb high tons, not reflecting them on the road again.

  On places where roads are going next to settlements except protection walls, green protective belts are also implemented.

  Individual trees and alleys have minor protective function with regard to live fences consisting from tress together with bushes forming rich green texture.

Possibility for noise decreasing using green belts depends also on sound frequency. Best way to throttle sound frequencies between 500 and 2000 Hz is using conifers trees, and deciduous trees are best for frequencies between 2000 and 8000 Hz.

- Protection from pollutants and dust

On places in near and wider surrounding of motorway route, where pollutant concentration oversteps allowed limits it is necessary to build protective belts made of plants able to filtrate air, such as: catalpa, lime-tree, chestnut-tree, viburnum, or previously identified plants that tolerate presence of certain pollutants on given space (Professional and scientific works from this field).

- Protection from wind

Motorway route in plain part, especially on high embankment, is exposed to various wind influences. Building of protection belts can in high degree decrease intensity of wind impact.

- Protection from snow

Regarding protection from snow, trees and bushes should be planted in such way that snow bank zone lays between vegetation and road. Live fences consisting of trees and bushes van be placed in several rows one behind the other, which can be very efficient for protection from snow.

6.3.7.4. Measures for protection of natural legacy

Nourishment measures regarding protection of natural legacy diversify for different categories of se natural legacy:

- Nature monuments and reservations within national or regional parks and memorial parks along with valuable plant communities should be kept in original size.

- Protection of natural legacy in which are enclosed categories of preserved natural vales: national and regional parks, special nature suites, zones of water supply protection are different from natural legacy within first category.

  On these areas can be allowed only usage, which will not harm properties and purpose of such spaces. Interventions should be harmonized and implemented with respect of landscape values and attributes. Such areas are in most cases dedicated to sports, hunting and fishing, forestry, etc.

  According to existing space-planning documentation in such categories of green could be enclosed: Regional park "Crni vrh" Tešanj, canyon of Papratnica river Žepče, area complex including Bistrtičak – Crna Glava – Orahovica Zenica, ait on Bosna river in Topčić Polje and settlement Janjići, canyon of Bosna river from river Lašva mouth to Janjići ait, etc.

- Following protection mode enclose preservation of natural resources and protection from possible pollutant, respectively creating of conditions for their normal natural reproduction. Regarding this category of natural legacy, the most part consisting of recreation areas. Here can be built protective belts consisting of trees and bushes, which have large capacity of air filtering. Natural values of landscape must be preserved in biggest possible measure, as extremely valuable bearers of recognizable identity of relevant areas.

By insight in documentation focused on cultural inheritance, it can be concluded that here is very rich content of cultural inheritance on the areas through which is passing motorway section LOT 2. Each object that is a part of relevant cultural inheritance require special attention during landscape arrangement, heaving in mind that there are object with special purpose in question.

6.3.7.5. Measures for arranging and repairs of motorway negative impact on particular landscape categories

Landscape repair of existing vegetation covering wide zone (300m)

- Placing of fences beneath top of the trees in order to protect trees during motorway construction works from earth covering or laying bare of top soil layers around trees (in narrower comprehended zone).
- Forest edge formatting in order to protect content of forest from harmful influences near motorway presence.
- Filling up with trees and bushes planting aiming to substitute loss of existing forest formation and enriching with new plant breeds.
- Transplantation of valuable tree samples with high biological and esthetic qualities.
- Forestation in order to stabilize terrain in case of forest content destruction during construction of motorway.

Landscape repair of notches using engineer bio-technique

- Technical preparations of notches with geo-nets.
- Building of grass coverage with purpose of protection from erosion and notch arrangement – moss, hydro-sowing.

Landscape repair of embankments using engineer bio-technique

- Technical preparations of embankments with geo-nets.
- Building of grass coverage with purpose of protection from erosion and embankment arrangement – moss, hydro-sowing.

Landscape arrangement and repair of tunnels entrances and exits

- Building of grass coverage on slant surfaces on both tunnel ends
- Technical preparations of slants with geo-nets.
- Building of grass coverage with purpose of protection from erosion and arrangement – moss, hydro-sowing a
- Landscape arrangement with "dendro" vegetation (trees, bushes, climbing plants) and soil covers, with purpose of integration in existing scenery.

- Forestation with purpose of terrain stabilization.

Landscape arrangement of CP

- Building of grass coverage by sowing of grass mechanically or manually.
- Landscape arrangement with "dendro" vegetation (trees, bushes, climbing plants) and soil covers, taking account of penology phenomena, such as leafing dynamic, flower and fruit decorative properties, and general decorative properties in winter time, aiming to reach integration in existing scenery.

Landscape arrangement of loop

- Building of grass coverage on loop slant surfaces
- Technical preparations of slants with geo-nets.
- Building of grass coverage with purpose of protection from erosion and arrangement
- Building of grass coverage on flat surfaces within the loop by sowing of grass mechanically or manually.
- Landscape arrangement using "dendro" vegetation (trees and bushes) and terrain covers with pronounced decorative attributes and taking care of penology phenomena, such as leafing dynamic, flower and fruit decorative properties, and general decorative properties in winter time, aiming to reach integration in existing scenery.
- On parts of the loop where settlement id placed near by are formed protective belts in order to protect these settlements from harmful influences of close motorway presence (dust, noise, reek, wind, flash, etc.).

Landscape arrangement of PUO

- Building of grass cover on flat surfaces manually or mechanically.
- Technical preparations of slants using geo-nets.
- Building of grass cover on slants for their arrangement and protection from erosion.
- Landscape arrangement using "dendro" vegetation (trees and bushes) and terrain covers with pronounced decorative attributes and taking care of penology phenomena, such as leafing dynamic, flower and fruit decorative properties, and general decorative properties in winter time, aiming to reach integration in existing scenery.
- Within PUO are formed surfaces for different purposes and functions for: resting space, children playground, car picnic spot, gazebo, green splitting island.

Landscape arrangement of COKP

- Building of grass cover.
- Planting of trees.

Overview of intervention, regarding aesthetic and functional formatting of motorway route space on corridor Vc, section LOT2 Doboj – south (Karuše) – Sarajevo – south (Tarčin), will be presented per sections in detail in form of textual and graphical addendums in measurement ratio 1:500, when complete documentation be available.

6.3.8. Protected Parts of Nature

Zaštićeno područje u okolini Žepča je prvenstveno uspostavljeno radi očuvanja serpentinskog kompleksa koji se odlikuje visokim stepenom biološke raznolikosti sa visokim stepenom endemičnih biljnih vrsta. Izgradnjom autoputa povećat će se broj posjetilaca koji dolaze u ova područja da bi shvatili i cijenili vrijednosti zbog kojih je osnovano zaštićeno područje i kako bi stekli određenu personalnu korist. Turizam u zaštićenom području ovisi o očuvanju kvaliteta ekosistema. Ovo je od suštinskog značaja za održavanje ekonomije i kvaliteta života. Stoga je potrebno vrlo pažljivo planirati, upravljati i vršiti osmatranje turističkih operacija u zaštićenom području kako bi se osigurala njihova dugoročna održivost. U protivnom, nastati će negativni uticaji tako da će turizam umjesto doprinosa očuvanju narušiti kvalitet zaštićenog područja.

6.3.9. Cultural and Historical Heritage

All measures of cultural-historical heritage protection are already contained in protective measures for the quality of air, water, soil, noise etc.

6.3.10. Hunting Game

Measures for protection of hunting animals in various sections rich in hunting animals (Medakovo-Ozimice, Poprikuše-Nemila, Nemila - D.Gračanica, D.Gračanica-Drivuša, Drivuša-Kakanj) are facilitated by the construction of numerous tunnels, viaducts, and bridges.

Concreate measures are predited for each sector:

- **Section 2. Medakovo - Ozimica (km 4+000 to 24+901,587)**

At 6+072.546 – 7+166.544 construction of passage for animals as underway or «green bridge» (Fig. 1. in Annex 12.2.).
At 17+465.017 – 18+304.836 km construction of passage for animals (Fig. 2. in Annex 12.2.).

- **Section 3. Ozimica – Poprikuše (km 24+901,587 to 38+617,434)**

At 25+240.114-26+000.00 km fence for prevention of enter of smaller animals to the alignment (Fig. 3. in the Annex 12.2.).

- **Section 8. Blažuj – Tarčin (km 0+000 to 19+100)**

At 19+100.00 km fence from the upper side towards Tarčin and from the left side of the highway to prevent enter of animals to the alignment (Fig. 5. in the Annex).

At 13+182.00 – 13+275.3 km from Zabrđe to Toplice construction of animal passage (underway of «green bridge») – Fig. 6. in the Annex 12.2.

6.3.11. Noise

Noise sources on the motorway

Noise on the roads has four main sources: (a) motor vehicles, (b) friction between vehicle and road surface (c) driver's behaviour (d) construction and maintenance activities. Noise caused by motor vehicles arises from the engine, transmission, exhaust pipe, suspension system operation and the largest noise arises during accelerating of the motor vehicle up the rising ground, when braking by engine, on poorly maintained roads and under the "stop and go" conditions of the traffic development. Inappropriate maintenance of the motor vehicles contributes to increased emission of the noise level on the roads. Noise caused by the road arises due to friction on the contact point of the road and the motor vehicle tire and contributes to the total level of the traffic noise. Its level depends on the type and condition of the tires and the carriageway surfacing pavement. Noise of resistance is made while driving at high speeds and at motor vehicle braking. Driver's behaviour adds to noise increase when using the horn, playing music very loudly and when sudden acceleration or braking of the motor vehicle. Construction and maintenance in essence require usage of heavy machinery contributing also during its operation to increase the noise level on the construction site.

The most essential factors of noise spreading are:

- Type of source (spot or linear)
- Distance from source
- Atmospheric absorption
- Wind
- Temperature and temperature gradient
- Obstacles, such as barriers or buildings
- Soil absorption
- Reflection
- Humidity
- Precipitations

For obtaining representative measurement results, these factors should be taken into consideration. The provisions frequently determine the conditions for each of these factors.

Existing and future impact of noise on the existing road network

If the peak traffic per day ranges from 4,000 to 20,000 vehicles in 2013, it can be taken that impact from traffic noise in the settlements along the existing roads (sections of M5 road and M17 road) is rather unbalanced and on some sections it is high. The affected residential buildings are arranged also along the M5 road and M17 road for almost 60% of the road section length. Especially in places such as Zenica, Žepče, Maglaj, and Tešanj. The existing road interacts or passes through the settlements. Construction of the motorway on the lot 2 will bring about the redistribution of traffic volumes from the existing network to the new network and have an influence on reduction of the noise level in the residential settlements along the network of roads without any investment.

Construction of the motorway will be of benefit for the noise situation for the most part of the existing sections. With the foreseen increment of the traffic of 62% till 2013, the current noise level will be increased by about +2.0 dB(A) without constructing the motorway.

With the motorway constructed, it is foreseen for the traffic volumes on the existing roads to reduce compared with the present levels on certain sections even by about 400%, providing consequently a reduction of noise level of -6.0 dB(A).

Ecological standards for the noise impact levels

Even up to now, standards for the noise level have not been specified by the Government of Bosnia and Herzegovina. Consequently, standards to be applied for the motorway lot 2 have been set by the Sarajevo Canton. Relative standards are presented together in the Table 6.3.11.1.

Knowing that rural areas along the alignment have a mixed character both for residential and industrial usage, in the further text classification of zone IV for residential settlements along the motorway will be used. Therefore, for the purposes of this Study, noise standards applied for the assessment of noise effects are 60 dB(A) during the day and 50 dB(A) during the night. In cases where an object or objects belong to I, II or III group, the level of the permitted noise was determined for the pertaining zone classification.

The applied standards of 60/50 dB(A) may be compared with those applied in compliance with WHO regulations (World Health Organization) and the regulations of the Member countries of European Community.

Table 6.3.11.1. Applicable Noise Impact Standards (Canton of Sarajevo)

Zone	Area Use Characterisation	Outdoor Noise Standard in dB(A)		
		daytime	night-time	Peak
I	Hospitals	45	40	60
II	Tourist and recreation areas	50	40	65
III	Solely residential and educational areas	55	45	70
IV	Mixed residential and commercial areas; close to transportation corridors	60	50	75
V	Mainly commercial, administration, business and trading centres; public mains	65	60	80
VI	Industrial, storage areas , traffic areas without residents	70	70	85

Source: Noise and Air Quality Act, Official Gazette of Sarajevo Canton No. 95/99, May 28, 1999

Noise effect without measures for noise protection

The traffic on the motorway will cause noise emissions at high level due to the foreseen AADT. Noise level during the night will exceed the standard value of 50 dB(A) in the vicinity of the motorway. Therefore, noise will have a negative effect on settlements situated along the planned alignment.

For identification of jeopardized areas, examination of noise modelling was made by using “SoundPLAN” software (Version 6.1) which is being used as standard software for calculation of noise in Germany and other countries of the European Community. The basic conditions used are as follows:

- The forecast of the traffic volume for the by-pass in the year 2013 according to the data specified in the Traffic Study – Final Report, as stated in Chapter 4 of the Study.

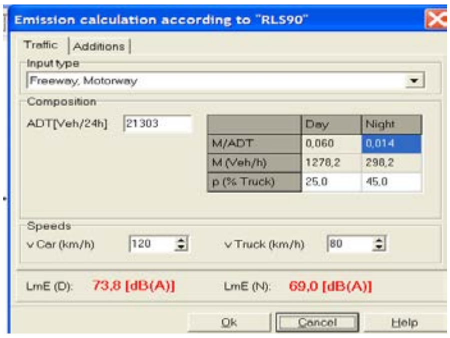
The motorway specifications have been taken from the Preliminary solution (for example: cross-section profile of the motorway, design speed and so on). ☐ As to the concrete will be used. The method of calculation was taken from the „Guidelines for control of noise caused by road traffic“ – RLS 90 issued by the German Ministry of Transport (1990). Drawings of the settlements have been gathered from several sources: for example Topographic maps and satellite surveys undertaken in 2005.

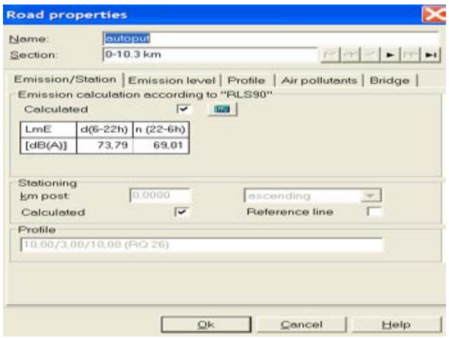
For evaluation of the foreseen noise effects, levels of noise during the night are used as the criteria because the standard of noise during the night is more restrictive than the standard for the noise level during day. Contour lines of noise during the night are presented on the noise maps. The given results indicate the impact of noise on the objects located in the vicinity [41] of the motorway. The noise maps present two scenarios. The first scenario shows the noise map for a situation without the protection measures, and the other one shows the situation with the protection measures.

The noise map without protection measures determined the required length of the protective acoustic wall with the populated areas endangered by the impact of noise because the noise level is higher than the noise standard during night.

The noise map without protection measures was obtained based on calculations analyzing the situation with the construction of the motorway in 3D. It means that the model analyses the designed characteristics of the motorway right-of-way and terrain. The motorway characteristics understand defining the daily and night period and standard used for calculating noise level. AADT is taken from the Traffic study, as well as the relation between the day and night traffic and percentage of participation of the freight vehicles in the traffic flow. The profile of the motorway is defined in the Preliminary solution. Detailed calculation of noise levels and protection measures for lot 2 will be made in the Preliminary Design of the protection against noise.

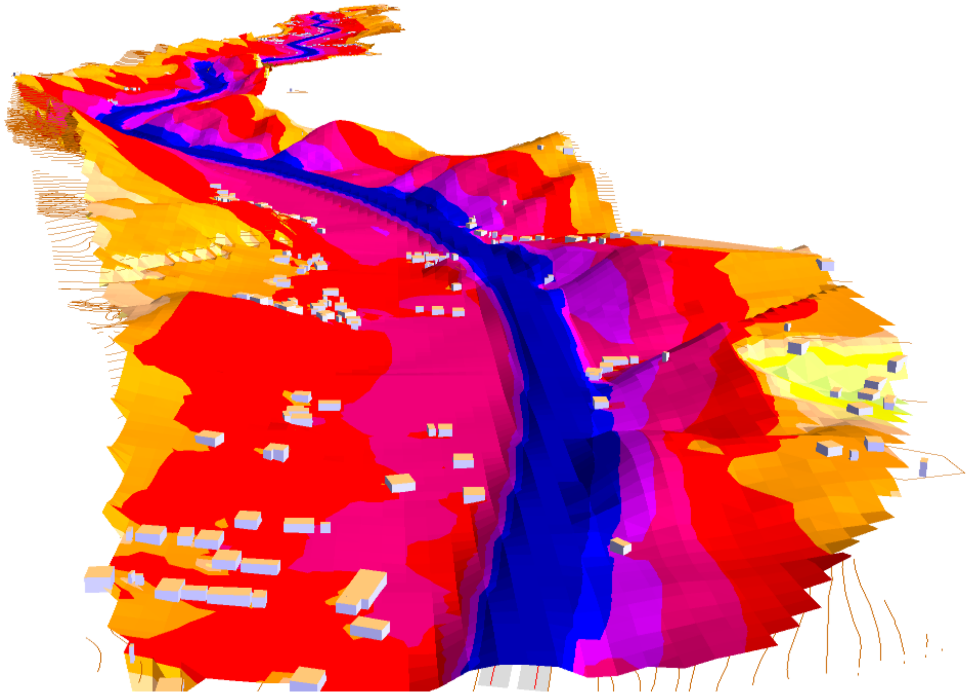
Illustration 6.3.11.1. Definition of calculation model





[41] Noise levels 200m on the left and right side from the motorway axis have been analysed.

Illustration 6.3.11.2. 3D motorway model



Potential measures of reduction of level of noise

One of the main objectives of evaluation of noise is to research the effect of mitigation measures in order to avoid the negative influences of noise on the objects surrounding the motorway. Reduction of noise can be achieved by various procedures:

- By reduction of transfer of noise by putting up sound barriers
- By reduction of emission of noise on its sources (vehicles, surface of lane of motorway)
- By reduction of influence of noise in residential areas by installing insulation windows for protection from noise at individual objects.

The sequence for implementation of these measures starts from setting up sound barriers; second is elimination of source; and third is elimination at receptors.

One of the most important measures of mitigation is construction of sound barriers. Knowing that the motorway in LOT 2 is mostly on embankment, it is considered more justified to set up thin walls for prevention of noise (for example, panels), than to set up wide constructions that have the quality of preventing the spreading of sound.

Illustration 6.3.11.3. Cross section of the embankment with noise contours without measures of protection from noise

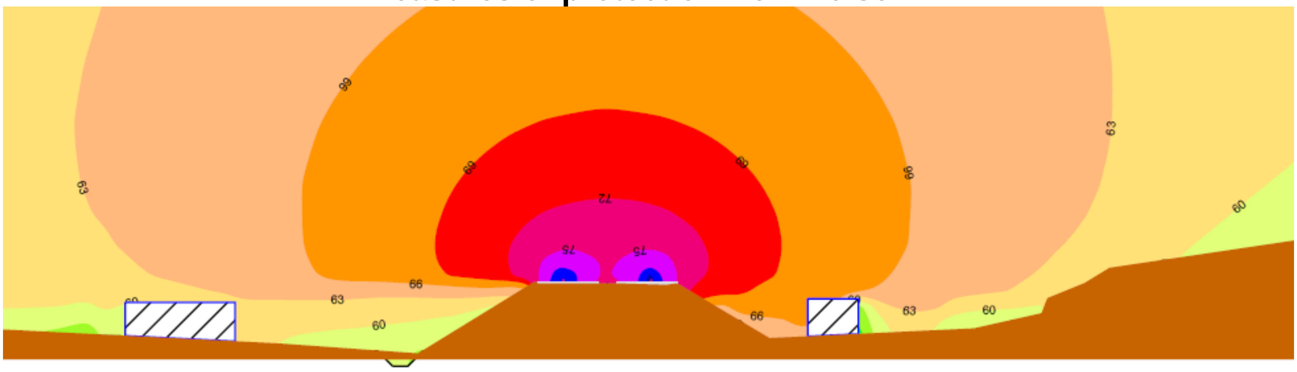
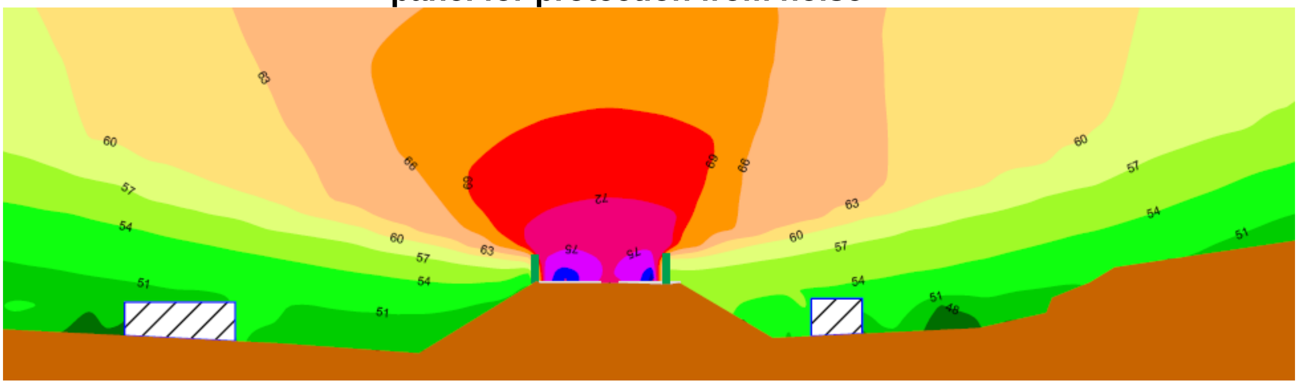
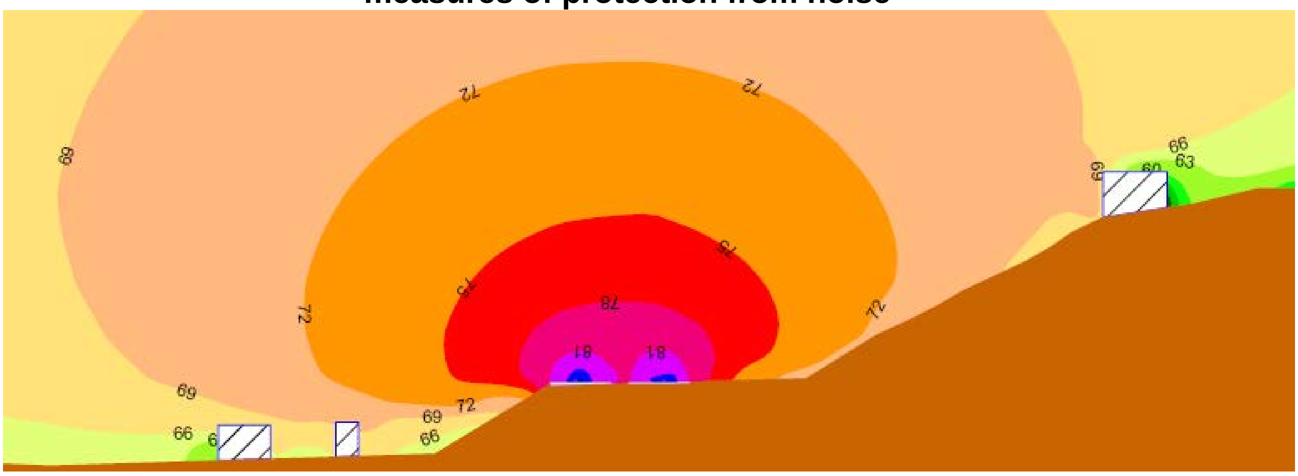


Illustration 6.3.11.4. Cross section of the embankment with noise contours and panel for protection from noise



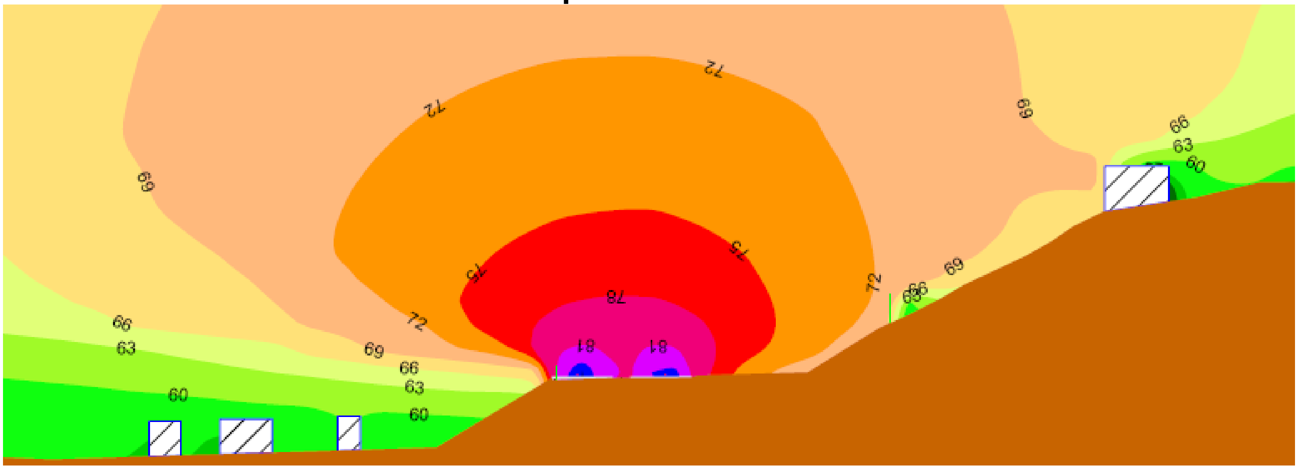
Configuration of the terrain has a key influence on the possibility of protection from noise by use of protective panels. On picture 6.3.11.5 an example is given of the cross section of the motorway where on the right side the object is higher than the motorway. In the picture it can be seen that the projected height of the protective acoustic wall of 5m is not sufficient to achieve the predicted standard, while on the left side of the motorway, where the object is beneath the level of the motorway, a height of 2m was sufficient for achievement of the predicted standard of allowed level of noise of 60dB(A) in daily conditions. For objects that cannot be fully protected by protective acoustic walls, it is recommended to use passive measures.

Illustration 6.3.11.5. Cross section of the semi-cut with noise contours without measures of protection from noise



Measures of reduction of noise at its source consist of “quiet asphalt” that reduces noise, local limitation of speed, and optimised vehicles. The latter is outside the influence of planning the section and depends on the progress of production of vehicles regarding the emission of noise and design of wheels. Having in mind the general intent that the motorway should ensure fast flow of traffic, limitation of speed is not considered as something that can be applied unless there are other acceptable measures.

Illustration 6.3.11.6. Cross section of the semi-cut with noise contours and with measures of protection from noise



Restrictive limitations of speed of vehicles can reduce the emission of noise; for example even up to 2dB(A) if the speed for passenger cars is limited to 80 km/h instead of the speed of 120 km/h, and the speed of big and heavy vehicles to 60 km/h instead of the speed of 80 km/h. Construction of a special kind of pavement, the so called porous asphalt that ensures a smooth surface and in that way reduces the emission of noise from the vehicle’s tyres, is a significantly more expensive option compared to the standard pavement with asphalt-concrete.

Generally, that is a much more expensive option than setting up sound barriers. Beside that, it could be considered that a change of pavement layer (for example, in the phase of maintaining roads) can become one of the measures of mitigating future negative influences that will be generated by the increase of traffic. For areas with a small density of residential buildings or in the case of individual separate residential objects outside of rural areas, construction of walls for protection from noise is not always economically justified since the number of protected objects is not in proportion in comparison with the scope and price of construction. For such scattered houses in endangered areas, it is recommended to install insulated windows for reduction of noise (passive protection from noise). Passive protection from noise is also the preferred choice where the buildings are located higher on slopes above the motorway where even the high walls for protection from noise would not enable effective protection from noise due to the fact that the noise spreads upwards. Installing of windows for protection from noise is also recommended if satisfaction of standards is not guaranteed by implementation of protection measures at the motorway.

Approach for determining the necessary height of walls for protection from noise

In order to compare the effects of protection of various heights of walls for protection of residential areas from noise along the new motorway, the noise contour of relevant noise was calculated. Based on that, the dimensions of noise protection walls were determined depending on the location (height and length) in order to satisfy the standard of 50 dB(A) at night. Measures of mitigation are given in total in the table…… The height of walls for section 00+000 km – 24+900 km is from 1m to 5 m at most. For sections from 24+900-82+559 km and section Blažuj-Tarčin, a length of 18+800 km, the protective noise panels are calculated by use of corrected solutions of section from the preliminary solution that was done in 2D. The calculated height of walls is satisfactory in most cases, considering that the motorway is mostly on an embankment. For residential objects that are located higher on the slopes of the hill above the effective height of the noise protection walls, especially where they are located directly by the section, it would be necessary to use noise protection walls of heights (5 to 10 m), which would be unreasonable and unacceptable in terms of price, and would prevent the view for the residents. In these residential areas effective noise insulation windows should be installed (passive/measures).

Detailed calculation results overview for noise levels with and without protection measures

Calculations of noise levels are made for two scenarios: without noise protection measures as referent value for calculation protection measures (length and high of noise protection barriers) and final value of noise at objects after construction of protection measures.

For EIS LOT 2 detailed calculations have been made for all 8 sections according with previous described calculation process. Due to large quantity of output results in EIS we will present only output results in tables for scenario with and without protection measures for section 1 Lot 2 from km 0+000 up to 4+000 km.

Calculation results:

Illustration 6.3.11.7. Overview of noise levels without protection measures Lot 2 section 1

Proračun nivoa buke
Lot 2 dionica 1

Road	LmE day dB(A)	LmE night dB(A)	ADT veh./2	PT %	PN %	M/Day (Facto	M/Nig (Facto	Lm25 day dB(A)	Lm25 night dB(A)	v car km/h	v km/h	Dv day dB(A)	Dv night dB(A)	D surf dB(A)	Gradie %	D dB(A)	D Refl dB(A)
autoput 0+000-2+000	73.8	69.0	21303	25.0	45.0	0.060	0.014	73.2	68.8	120.0	80.0	0.6	0.3	0.0	0.3	0.0	0.0
autoput 2+000-3+000	74.2	69.4	21303	25.0	45.0	0.060	0.014	73.2	68.8	120.0	80.0	0.6	0.3	0.0	5.7	0.4	0.0
autoput 3+000-4+000	73.8	69.0	21303	25.0	45.0	0.060	0.014	73.2	68.8	120.0	80.0	0.6	0.3	0.0	0.3	0.0	0.0

Illustration 6.3.11.8. 24 h distribution of noise for 13 objects without protection measures

24 časovna distribucija buke
Lot 2 dionica 1
Bez mjera zaštite od buke

RNo	00-01 AM	01-02 AM	02-03 AM	03-04 AM	04-05 AM	05-06 AM	06-07 AM	07-08 AM	08-09 AM	09-10 AM	10-11 AM	11-12 AM	12-01 PM	01-02 PM	02-03 PM	03-04 PM	04-05 PM	05-06 PM	06-07 PM	07-08 PM	08-09 PM	09-10 PM	10-11 PM
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 61.9 dB(A) LrN 57.1 dB(A)																						
1	57.1	57.1	57.1	57.1	57.1	57.1	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	57.1
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 62.3 dB(A) LrN 57.6 dB(A)																						
2	57.6	57.6	57.6	57.6	57.6	57.6	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	62.3	57.6
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 61.2 dB(A) LrN 56.4 dB(A)																						
3	56.4	56.4	56.4	56.4	56.4	56.4	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	61.2	56.4
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 63.5 dB(A) LrN 58.8 dB(A)																						
4	58.8	58.8	58.8	58.8	58.8	58.8	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	63.5	58.8
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 59.3 dB(A) LrN 54.5 dB(A)																						
5	54.5	54.5	54.5	54.5	54.5	54.5	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	54.5
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 60.7 dB(A) LrN 55.9 dB(A)																						
6	55.9	55.9	55.9	55.9	55.9	55.9	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	60.7	55.9
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 60.4 dB(A) LrN 55.6 dB(A)																						
7	55.6	55.6	55.6	55.6	55.6	55.6	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	55.6
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 61.6 dB(A) LrN 56.8 dB(A)																						
8	56.8	56.8	56.8	56.8	56.8	56.8	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	61.6	56.8
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 61.4 dB(A) LrN 56.7 dB(A)																						
9	56.7	56.7	56.7	56.7	56.7	56.7	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	56.7
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 58.8 dB(A) LrN 54.1 dB(A)																						
10	54.1	54.1	54.1	54.1	54.1	54.1	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	58.8	54.1
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 60.4 dB(A) LrN 55.6 dB(A)																						
11	55.6	55.6	55.6	55.6	55.6	55.6	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	55.6
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 60.2 dB(A) LrN 55.4 dB(A)																						
12	55.4	55.4	55.4	55.4	55.4	55.4	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	55.4
6	Floor EG LrD,max 55 dB(A) LrN,max 45 dB(A) LrD 60.5 dB(A) LrN 55.7 dB(A)																						
13	55.7	55.7	55.7	55.7	55.7	55.7	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	55.7

Illustration 6.3.11.9. 24 h distribution diagram for object nr. 01 without protection measures.

RNo. 1 Floor EG LrD 61.9 dB(A) LrN 57.1 dB(A)

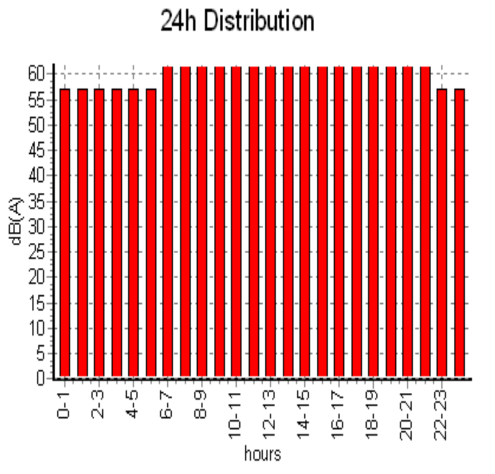


Illustration 6.3.11.10. Noise levels on object façade without protection measures

SUO Lot 2
Proračun nivoa buke
situacija bez mjera zaštite

RNo	Floor	LrD dB(A)	LrN dB(A)
1	EG	61.9	57.1
2	EG	62.3	57.6
3	EG	61.2	56.4
4	EG	63.5	58.8
5	EG	59.3	54.5
6	EG	60.7	55.9
7	EG	60.4	55.6
8	EG	61.6	56.8
9	EG	61.4	56.7
10	EG	58.8	54.1
11	EG	60.4	55.6
12	EG	60.2	55.4
13	EG	60.5	55.7

Short result overview of noise levels without protection measures has been given for 13 objects on section 1 lot 2. From images it can be seen that the noise levels are higher than allowed. In order to achieve standard, the dimensioning of noise protection barriers has been made for locations (described by chain age) which have higher noise levels than allowed. On next images the same object has been represented with noise levels on objects after implementation of noise protection measures.

Illustration 6.3.11.11. 24 h distribution of noise for 13 objects with protection measures

24 časovna distribucija buke
Lot 2 dionica 1
Sa mjerama zaštite

No.	00-01 AM	01-02 AM	02-03 AM	03-04 AM	04-05 AM	05-06 AM	06-07 AM	07-08 AM	08-09 AM	09-10 AM	10-11 AM	11-12 AM	12-01 PM	01-02 PM	02-03 PM	03-04 PM	04-05 PM	05-06 PM	06-07 PM	07-08 PM	08-09 PM	09-10 PM	10-11 PM
RNo. 1 Floor EG LrD 52.9 dB(A) LrN 45.4 dB(A)																							
1	45.4	45.4	45.4	45.4	45.4	45.4	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	45.4
RNo. 2 Floor EG LrD 52.9 dB(A) LrN 45.4 dB(A)																							
3	45.4	45.4	45.4	45.4	45.4	45.4	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	45.4
RNo. 3 Floor EG LrD 56.0 dB(A) LrN 48.5 dB(A)																							
5	48.5	48.5	48.5	48.5	48.5	48.5	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	56.0	48.5
RNo. 4 Floor EG LrD 56.8 dB(A) LrN 49.3 dB(A)																							
7	49.3	49.3	49.3	49.3	49.3	49.3	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	56.8	49.3
RNo. 5 Floor EG LrD 52.9 dB(A) LrN 45.5 dB(A)																							
9	45.5	45.5	45.5	45.5	45.5	45.5	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	52.9	45.5
RNo. 6 Floor EG LrD 51.3 dB(A) LrN 43.9 dB(A)																							
11	43.9	43.9	43.9	43.9	43.9	43.9	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	51.3	43.9
RNo. 7 Floor EG LrD 54.4 dB(A) LrN 47.0 dB(A)																							
13	47.0	47.0	47.0	47.0	47.0	47.0	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	54.4	47.0
RNo. 8 Floor EG LrD 57.1 dB(A) LrN 49.7 dB(A)																							
15	49.7	49.7	49.7	49.7	49.7	49.7	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	57.1	49.7
RNo. 9 Floor EG LrD 56.4 dB(A) LrN 49.0 dB(A)																							
17	49.0	49.0	49.0	49.0	49.0	49.0	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	49.0
RNo. 10 Floor EG LrD 55.3 dB(A) LrN 47.9 dB(A)																							
19	47.9	47.9	47.9	47.9	47.9	47.9	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	55.3	47.9
RNo. 11 Floor EG LrD 56.9 dB(A) LrN 49.4 dB(A)																							
21	49.4	49.4	49.4	49.4	49.4	49.4	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	49.4
RNo. 12 Floor EG LrD 53.5 dB(A) LrN 46.0 dB(A)																							
23	46.0	46.0	46.0	46.0	46.0	46.0	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	53.5	46.0
RNo. 13 Floor EG LrD 54.3 dB(A) LrN 46.8 dB(A)																							
25	46.8	46.8	46.8	46.8	46.8	46.8	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	54.3	46.8

Illustration 6.3.11.12. 24 h distribution diagram for object nr. 01 with protection measures

RNo. 1 Floor EG LrD 52.9 dB(A) LrN 45.4

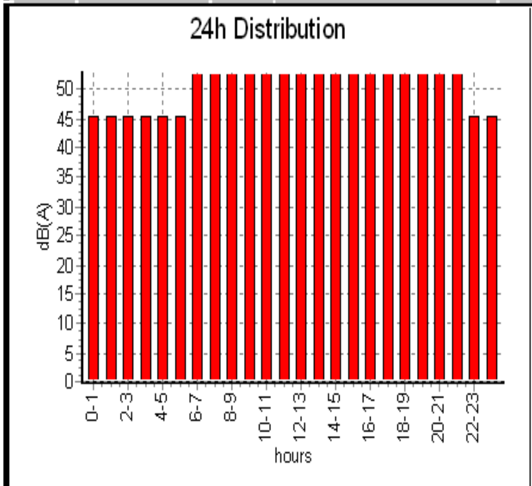


Illustration 6.3.11.13. Noise levels on object façade with protection measures

SUO Lot 2
Proračun nivoa buke
Situacija sa mjerama zaštite od buke

RNo	Floor	LrD dB(A)	LrN dB(A)
1	EG	52.9	45.4
2	EG	52.9	45.4
3	EG	56.0	48.5
4	EG	56.8	49.3
5	EG	52.9	45.5
6	EG	51.3	43.9
7	EG	54.4	47.0
8	EG	57.1	49.7
9	EG	56.4	49.0
10	EG	55.3	47.9
11	EG	56.9	49.4
12	EG	53.5	46.0
13	EG	54.3	46.8

From table it can be seen that the recommended standard after dimensioning of noise protection barriers on all objects has been achieved.
Module for dimensioning noise barriers calculates automatic length and high segments of noise barriers. Dimension of barriers mainly depending on traffic and geometric conditions, speed, object distance of noise source and terrain configuration.

Illustration 6.3.11.14. Dimension of the noise protection wall.

chainage (km)	high (m)	length (m)	surface (m^2)
Zid 4			
0+485	1,5	19,5	29,25
	5	20	100
	4	20	80
	4,5	20	90
	4,5	20	90
	3,5	20	70
	3	20	60
	3	20	60
	4,5	20	90
	5	20	100
	4,5	20	90
	4,5	20	90
	5	20	100
	5	20	100
	5	20	100
	5	20	100
	4,5	20	90
	4,5	20	90
	4	20	80
	4,5	20	90
	4,5	20	90
	4,5	20	90
	4,5	20	90
	4,5	20	90
	4,5	20	90
	4,5	20	90
	4,5	20	90
	4	20	80
	4,5	20	90
	2	20	40
	2	20	40
	2,5	20	50
1+144	2,5	19,5	48,75
Total surface			2678

Dimensioning of noise protection barriers according to described methodology and using SoundPlan module for automatic calculation of barriers length and high (min. length of one segment 20 m except first and last segment in one noise protection wall) enable optimization of needed surface and minimization of construction and maintenance costs.
Total cost of noise protection measures on Lot 2 can be divided in two groups:

- Passive measures and
- Noise protection walls (barriers).

Passive measures are proposed for those objects for which it was not possible to reach standard even after construction of noise protection barriers (objects are much higher than motorway) and for objects that are separated in space.
Noise protection barriers are constructed to achieve standards and to minimize the costs.

Total surface of designed noise protection walls	267.711 m^2
Average price with construction works	380 KM/m^2
Total price of noise protection walls construction	101.730.180 KM
Proposed nr. of objects for passive protection:	729 objects
Average price per object	5000 KM
Total price of passive protection	3.645.000 KM

Total price of noise protection on Lot 2 **105.375.180 KM**

Table 6.3.11.15. Necessary measures for mitigation of noise impact

Section	Chainage (km)	Wall at the right side of the motorway[42]		Wall at the left side of the motorway		Area of the wall (m2)	Recommended number of structures for passive protection
		Height of the wall (m)	Length of the wall (m)	Height of the wall (m)	Length of the wall (m)		
Section I 0+000-04+000 km	0+81,5-0+191	1-5	109,5	--	--	438	17
	0+010-0+150	--	--	1-5	140,0	530	
	0+455,5-0+646,5	1-5	152	--	--	600	
	0+485-1+144	--	--	1-5	659	2678	
	0+785-1+199	1-5	414	--	--	1943	
	1+590-1+770	--	--	1-5	180	630	
	2+324-2+590	--	--	1-5	266	1237	
	2+220-3+280	1-5	1060	--	--	3610	
	3+280-5+152,5	1-5	1872,5	--	--	7307,5	
	3+699-4+075	--	--	1-5	376	1662	
Section II 04+000-24+901	4+243,5-4+812,5	--	--	1-5	569,5	2470,5	133
	5+175-5+664,5	--	--	1-5	489,5	2407,5	
	7+804-8+064	1-5	260	--	--	1180	
	8-900-10+280	1-5	1380	--	--	3330	
	9+367-9+567	--	--	1-5	200	900	
	9+596-9+676	--	--	1-5	80	340	
	10+153-10+191,5	--	--	1-5	38,5	192,5	
	10+271-10+949	1-5	678	--	--	2895	
	11+007-11+107	1-5	100	--	--	100	

[42] Direction follows the chainage of the road.

km	11+205-11+825	1-5	620	--	--	2950	
	10+414-10+745	--	--	1-5	331	1210	
	11+197-12+037	--	--	1-5	840	3980	
	17+037-17+237	1-5	200	--	--	600	
	17+437-17+808	1-5	371	--	--	1629,5	
	17+929-18+849	1-5	920	--	--	4220	
	18+900-19+300	1-5	400	--	--	1840	
	19+308-19+688	1-5	380	--	--	1800	
	16+764-16+824	--	--	1-5	60	300	
	16+888-16+988	--	--	1-5	100	340	
	17+090-17+264	--	--	1-5	174	810	
	18+020-18+620	--	--	1-5	600	2410	
	18+647-19+444	--	--	1-5	797	3502,5	
	19+695-19+935	--	--	1-5	240	1200	
Section II 04+000-24+901 km	20+166-20+226	--	--	1-5	60	300	
	20+445-20+705	--	--	1-5	260	1270	
	20+745-20+845	--	--	1-5	100	490	
	21+120-21+676	--	--	1-5	556	2334	
	21+676-22+036	1-5	360	--	--	1680	
	22+680-23+011	1-5	331	--	--	1153	
	23+010-24+750	1-5	1740	--	--	7170	
	21+520-22+089	--	--	1-5	569	2680,5	
	22+200-22+520	--	--	1-5	320	1270	
	22+830-23+350	--	--	1-5	520	1840	
	23+359-24+659	--	--	1-5	1300	5660	
Section III 24+876-37+726	27+849-28+501	3	652	--	--	1956	82
	28+649-29+724	3	1075	--	--	3225	
	31+776-32+130	3	354	--	--	1062	
	32+336-32+612	3	276	--	--	828	
	32+926-33+266	3	340	--	--	1020	
	35+376-35+630	3	254	--	--	762	
	37+376-37+839	3	463	--	--	1389	

	24+890-26+008	--	--	3	1118	3354	
	26+250-26+768	--	--	3	518	1554	
	27+856-28+506	--	--	3	650	1950	
	28+600-29+748	--	--	3	1148	3444	
	31+750-32+103	--	--	3	353	1059	
	32+336-32+610	--	--	3	274	822	
	32+880-33+300	--	--	3	420	1260	
	35+120-35+547	--	--	3	427	1281	
	37+199-37+752	--	--	3	553	1659	
Section IV 38+617-46+289	41+390-42+488	3	1196	--	--	3588	16
	42+660-43+488	3	828	--	--	2484	
	43+870-44+241	3	371	--	--	1113	
	46+040-47+062	3	1022	--	--	3066	
Section V 46+289-58+434	46+964-46+972	3	8	--	--	24	70
	47+022-48+768	3	1746	--	--	5238	
	49+988-50+304	3	316	--	--	948	
	51+269-51+787	3	518	--	--	1554	
	54+944-55+113	3	169	--	--	507	
	55+992-56+646	3	654	--	--	1962	
	57+516-58+733	3	1217	--	--	3651	
	58+311-58+733	--	--	3	422	1266	
	57+553-58+275	--	--	3	742	2226	
	51+212-52+504	--	--	3	1292	3876	
Section VI 58+434-66+959	59+053-59+868	3	815	--	--	2445	108
	59+908-60+166	3	258	--	--	774	
	60+169-60+554	3	388	--	--	1164	
	60+899-61+600	3	701	--	--	2103	
	61+678-61+896	3	218	--	--	654	
	62+804-63+342	3	538	--	--	1614	
	63+476-67+070	3	3594	--	--	10782	
	59+908-60+166	--	--	3	258	774	
	60+169-60+562	--	--	3	393	1179	

	61+113-61+589	--	--	3	476	1428	
	61+670-61+888	--	--	3	218	654	
	62+804-63+342	--	--	3	538	1614	
	63+930-65+352	--	--	3	1422	4266	
	65+517-66+401	--	--	3	884	2652	
	66+568-66+981	--	--	3	413	1239	
Section VII 66+959-82+559	66+864-68+669	3	1835	--	--	5505	145
	68+701-69+266	3	565	--	--	1695	
	72+530-74+388	3	1858	--	--	5574	
	74+597-75+744	3	1147	--	--	3441	
	76+597-77+315	3	718	--	--	2154	
	78+092-79+023	3	931	--	--	2793	
	79+148-81+614	3	2466	--	--	7398	
	66+857-67+665	--	--	3	808	2424	
	69+064-69+295	--	--	3	231	693	
	72+404-74+403	--	--	3	1999	5997	
	75+578-76+273	--	--	3	695	2085	
	77+440-80+108	--	--	3	2668	8004	
	80+738-81+850	--	--	3	1112	3336	
Section VIII 0+000-18+800	1+510-2+540	3	1030	--	--	3090	158
	2+680-3+043	3	363	--	--	1089	
	3+225-5+894	3	2669	--	--	8007	
	6+010-6+363	3	353	--	--	1059	
	7+185-8+131	3	946	--	--	2838	
	9+080-9+868	3	788	--	--	2364	
	10+140-12+231	3	2091	--	--	6273	
	12+405-14+239	3	1834	--	--	5502	
	18+240-18+717	3	477	--	--	1431	
	1+450-3+946	--	--	3	2496	7488	
	4+153-5+000	--	--	3	847	2541	
	5+105-5+602	--	--	3	497	1491	
	7+185-8+131	--	--	3	946	2838	

	9+250-9+848	--	--	3	598	1794	
	10+140-10+881	--	--	3	741	2223	
	11+302-12+989	--	--	3	1687	5061	
	13+110-13+684	--	--	3	574	1722	
	18+240-118+717	--	--	3	477	1431	

Influence of future growth of traffic

With the predicted growth of traffic, it will be necessary to improve the mitigating measures that were previously listed. That will also depend on the real rate of increase of traffic. Assuming that no progress is made in terms of noise reduction on the roads or the vehicles, the calculated level of noise for 2013 will increase between 1.3 dB(A) and 6 dB(A) for the year 2042. Maybe additional measures will be necessary for noise protection where settlements are located close to the section. Besides the extension of walls for noise protection, other mitigation measures that were previously listed might be established in order to prevent exceeding of standards used for noise. As one of the justified means, improvement of the structure of the pavement surface could be used on certain sections during general reconstruction works by completing the asphalting by using porous asphalt that reduces the noise, by reducing the level of emission of noise for 2 – 3 dB(A), and that would be a countermeasure for the increase of noise from the increased volume of traffic on most sections. However, in order to reduce the future negative influence of noise, it might be necessary to install noise insulation windows for protection from noise.

6.3.11. Vibrations

Vibration has no relevant impact on the settlements surrounding the motorway during motorway operation. Bearing in mind that all the structures surrounding the motorway are physically separated from the structural elements of the motorway, vibration transfer is negligible. Vibrations of the highway elements (bridges, viaducts ...) are calculated and provided in technical descriptions in the Preliminary design.

6.3.12. Infrastructure Systems

Conflict between the motorway and infrastructure systems has been solved during the motorway design phase. During the operation of the motorway the interference between the motorway and other infrastructure systems should be taken into account, so that they would function as one system. Special attention should be taken into account regarding potential accidents. In the vicinity of the motorway, large structures, industrial plants and facilities representing considerable potential for accidents have not been identified in the present moment, but there is a possibility that such structures will be constructed in the future.

7. ALTERNATIVE SOLUTIONS AND DESCRIPTION OF REASONS FOR CHOSEN ALTERNATIVE ADOPTION RESPECTING ENVIRONMENTAL IMPACTS

In documentations defined as «preparation, optimization and verification of Conceptual Design" a multi criterion analysis of the route alternatives proposed the most favorable alternative. In the previous section of the documentation titled Technical Study, the selection of the routes in the corridor has been made by a short two-step, multi-criteria analysis on the ground of the studied corridors and background documentation for planning. The first step has been implemented by applying eliminative criteria which include: water-supply find - zone I, cultural and historical inheritance (objects and zones defined by decisions and planning documents), natural values and rarities (on the grounds of valid documents), urban constructions, finished industrial complexes, significant power facilities, first category fertile soil, land-reclamation. After the selection has been done in accordance with the above mentioned criteria, the second step will assess the technical characteristics in the case when the number of the other route options is above 2 - 4, and the elements mentioned in Protocol 2[43] have been proposed for the assessment.

The subject of the multi-criteria analysis is the assessment and comparison of the route options for the motorway which were short-listed and technically developed as conceptual designs at a scale of 1:5,000, and the proposal for the selection of the most favorable route.

The aim of the analysis is to make possible for the Client to select the most favorable position for the Motorway – Corridor Vc on the grounds of the studied and classified data, and information available; this will be the basis for the future phases of development of planning and study documentation (traffic study, pre-feasibility study, preliminary design, and feasibility study).

Four main groups of criteria have been selected as follows:

A. Technical – operational characteristics which determine traffic conditions, costs of operation, costs of travel time, costs of accidents, and costs of maintenance,

B. Costs of construction which have a significant impact on profitability and economic-financial feasibility of the project,

C. Space-environmental characteristics which predetermine acceptability and feasibility of the project from the point of space utilization and environmental and socio-economic effects on the environment, and

D. Time and conditions of construction which also have a significant effect on the final judgment on the acceptability and feasibility of the project.

Each of the above mentioned criteria includes larger or smaller numbers of parameters – criteria of lower rank (sub-criteria), by which assessment of the options is done from the point of the basic criterion, applying the multi-criteria procedure. When interpreting criteria and their application by the method of relative weights, special attention is paid to avoiding of double or multiple ranking.

[43] Protocol on methodology for selection of alternative variants for all four Lot-s.

Spatial-environmental characteristics which predetermine acceptability and feasibility of the project from the point of space utilization, environmental and socio-economic effects on the environment, have become an increasingly important element lately for making decisions on investments. The principle of sustainable development respects the above-mentioned factors more and more which means caring for the environment and a development which is harmonized with the minimum disturbance of the environment, or in the worst case, reduction of detrimental effects to an acceptable level. This criterion has been divided into two, only for the purpose of expressing one portion of the criterion (parameter) in traditional units of measurement while the other portion of the criterion (parameter) can be expressed in qualitative and relative values. While we have the usual units of measurement for quantitative units, relative relations between sub-criteria should be applied for qualitative indexes.

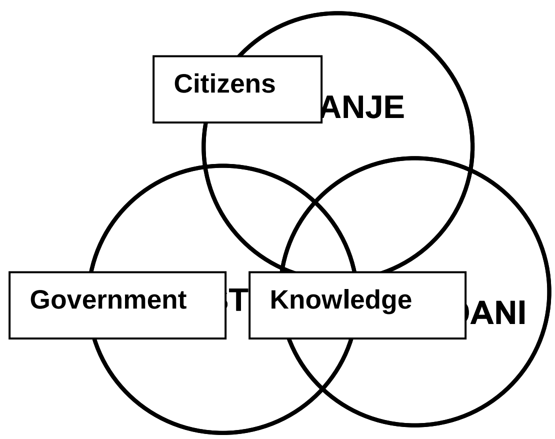
Evaluation i.e. final calculation of alternatives' indexes was made on the basis of previously calculated indexes of all single criterions and respecting relative criterion weights.

On the basis of previous calculation, for analyzed criterions and multi-disciplinary estimation of importance for each criterion (as each member of evaluation team assessed), most favorable alternative was chosen and adopted for further analysis.

8. DIFICULTIES EXPERIENCED IN PREPARATION OF EIS

Traffic planning in the country, designing the transport corridors and the motorway alongside it cover activities that involve numerous stakeholders and require the acquiring of a substantial amount of information. It is particularly important to create a good organisation for decision making including the participation of the Government, citizens and experts (knowledge) – Fig. 8.1. Project of the motorway for Corridor Vc that is being implemented by the Ministry of Transport and Communications of BiH is the first major infrastructure project within BiH. It is being carried out under enormous pressure due to the underdevelopment of BiH compared to other, and even neighbouring, countries in terms of a motorway network. Therefore it was necessary to create an organization for designing the motorway in all dimensions (profitability, current spatial plans, engineering designs, and environmental aspects) under the conditions of previous discontinuity. All the activities should have been conducted in parallel. In order to achieve the missed items the deadlines set up were short.

Illustration. 8.1. Making decisions – interaction of Governments, citizens and experts (knowledge)



Therefore the work has been carried out with difficulties such as:
- Conflict in terms of spatial plans (BiH in 1982, municipal plans);
- Lack of statistical data;
- Recent system of decision making on major spatial actions

However these considered difficulties have not impacted upon the quality of judgement. The truth is that certain measurements and analyses remain to be carried out and although these cannot impact upon the overall results, they could cause certain minor changes particularly during the process of producing the detailed design of the motorway.

Also, one of the problems is the lack of detailed hydrological map of narrow belt around the highway received on the base of research works. Objects for waste water treatment can be located within the area defined as sensitive within this Study,, but before final selection of object disposition, it should be consulted the detailed hydro geological basement of narrow belt around the highway in the scale 1:5.000. It is needed to pay attention that the objects not set up in aquifer area where determined high levels of underground water to avoid disturbance of hydraulically regime of underground water flow and similar. Having in mind all above mentioned, it is necessary to perform control of assumed water impact on the base of data that will be received after completion of survey works, and hydro geological maps and longitudinal profiles of narrow belt of the highway in detailed scale (1:5.000).

9. CROSS-BORDER IMPACT

Although the considered segment of the motorway does not cross the border of BiH it is necessary to review the motorway impacts in a cross-border aspect. The motorway construction:

(i) impacts the change of the traffic patterns in Croatia (Slavonia)

Furthermore the motorway generates a traffic structure in Croatia that

(ii) could have a great impact for accidents (an accident in Croatia with the vehicle involved that is transporting hazardous materials for BiH industry purposes).

BiH traffic itself could impact upon the Croatian environment through:

(iii) excessive air pollution, and
(iv) excessive water pollution and possibly
(v) accidents during the motorway construction

Concerning the impacts under (i) and (ii) it should be borne in mind that they will also be reflected in the Croatian part of the motorway along the same Corridor Vc and the design documents will ensure that measures for avoiding accident situations are adopted in the same way as for the BiH part of the motorway with regulated environmental studies, papers and the practice in BiH.

Concerning the excessive air pollution (iii) traffic could be a great source of emission of NOx only in the case of enormously high traffic volumes. However for the traffic conditions in BiH the ratio of emissions of the stationed?? sources of the Corridor area: traffic at the LOT 2 amount:

NO_x	10,5 : 1
SO_x	8248 : 1
PM	262: 1

i.e. the traffic emission is minor if compared to the air emission from the stationed?? sources.
The conclusion is that the excessive impacts of the motorway for LOT 2 are not significant except in the case of accidents and for this appropriate organisational measures should be applied including cooperation with the government of Croatia.

10. MONITORING SYSTEM WITH ESTABLISHING OF METHODOLOGY

10.1.Introduction (Background)

Besides the detailed analysis and calculations, individual assessments of the environmental impact as a basis for seeking design solutions could be insufficiently reliable. Furthermore the environment conditions are being changed in time causing a change of environmental standards. Therefore it is possible to find out that some proposed measures for mitigating the environmental impacts are not sufficient after completion of the motorway or even the planned activities have not been carried out in full. So the task of the relevant bodies is to establish environmental monitoring. Specifically the task of the monitoring is to monitor emissions (air, water) and change of environmental parameters (air quality, noise level, river quality, change of the soil quality). Generally it is to monitor social-economic parameters also. The monitoring system goal is to check all systems contributing to the environmental quality and depends upon (purification of waste water collected from the motorway, maintaining the equipment, checking their operation in case of accidents – run-off of chemicals from the motorway, etc.) Based on the monitoring results additional organisational or financial measures could be taken.
Monitoring is multipurpose: (i) for managing events, (ii) for informing, including planning requirements and (iii) scientific purposes. Monitoring could be in real time when information should be sent promptly (accident) or reported on an annual basis.

Such Project monitoring is not a prerequisite for obtaining environmental approval but it is for publishing the construction tender as well as a requirement for road maintenance projects.

As mentioned in 2.1 the motorway impacts have significant environmental impacts that could be specified as desired, necessary or unwanted. 'Desired' impacts are the planned landscape change, including the constructed motorway and wider economic effects. 'Necessary' impacts are for example the accepted change of use of arable land at a certain place and a certain area or a noise within the approved limits. 'Unwanted' impacts are run-off of oil derivatives into a river in the case of an accident or excessive air pollution or destruction of a forest area during construction. To monitor the changes the country should include, maintain and use the environmental impact monitoring system (environmental monitoring). Monitoring should identify:

1. Conditions at the time of preparing the Environmental Impact Assessment;
2. Conditions at the time of work commencement;
3. Conditions at the time of work completion, and
4. Conditions at the time of a road in operation

This practically means that the monitoring system should be established at once. Certainly it could not be fully operational at the initial moment since it is not established yet but it should be promptly designed and developed particularly having in mind the responsibility of its establishing, functioning and data dissemination. It is obvious that the responsibility is up to the government body responsible for the overall motorway project as well as bodies legally responsible for environmental issues. The system itself could be divided into three stages: monitoring the initial state, monitoring the construction and monitoring the operation.

Monitoring does not cover monitoring of the parameters only, but also monitoring the ability of responsible government bodies to organise the monitoring and to verify their ability to disseminate the monitoring results.

The Law on environmental management in FBiH regulates the procedure of assessing the environmental impacts of certain area actions based on the Article 3 and 4 of the Regulation on Plant and Equipment that could be constructed and operational with the environment approval only. (Gov. Gazette of FBiH No. 19/04).

Since this is the case for constructing the motorway, the project of Corridor Vc is listed as one that requires an obligatory environmental impact assessment as follows:

- Establishing conditions of damaged and contaminated land;
- Selection of possible protection and rehabilitation measures;
- Assessment of alternative methods and the design of the final protection;
- Assistance in developing the environmental management plan

Methodology of Soil Monitoring

Field Work – Site Reconnaissance

Site inspection in an area 500m wide in order to identify the pedo-system classification of soils and cartographic units, i.e. land classification.
Soil sampling:

- For identifying the initial state, one average sample from the soil surface within the motorway alignment on average at each 2km of the alignment which makes a total of 32 samples, with the intention that samples “cover” all types of land use.
- For identifying degradation and pollution during the construction stage where an exact number of locations could not be anticipated the sampling should be carried out at all places where machines are parked, where fuel and lubricants are stored and where spillage of such substances occurs. However sampling should be taken at each section (9 sections) from 3 positions which amount in a total of 27 samples.
- Operation stage requires one average soil sample to be taken at the exact determined location using GPS for each important soil type (some 20 types and varieties). This means that the future monitoring would be carried out at some 20 locations along the motorway alignment where one average sample would be taken each year from the same location to analyse the heavy metal content as well as other hazardous materials.

Therefore the complete monitoring would take a total of soil samples as follows:
- Initial state 32 soil samples

- Construction stage 27 soil samples a year
- Operation stage 20 soil samples a year

Laboratory Analyses

In order to establish the state of soil/land quality, standard chemical analyses of all samples would be carried out. Basic chemical features of the soil/land to be established are as follows:

- Top soil content;
- Soil reaction, pH of water and n KCl;
- State of absorption complex;
- Content of total Nitrogen (N%);
- Content of the plant available P_2O_5 and K_2O;
- Content of total forms of heavy metals (Cd, Pb, Co, Ni, Cu, Cr, Zn),
- Content of PAH (poly-cyclic aromatic carbon-hydrogen) and if necessary mineral oils in accordance with guidelines and regulations of the EU.

Processing of Results

Based on the obtained results and the conducted monitoring it is possible to anticipate the appropriate measures of arable land and agro-systems along the VC motorway for the section LOT 2.

The Contractor should form a competent research team who will carry out the field work, sampling, laboratory analysis of soil and data processing and to prepare the final report.

10.2. Monitoring of Initial State

Monitoring of so-called ‘initial’ state should monitor the state starting from preparing the study until commencement of construction. It should (i) indicate if an unwanted change of some environmental parameters occurred before the construction and (ii) particularly important is to obtain additional basis for carrying out the detailed design, i.e. defining the environmental conditions required for obtaining the construction permit. Monitoring the initial state should particularly cover:

- Changes in use of the area (plans and physical changes): construction plans of auxiliary and alternative roads, change of spatial and urban plans, construction or removing important structures;
- water,
- soil,
- eco-systems.

In the period up to commencing the motorway construction and the analysed information shows that it is required to carry out a detailed study of heritage with a possibility of reviewing all municipal spatial plans and maps at minimum scale 1:5,000 to exactly define the location of the alignment relating to the preserved structures and to provide for their full preservation. Besides the above-mentioned, and bearing in mind the ground features, it will be necessary to carry out an investigation of the ground bearing capacity for the selected road alignment, at the marked areas to obtain reliable information that could necessitate a change of the detailed designs, which is normal practice in road construction. Change of ground streamlets could significantly impact upon the conditions of cultural/historical heritage so this aspect will be particularly studied within the heritage impact study at the same level as the impact from chemical pollution that is related to the construction and operation of the road.

Monitoring the Initial State of the Ground

Documents of PEIS clearly state that there is no relevant information on the present state of soil quality alongside the motorway alignment. Since the first stage of the analysis has not acquired the relevant information, it is necessary to supplement the research with information that will be collected during the preparation of EIS. According to this it is necessary to conduct a certain monitoring in order to obtain the information on the initial state of the soil quality.

The subject of this monitoring is the soil/land that is located within a strip some 500m wide for the proposed motorway alignment for the 102km section LOT 2, where arable land covers some 49km and forests 13km. Other parts of the alignment are tunnels and bridges.

Analysis of the adopted alignment of the motorway for the corridor Vc determines 32 locations where soil sampling is anticipated in order to establish the initial state quality.

Analysis of the predictable impacts of the motorway section LOT 2 upon the arable land and agro-ecosystem in view of emitting pollutants into the soil with separated emissions of solid and liquid materials, gases and emission of ice-melting salt. The very complex issue of polluting the soil by heavy metals near to the pavement will be particularly examined.

Considering the impacts of individual soil features to penetration, coherence, mobility and loss of heavy metals and other pollutants emitted from the motorway the soils will be divided into classes/categories. Each category will propose appropriate measures of soil protection. The measures are based upon a total protection of the most valuable categories of arable lands, spraying the pollutants at the narrower area of the motorway and collecting water from the road using the closed drainage system. Technical and biological measures will be proposed for the protection based upon safety barriers and planting.

10.3. Monitoring During the Construction Stage

Monitoring during the construction stage covers the period from planning and preparation of the site until the works completion. It covers the impacts that exist in the stage of preparing the material within the corridor zone (asphalt plants, etc), transport of material and machines and the construction itself (work impacts and operation of machines) and the consequences of those impacts. Costs of the monitoring should be included in the construction costs of the motorway.

Particularly important is the presence of archaeologists during the construction period. Areas that require the presence of archaeologists are marked in the Table 10.3.1

Monitoring the Soil During the Construction Stage

The construction stage will lead to problems of degradation and contamination of soil by organic pollutants and heavy metals.

Monitoring of Degradation

Construction stage of the motorway requires monitoring, i.e. monitoring the conditions and changes that are reflected through:

- Appearance of erosion due to removing vegetation and cutting the soil;
- Appearance of aquifers due to collecting run-off and drained water;
- Constructing the site facilities (accommodation, parking places, storages and storing areas, etc.)
- Establishing storage for the fertile soil stripped of;
- Using the borrow pits for filling, etc.

Monitoring the Contamination

Use of construction machines and transport of construction materials and the construction itself will lead to soil contamination due to spillages of oil, lubricants and fuel and that is reflected through:

- Polluting by organic pollutants (light and heavy fractions of carbon-hydrogen)

All such damages should be estimated and preventive/remedy measures determined through preparing appropriate programmes and projects.

Table 10.3.1 Locations that require the presence of archaeologists during the construction phase

1. SECTION: KARUŠE - MEDAKOVO	River Tešanjka and its tributaries: Trebačka Rijeka and streamlets. Permanent presence of archaeologists in the stage of earthworks.
2. SECTION: MEDAKOVO - OZIMICA	Trebačka Rijeka, Strupinski Potok, Lješnica and their tributaries. Permanent presence of archaeologists in the stage of earthworks.
3. SECTION: OZIMICA - POPRIKUŠE	River Bosna, tributaries. Permanent presence of archaeologists in the stage of earthworks of the alignment and bridges.
4. SECTION: POPRIKUŠE - NEMILA	River Bosna, tributaries (Mala Rijeka, etc.) Permanent presence of archaeologists in the stage of earthworks of the alignment and bridges.
5. SECTION: NEMILA – D.GRAČANICA	River Bosna, tributaries (Gračanička Rijeka, etc.) Permanent presence of archaeologists in the stage of earthworks of the alignment and bridges.
6. SECTION: D. GRAČANICA - DRIVUŠA	River Bosna, tributaries (Mutnica, Mrstava, Stijenčice, Babina Rijeka, Dobra Voda). There is particular importance for the permanent presence of archaeologists in the stage of earthworks of the alignment and bridges.
SECTION: DRIVUŠA - KAKANJ	River Bosna. Permanent presence of archaeologists in the stage of earthworks of the alignment and bridges.
SECTION: BLAŽUJ - LEPENICA	Permanent presence of archaeologists in the stage of earthworks of the alignment and bridges.
SECTION: LEPENICA - TARČIN	River Lepenica, Bijela Rijeka. Permanent presence of archaeologists in the stage of earthworks of the alignment and bridges.

10.4. Monitoring During the Stage of Motorway Operation

Monitoring during the stage of motorway operation should cover:

- Monitoring the change of social/economic parameters (indicators) that are related to a wider area of the motorway (change in number of inhabitants, settlement development nearby the motorway, change of the economic development parameters);
- Monitoring possible changes in water supply and possible emissions into water;
- Monitoring the soil quality and possible soil pollution;
- Monitoring air quality and ambient noise.

10.5. Water quality monitoring

Monitoring establishment is the integral part of observation and evaluation of changes which appeared in environment during the construction and exploitation phases. Monitoring of baseline state of water quality is the prerequisite for conducting adequate analyzes, and for undertaking of appropriate measures for both of these phases. Having regard to the hydro-geological, hydrographical and hydrological characteristics of the area through which the route is passing, baseline state of the surface and ground water quality is presented in section 4.5. of this study.

Within this Study, a water quality monitoring plan for the motorway construction and exploitation phases is also given. As a most significant element of that plan, it is necessary to predict establishing of the system for water quality monitoring in the area of the impact from designed motorway, for the newly planned sampling sites (12) before the beginning of any type of construction works (baseline monitoring), and for all sampling sites (12+5=17) during the construction and exploitation phase. Positions of all sampling sties for the monitoring of the surface water quality are presented in the Annex 12.3.5.

10.6. Monitoring of current situation of water quality

Surface water

In chapter 4.5. on the basis of available data, evaluation of the current state of quality of surface water was given, for those watercourses which normally flow by the adopted motorway route for LOT 2, or the route is passing over them.

In the Sava river basin in FB&H, after the war, there was no continual systematic monitoring of quality of surface water of the main watercourse and its tributaries. In September, 2005, there was beginning of the project “Analysis of surface water quality, in the four series, within one hydrological year (physical –chemical, microbiological and biological parameters) in the area of Sava river basin in FB&H”, which is financed by the Public Company for Watershed Area of Sava River (PCWA Sava), Sarajevo. Existing data from five hydrological sampling sites, from 2005, obtained by analysis of one series of sampling on the Bosna River (sites upstream and downstream of Zenica, upstream and downstream of Maglaj) and on Lašva River (site at the mouth), were used for evaluation of the current state.

Furthermore, consultant harmonized the monitoring planning approach and all activities related to it, with representatives of PCWA Sava – water protection sector, and according to that, proposed new twelve (12) sampling sites on which is necessary to evaluate current state, before starting any construction works. These profiles were chosen for purpose of satisfying the following criteria:

- To include sections of motorway passing over the surface watercourses and on which there is possibility for more intensive and more detailed construction works (bridges, viaducts and interchanges).
- To clearly identify the changes provoked by pollution from industry and sewerage system, and to differentiate between those types of pollution and pollution that could be caused by works on construction of the motorway (localities before and after settlements).
- To include longer sections of motorway, which pass through aquifer areas, in order to cover mutual interaction of surface and ground water.

Proposed new sampling sites are given in Table 10.6., together with sites (marked with *) on which the PCWA Sava is implementing the quality monitoring, and for which the data for 2005 was obtained.

Table 10.6. Overview of surface watercourses and corresponding sampling sites on section Doboj south (Karuše) – Sarajevo south (Tarčin) - LOT 2

Sampling site (SS)	Watercourse	Exact location
SS 1.	Usora River	upstream from Karuše interchange, LOT 1 Settlement Hrastići
SS 2.	Tešanjka River	Medakovo interchange – settlement Medakovo
SS 3.	Ozimica River	Ozimica interchange – settlement Perkovići-Brežđe
SS 4.	Bosna River	Poprikuše interchange – settlement Golubinja
SS 5.	Bosna River	Nemila interchange Settlement Nemila
SS 6.	Dobra voda	Settlement Ričice, Municipality Zenica
SS 7.	Stjenčice	Settlement Klopče Municipality Zenica
*SS B-7**	Bosna River	*upstream from Zenica, Settlement Raspotočje*
*MP B-8**	Bosna River	*downstream from Zenica, Jelina*
*SS B-10**	Bosna River	*upstream from Maglaj*
*SS B-11**	Bosna River	*downstream from Maglaj*
*SS Ls-1**	*Mouth of Lašva River*	*Settlement Bijela River*
SS 8.	Bosna River	Lašva interchange arm 2 Settlement Putovići Municipality Zenica
SS 9.	Bosna River	Settlement Modrinje
SS 10.	Bosna River	Dumanac – D.Kakanj
SS 11.	Lepenica River	Lepenica interchange Settlement Žeželevo -Kuliješ
SS 12.	Bijela River	Tarčin interchange Settlement Tarčin

For the new sampling sites for which there are no data about current state, it is necessary to perform water sampling in the minimum of two series, during hydrological minimum and maximum, and before performance any construction works.

On every predicted site, after water sampling, it is necessary to perform detailed analysis of the following parameters, which are specific for analysis of road impact on quality of surface watercourses:

1. Temperature
2. Electro conductivity
3. pH value
4. COD
5. BOD

6. Turbidity
7. Total suspended matter
8. Chloride
9. Sulphate
10. Heavy metals (Cadmium, copper, chromium, zinc, nickel, lead, iron, manganese, mercury)
11. Ammonia, nitrite, nitrate
12. Oil and grease
13. Mineral oil
14. Phenols
15. Total dissolved carbon (TDC)
16. PAH-total (chloroform, tetrachlorcarbon, tetrachlorethylene, trichlorethylene, trichlorethane)

Considering the indications that PCWA Sava will, in future, continuously monitor the surface water quality of main watercourse and its tributaries, on the defined sites, it is proposed that when the baseline monitoring on 12 new sampling sites is performed, the existing data for five sites for which the current state is given in this study, is also collected.
Considering that at this moment, time when construction of the motorway LOT 2 should start could not be estimated, and it is also not possible to predict whether all sub-sections will be constructed at the same time, or only some of them, we think that it would be good to update the data for all five sites for which the state in 2005 was given in this study.

Groundwater
In the investigation area, there is a certain number of local water sources (village water works that are not connected to the public water supply system, but are used to supply certain number of households with water). On the basis of data collected during development of this Study, under the item 4.5.1.1., there is an evaluation of current state of quality of groundwater, i.e. water from five local water sources located within the investigation area. These are the following water sources:

1. Water source Šume - Municipality Doboj-jug
2. Water source Tešanjka, within the local Tešanjka water work, Municipality Tešanj
3. Water source Oaza - Municipality Tešanj
4. Water source Tešanjska vrela - Municipality Tešanj
5. Water source Klopče – Zenica city

On locality of Doboj –Jug Municipality, besides source Šume, where water quality is monitored, there are also sources Kilavi dolovi and Grab, for which the current water quality state should be analysed, before performance of any construction works. Also, in the Kiseljak Municipality -Local Community Lepenica, there are three important local sources- Laze, Gaj, Vukuše, which should be analysed. In the area of Local Community Novi Šeher there is a water intake, and there are also groups of water intakes in the area of Žepče Municipality, and on the locality of Kakanj Municipality – sources in Local Community Tičići and Bunari, for which current water quality state should also be analysed. All these analyses should be preformed before any construction works.

On all these sources, after water sampling in one series, it is necessary to perform detailed analysis of the following specific parameters- indicators of road impacts on groundwater quality:

1. Odour
2. Colour
3. Taste

4. Turbidity
5. Temperature
6. Electro conductivity
7. pH value
8. KMnO4 consumption
9. Residual chloride
10. Fluoride
11. Chlorine
12. Sulphate
13. Heavy metals (Cadmic, lead, iron, manganese)
14. Ammonia, nitrite, nitrate
15. Oil and grease
16. Mineral oil
17. Phenols

It is necessary to determine the quantity status on the water sources (water sources abundance Q).

The report on performed monitoring of current state of quality of surface and ground water should be delivered to relevant administrative authorities and institutions of water and environmental sectors in FB&H.

10.7. Construction phase monitoring

Surface water
During the works on the motorway construction on this section, because of possible impact of mechanization and personnel, it is necessary to implement monitoring of surface water quality. Selection of sites on which monitoring will be performed depends on whether the construction of all sub-sections will be carried out at the same time, or only some of them. In the following phase of project documentation development, it is necessary to pay attention to defining of sites for construction phase monitoring, depending on where the active construction site will be located. This kind of approach is justified because the future contractor should not have obligation to monitor all 17 sites proposed for the entire section, if construction would be realized one sub-section after another.
During the construction time, it is necessary, once a month, to perform detailed analysis of 16 specific indicators (item 10.6.) for investigation of impacts of motorway construction on surface water quality.

In order to see the direct impact on surface water quality, from the established active construction sites and mechanisation bases, which are used for performance of construction works, it is also necessary to perform smaller – weekly water quality analysis, which includes analysis of the following indicators:

1. Total suspended matter
2. Oil and grease
3. Organic matter
4. Heavy metals (lead, iron, manganese, copper, chromium, zinc, nickel)
5. Volatile matter
6. pH value

7. Electro conductivity

Proposed smaller analysis of water quality should be performed only on profiles in the direct vicinity of construction site (that is place predicted for placement of mechanization, personnel, etc.). These localities will be defined depending on the construction site organisation project. In the later phases of project documentation development, it will be necessary to have more precise data in order to select sampling sites for reduced analysis. During this phase, engagement of environmental expert, by the investor, is necessary. In other words, there should be contractor who would observe the progress of the construction on daily basis, on each section, from the aspect of possible impacts on surface water quality in direct vicinity of the construction site.

Groundwater
During the motorway construction works - LOT 2, because of possible impact of used mechanization and personnel, it is also necessary to realize monitoring of ground water quality.
As for the surface water, selection of sources on which the monitoring will be performed, also depends on whether construction of all sub-sections will be carried at the same time or not, in other words it is necessary to monitor only those sources that are located near the construction site. This type of approach is justified because the future contractor should not have obligation to monitor all local sources (defined in items 10.6.) identified for the entire LOT 2 section.

This quality control includes sanitary control of drinking water in accordance with existing Drinking Water Rulebook, in weekly intervals. Detailed analysis of 17 specific parameters (item 10.1.1.2.), should be performed at least once a month.

10.8. Exploitation phase monitoring

Surface water
Considering that in FB&H by-laws which define conditions for discharging of waste water in surface watercourses and soil do not exist, it is then recommended to use as a guideline the limit values defined in the "Rulebook on Conditions of Wastewater Discharge in Surface Watercourses" Official gazette RS, No. 44/01. This is the reason more, because the LOT 1 section in RS passes through Bosna River valley for most of its way, for which these conditions were defined by relevant water sector institutions, and LOT 2 section is the continuation of that LOT 1 section.

In case that wastewater is discharged in watercourses, it must be treated to achieve the quality of recipient water, in other words, it quality must be, by all parameters, the same as quality of recipient. In that sense, it is necessary, during exploitation, to predict continuation of water quality monitoring, in the area of planned motorway impacts on the selected sampling sites (12+5=17) from Table 9. It is necessary to perform measurements every four months, for at least two years. If during that period, motorway would not have any impacts on these watercourses, then the number and frequency of these analyses could be reduced and harmonized with the requirements of FB&H Water Law. Positions of these sampling sites for monitoring of surface water are given in the Annex 12.3.5.

Wastewater from the wastewater treatment structures

It is necessary to perform quality control of wastewater from road at all places where wastewater from wastewater treatment structures is discharged. This control should be realized four times per year; during intensive rainfalls; during the summer; after the first rain and after a longer period without rain. During these analyses, it is necessary to perform analysis of 16 parameters (indicators) which are listed in item 10.6.
Maximum allowed values for discharged water are defined in accordance with the type of water that receives the wastewater from road surface (sewerage system, soil, watercourses). For determination of maximum allowed values, the values from “Rulebook on Conditions of Wastewater Discharge in Surface Watercourses” Official gazette RS, No. 44/01. are recommended, or “Rulebook Conditions of Wastewater Discharge in Public Sewerage System” Official gazette RS, No. 44/01.

Groundwater
After motorway starts to operate, it is necessary to perform monthly control of sanitary quality of drinking water at well fields (defined in item 10.6.) of local water works, which are located in the vicinity of the motorway, for at least two years. Besides that, analysis of characteristic parameters (heavy metals- cadmium, lead, iron, manganese, oil and grease, mineral oil and total phenols) should be realized at least three times per one year.

If within that period it would be established that during exploitation phase there is no any impact on these sources, then the number and frequency of these analyses could be reduced and harmonized with requirements of FB&H Water Law, which prescribes minimum number of bacteriological analyses of drinking water from this local water supply systems.

10.9. Monitoring of ecosystem situation (biological monitoring)

Monitoring of baseline state of ecosystem

Integral part of monitoring and mitigation of motorway impacts on water ecosystem on LOT 2 section is also the monitoring of quality of surface water in the phase of construction and exploitation. Adequate evaluation of surface water quality is possible according to the qualitative-quantitative composition of phytos benthos and zoo benthos and ichthyopopulation. These organisms, because of their large sensitivity to degradation of water ecosystem, react very fast, and it is possible to monitor that through their presence or numbers of their populations. At present, biomonitoring performed by the PCWA Sava, is in the progress on five profiles within Bosna river basin, and that data has already been used for evaluation of baseline state of ecosystem. According to obtained results from October 2005, river Bosna is in category of polluted waters, and only mouth of Lašva River is in category of water with well developed fauna (II category). Proposed localities for monitoring are listed in Table 10.6. (12). They include watercourses which are not integral part of this project, so there is no record of baseline state of ecosystem for them. According to ecological characteristics, rivers: Bijela, Lepenica, Tešanjka, Papratnica and others, are the watercourses with high level of water quality and with special habitat of hydrobionates, and like that, those river require control through the analyses and state assessment. On the basis of these data, it is possible to monitor changes during the construction and exploitation of the motorway. In that way it is possible to find adequate protection measures. Many of these watercourses, with their riverbeds, are habitats for endemic and endangered species (river crayfish, then native brown trout) which are by the European directive on habitat protection, are strongly protected. Besides that Red IUCN List include a number of species which are live in these water currents.

For the new measurement profiles, for which there is no data about zero phase situation of ecosystem, it is necessary performed water sampling at least in two series, during hydrological minimum and maximum, and before performing any construction works.

Monitoring in the construction stage

Monitoring of state of these populations or biomonitoring will significantlly contribute to the adequate natural resource management and revitalisation of all impacts caused by the highway construction. Biomonitoring in the construction stage should be carried out after four months, and it will include the analysis of phytobentos, macroinvertebrates and ichtyopopulation composition.
Approach, selection of profile and dynamics for this monitoring should be adjusted completely with proposed monitoring for surface waters in the construction stage.
During this stage it would be necessary to engage an environmental expert by the investor, taht is constructor whih should on the daily basis monitor construction on sections, from aspects of possible impacts on the ecosystems in the vicinity of construction site.

Monitoring in the exploatation stage

Biomonitoring in the exploiatation stage shoud be carried out every four months during the year, and it would include the analysis of phytobentos, macroinvertebrate of bentos, and composition of ichtyopopulations.
Approach, selection of profile and dynamics for this monitoring should be adjusted completely with proposed monitoring for surface waters in the construction stage.

10.10. Role of Government Bodies for the Motorway Maintenance

The cycle of assuring the environment quality ends when the works are completed, but a new cycle starts with the role and responsibility of the government body responsible for the motorway maintenance. This means in the first place the responsibility for introducing and functioning of the monitoring for determination of frost prevention, process of snow removing, maintaining devices for purifying water from the motorway, organising and maintaining the action system in case of accidents, etc.

From the date of adopting the study it should be clear which government bodies are responsible for the monitoring when the system should start to function. Certainly this could not be full capacity established from the first day but it is necessary to establish and develop it as soon as possible. If omitted this would create a bad image that the environmental impact studies have been made just to meet procedural formalities and not to assure the sustainable development of the corridor and the country.

11. MEASURES CONNECTED TO TRANSPORTATION CONDITIONS IN EXTRAORDINARY CIRCUMSTANCES

Environmental impacts in most cases are considered to be continuous events (e.g. pollution of air by fuel combustion in engines). However, accidents may also occur and significant impacts on the surroundings may occur in a very short period of time. Accidents may be natural or caused by humans. Also, the accidents may occur on the road or outside of it. They may cause damages of different proportions. They can not be fully avoided and it is necessary to manage them through Risk management.

Procedure for the risk includes:

- risk assessment,
- risk management, and
- risk communication.

Risk assessment means identification of possible causes of accidents, the connection of accident and conditions which can cause it, change of accident frequency and assessment of impact on the environment in case of an accident. Risk is the product of multiplication of the probability of an accident and its consequences, and its function is the costs of prevention of risk, that is the cost of removal of consequences. Risk communication refers to all communications connected to the prevention of accidents, and removal of consequences of accidents.

In the case of a motorway, the accidents may be connected to:

1. usage of the motorway, and
2. activities which are implemented in the immediate surroundings of the motorway.

Accidents as result of motorway use

Use of a motorway results in accidents which can be caused by the following:

- inadequate driving conditions which are not in accordance with features of the road, traffic conditions or weather conditions,
- fatigue of the driver, including other conditions which influence quality of driving,
- lack of adaptation of traffic conditions to the specific load which is transported.

In order to decrease the probability of accident occurrence, allowed speed limits on individual sections have been harmonized with radius of bend (in horizontal and vertical plane), and notifications to drivers about speed limits. Fatigue of the driver can be a consequence of driving too long and a monotonous landscape, or landscape in which images move too fast. Parking lots and rest areas have been planned in that respect; when planning the landscape, it has been provided that it is interesting and that its features change from time to time. In accordance with the technical regulations, the necessary width around the road has been provided without special purpose in order to prevent too fast movement of images. Special attention has been paid to the time when day and night changes, including the conditions of night driving (lighting at intersections). The driver has to be informed in time and on several occasions about intersections ahead in order to be able to make a decision about leaving the road on time.

Risk is higher on bridges, overpasses and underpasses, and especially in tunnels. Here, it is necessary to pay special attention during the design phase of the road, and in case of longer tunnels a special risk management programme should be made which includes constant monitoring and a team for prevention of accidents and fast reaction.

The issue of traffic accidents is one of significant criteria which describe the relation between planned options of motorway with respect to environment. Detailed research of the issue of traffic accidents has to be done within traffic research and for the purpose of comparing optional solutions in the Technical study phase. On the ground of information collected up to now, in case of the motorway profile which is characteristic for section Doboj-Kakanj 0.3 accidents per kilometer annually of planned motorway should be expected in the planned period. If this projection is applied to the entire length of planned motorway section from Doboj to Kakanj it is possible to expect approx. 1 traffic accident per month.

The presented data show that the planned motorway has a very high degree of traffic safety and that environmental impacts are within the allowed limits for such a facility.

The planned motorway has been identified as a road used for intensive transport of dangerous materials because it connects areas of international significance. Dangerous materials mean such materials which are very toxic, can oxidize, explosive, ecologically toxic, combustible, self-combustible, and otherwise dangerous for people and the environment. Every road has some role in transport of dangerous materials due to its position in a network, and possible consequences are especially important in biologically valuable areas and in locations with concentrated traffic flow, which is one of the characteristics of the planned motorway. Having in mind features of transport performed over the planned road, the following dangerous materials can be expected:

- Combustible liquids – gasoline and diesel fuel, which are transported in tanks and various oils (machine, engine, reduction, hydraulic, emulsion), transported in various packaging,
- Compressed gases - propane, butane, packed in special steel containers,
- Oxidising materials – chlorides, peroxides, transported in tanks,
- Corrosive materials – sulphur, hydrogen chloride and nitrogen acid, transported in tanks or balloons,
- Poisonous and contagious materials - pesticides, herbicides, packed in sacks and small cartons.

Substances which do not belong to the above mentioned groups and in case of an accident can become pollutants are food for shop chains, agricultural products, industrial final products, construction material, textile products, electrical appliances etc.

Accidents as result of activities near the motorway

Activities in the immediate surroundings of the motorway are connected to accidents which can be caused by:

- industry in the motorway influential area
- operation of facilities (petrol stations etc.) along the motorway

Type of industry in the motorway influential area requires transport of special materials, from liquid fuels and oils to specific chemicals. It is necessary to assess risks for every potential material transported, and for working conditions of industrial and other plants outside the road, and to have recovery measures in case of accident (funds and responsibilities).

Besides transport which is performed on the motorway, it is necessary to identify and analyze the process of handling liquid fuel at petrol and natural gas stations. The process of handling fuel includes four interconnected systems:

I – system for fuel pouring
II - system for fuel storing
III - system for fuel distribution
IV - system for fuel serving

Buildings and activities at a petrol station and natural gas station and attached facilities can endanger the surroundings both during normal operation and in the case of chemical accident and uncontrolled release of pollutants.

During normal operation, petrol and natural gas stations release pollutants which come from motor vehicles, including pollutants which are the result of evaporation and spillage of petrol derivatives. In this way, air, land, surface and underground waters are endangered. Besides, a pump is the source of increased noise and vibrations. In extraordinary situations when uncontrolled fuel spillage occurs, a chemical accident may happen and this will result in polluting of the environment and create a risk for life and health of people, animal and plants.

Pollution that can be a consequence of operation of such facilities is constant and determined relatively by time and space, and it is primarily the result of:

- fuel spillage,
- operation of systems for washing of vehicles (automatic and manual)
- depositing of exhaust gases
- wearing out of tires
- load spillage
- disposal of organic and inorganic waste.

Accidents which may occur at the site of petrol and natural gas stations as a result of accidents with vehicles which transport petrol derivatives or accidents when fuel is poured happen rarely and it is very difficult to quantify them precisely. A special problem is the fact that these are almost immediate, very high concentrations that can not be anticipated either in terms of space or time

Also, accidental spillage during the process of pouring of fuel at petrol stations should be taken into account. In order to prevent petrol derivate from damaging the surroundings, it is necessary to remove the pollutant. The removal should be one of the petrol station's environmental protection measures.

Having in mind other countries' experience, it is necessary to define conditions for:

- selection of adequate absorbent;
- purchase, transport and storing of absorbent;
- application of absorbent;
- method of collection after application;
- regeneration (if absorbent is regenerative);
- disposal of absorbent.

Having in mind the above mentioned, it is necessary to ensure that the laws which refer to transport of dangerous materials are obeyed (law on transport of dangerous materials (Official Gazette RBH 13/94, Rules on the way of transport of dangerous materials in road traffic (Official Gazette RBH 13/94)), as well as international guidelines on transport of dangerous materials. In case of accident it is necessary to inform the police. On the road, there should be information on telephones for calling the police, ambulance and fire brigade, including an arrangement with telecom companies on constant coverage of the route by GSM signal. The police, ambulance and fire brigade should be in contact with utility and other companies (even scientific) on the ways of cooperation and acting in case of accident in accordance with the prescribed and practiced procedures. Fire brigades have to have information on special features of the load in the accident in order to provide a suitable response. The police, ambulance and fire brigade should know general phrases of safety and risk (S and R phrases) in order to be ready to react in case of accident.

Large industrial plants are situated in the motorway zone, especially in the towns of Zenica and Kakanj. These plants require a lot of transport (railway and motorway), but these are mainly internal materials (ore, iron products, coal, ash, slag,). Transport vehicles can slow down traffic and increase the need for overtaking. Also, since this section includes an arterial railway, it is necessary to encourage transport by railway.

Construction accidents

The biggest risk of environmental accident is the result of possible spillage of harmful/poisonous materials into water flows (and afterwards land). One example is uncontrolled spillage of fuel and oil which are used for the operation of construction machines and vehicles.

There is no efficient (reliable) measure for reduction of such impact, but there is general technological discipline, strict monitoring of the implementation of safety measures by the contractor (its managerial staff). However, reduction of impact can be implemented by informing all concerned parties situated downstream from the location of an accident, in order to implement preventive measures, before the polluted spillage reaches them – afterwards, curative measures should be introduced (filtering etc.).

An organization project should anticipate the system of reaction in the case of accidents and disasters, and to ensure the necessary means for dealing with it: communication, first aid, efficient transport vehicles and suitable channels/ways for emergency transport of intervention teams or injured people.

12. LIST OF ANNEXES

12.1. Rješenje o izradi SUO/Odluka o izradi SUŽS

12.2. zvještaj i sa obilaska terena (upitnici, anketni listovi, foto i video snimci).

Grafički prilozi rađeni u Mj 1:25000

12.3.1. Situacija usvojene varijante autoceste na koridoru Vc
The layout of chosen variant on corridor Vc motorway

12.3.2. Geološka karta / Geological map

12.3.3. Hidrogeološka karta / Hydrogeological map

12.3.4. Inženjersko-geološka karta

12.3.5. Karta ograničenja vezanih za vodne resurse duž koridora Vc Water resources related restrictions map on corridor Vc

12.3.6. Karta ograničenja vezanih za poplavne zone i planirane hidroenergetske objekte
Floodplain areas related restrictions map and planned HPP

12.3.7. Karta ograničenja vezanih za tlo i poljoprivredno zemljište duž koridora Vc
Restriction map of soil and agricultural land

12.3.8. Karta ograničenja vezanih za floru i zaštićena prirodna područja
The flora and natur protected areas restrictions map

12.3.9. Karta ograničenja vezanih za pejzaž duž koridora Vc
The landscape restrictions map

12.3.10. Karta kulturno historijskog nasljeđa duž koridora Vc
Map of cultural and historical inheritance along corridor Vc motorway

12.3.11. Karta ograničenja vezanih za infrastrukturu / Infrastructure restrictions map

12.3.12. Sintezna karta ograničenja / Synthesis map

Ostali grafički prilozi

6.3.10.1 Karta buke bez mjera zaštite od buke 1:25.000
6.3.10.2 Karta buke sa mjerama zaštite od buke 1:25.000

APPENDICES:

Table 1. Presence of different soil types in Corridor Vc

Section	Presence of different soil types																					
	Lithosols		Calcomelanosols		Rendzinas		Rankers		Vertisols		Calcocambisol		Eutric cambisol		Dystric cambisol		Luvisols		Pseudogley		Fluvisols	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
1	-	-	-	-	-	-	-	-	4,5	2,3	14,8	7,4	-	-	-	-	75,9	38,0	-	-	104,3	52,3
2	-	-	-	-	-	-	-	-	103,6	10,2	1,9	0,2	298,1	29,2	74,3	7,3	311,9	30,6	52,6	5,1	177,3	17,4
3	-	-	-	-	-	-	24,3	3,6	3,2	0,5	-	-	256,5	38,1	285,8	42,5	-	-	41,3	6,1	61,4	9,2
4	-	-	-	-	-	-	10,4	2,9	-	-	-	-	-	-	278,0	77,1	-	-	-	-	72,0	20,0
5	21,7	3,8	-	-	79.2	14,0	34,3	6,0	-	-	-	-	66,4	11,7	300,4	52,8	-	-	-	-	66,5	11,7
6	-	-	1,9	0,5	193,2	46,5	10,1	2,4	-	-	-	-	166,4	40,1	-		-	-	-	-	43,8	10,5
7	-	-	-	-	134,0	20,0	-	-	-	-	-	-	336,6	50,0	-		-	-	-	-	201,2	30,0
8	-	-	-	-	-	-	-	-	-	-	-	-	155,7	35,0	95,5	21,5	77,6	17,5	69,6	15,7	46,0	10,3
9	-	-	65,7	12,8	-	-	-	-	-	-	9,0	1,7	105,0	20,4	179,1	34,8	-		-	-	156,1	30,3
Total	21,7	0,4	67,6	1,4	406,4	8,3	79,1	1,6	111,3	2,3	25,7	0,5	1384,7	28,5	1213,1	24,9	465,4	9,6	163,5	3,4	928,6	19,1

Table 2. Categories of land usage in the motorway route corridor

Section	Agricultural		Forest		Built		Water		Other (tunnels)		Total
	ha	%	ha	%	ha	%	ha	%	ha	%	ha
1	115,5	58,3	47,0	23,7	20,4	10,3	2,7	1,4	12,4	6,3	198,0
2	555,1	53,2	271,9	26,0	84,0	8,1	3,2	0,3	130,3	12,5	1044,5
3	149,0	21,0	133,0	19,2	33,7	4,9	17,9	2,6	357,8	51,7	691,4
4	55,2	14,4	88,6	23,0	26,3	6,9	24,9	6,5	189,0	49,2	384,0
5	120,6	19,9	179,5	29,5	38,4	6,3	45,3	7,5	223,4	36,8	607,2
6	191,0	44,9	57,9	13,6	74,1	17,4	10,8	2,6	91,6	21,5	425,4
7	391,2	53,4	173,8	23,7	95,4	13,0	72,5	9,9	-	-	732,9
8	217,5	49,5	121,8	27,7	77,1	17,6	-	-	22,4	5,2	438,8
9	173,6	34,2	60,6	12,0	39,1	7,7	7,7	1,6	225,6	44,5	506,5
Total	1968,7	39,1	1134,1	22,5	488,5	9,7	185,0	3,7	1252,5	25,0	5028,7

Table 3. Way of agricultural land usage in the motorway route corridor

Section	Cultivated		Orchards		Meadows		Pastures		Barren		Total
	ha	%	ha	%	ha	%	ha	%	ha	%	ha
1	111,5	96,5	0,7	0,6	3,3	2,9	-	-	-	-	115,5
2	519,0	93,5	2,2	0,4	33,5	6,0	0,4	0,1	-	-	555,1
3	122,7	82,3	4,7	3,2	17,0	11,4	4,6	3,1	-	-	149,0
4	19,8	35,9	-	-	33,4	60,5	2,0	3,6	-	-	55,2
5	84,9	70,4	6,6	5,5	28,3	23,5	-	-	0,8	0,7	120,6
6	146,5	76,7	23,2	12,1	17,5	9,2	3,3	1,70	0,5	0,3	191,0
7	297,8	76,1	2,8	0,7	64,4	16,5	22,4	5,7	3,8	1,0	391,2
8	171,5	78,8	19,1	8,8	18,5	8,5	-	-	8,4	3,9	217,5
9	151,3	87,1	2,4	1,4	16,8	9,7	3,1	1,8	-	-	173,6
Total	1625,0	82,6	61,7	3,1	232,7	11,8	35,8	1,8	13,5	0,7	1968,7

Table 4. Bonity categories of agricultural land on some sections in the motorway route corridor (zone wide 500m)

Section	Bonity category																		
	I		II		III		IVa		IVb		V		VI		VII		VIII		Total
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha
1	-	-	52,6	45,5	27,1	23,5	0,6	0,5	32,1	27,8	3,1	2,7	-	-	-	-	-	-	115,5
2	-	-	226,4	40,8	142,0	25,6	13,3	2,4	114,4	20,6	47,8	8,6	9,9	1,8	1,3	0,2	-	-	555,1
3	2,1	1,4	28,4	19,1	35,8	24,0	12,1	8,1	57,1	38,4	10,5	7,0	0,6	0,4	2,0	1,3	0,4	0,3	149,0
4	-	-	16,6	30,1	12,6	22,8	4,7	8,6	7,4	13,5	4,3	7,8	2,0	3,6	7,6	13,8	-	-	55,2
5	-	-	14,5	12,1	2,0	1,6	8,4	6,9	23,9	19,8	13,7	11,4	50,3	41,7	7,0	5,8	0,8	0,7	120,6
6	-	-	21,2	11,1	30,0	15,7	6,2	3,2	79,1	41,4	23,2	12,2	25,7	13,5	4,2	2,2	1,3	0,7	191,0
7	-	-	141,5	36,2	38,5	9,8	30,8	7,9	70,6	18,1	57,9	14,8	37,7	9,6	4,4	1,1	9,8	2,5	391,2
8	-	-	17,6	8,1	108,2	49,8	3,7	1,7	78,7	36,2	0,9	0,4	-	-	-	-	8,4	3,8	217,5
9	-	-	72,0	41,4	86,5	49,9	-	-	11,4	6,7	3,7	2,1	-	-	-	-	-	-	173,6
Total	2,1	0,1	590,8	30,0	482,7	24,5	79,8	4,1	474,7	24,1	165,1	8,4	126,2	6,4	26,5	1,3	20,7	1,1	1968,7

Table 5. Bonity categories of agricultural land at each section in the motorway corridor (zone wide 50m)

Section	Bonity category																		
	I		II		III		IVa		IVb		V		VI		VII		VIII		Total
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	ha
1	-	-	10,6	70,7	2,0	13,3	0,3	2,0	1,2	8,0	0,9	6,0	-		-		-		15,0
2	-	-	40,7	63,7	13,8	21,6	1,8	2,8	4,4	6,9	3,0	4,7	0,2	0,3	-		-		63,9
3	-	-	3,2	20,4	3,5	22,3	0,8	5,1	6,0	38,2	1,4	8,9	-	-	0,7	4,5	0,1	0,6	15,7
4	-	-	1,0	19,2	0,2	3,8	0,4	7,7	1,3	25,0	0,7	13,5	-		1,6	30,8	-		5,2
5	-	-	0,1	0,7	0,2	1,4	0,3	2,2	3,6	26,1	1,5	10,9	7,7	55,8	0,4	2,9	-		13,8
6	-	-	3,5	15,3	2,5	11,0	0,5	2,2	9,2	40,4	4,2	18,4	2,3	10,1	0,6	2,6	-		22,8
7	-	-	20,6	48,6	5,4	12,7	1,5	3,5	2,8	6,6	10,2	24,1	1,5	3,6	0,0		0,4	0,9	42,4
8	-	-	2,1	8,4	9,8	39,0	0,5	2,0	12,1	48,2	0,4	1,6	-		-		0,2	0,8	25,1
9	-	-	7,2	37,1	10,9	56,2	-		0,6	3,1	0,7	3,6	-		-		-		19,4
Total	-	-	89,0	39,8	48,3	21,6	6,1	2,8	41,2	18,4	23,0	10,3	11,7	5,2	3,3	1,5	0,7	0,4	223,3

Table 6. Presence of agro-zones in the motorway corridor

Section	Agro-zone						Total
	I		II		III		
	ha	%	ha	%	ha	%	ha
1	112,4	97,3	3,1	2,7	-	-	115,5
2	496,1	89,4	57,7	10,4	1,3	0,2	555,1
3	135,5	91,0	11,1	7,4	2,4	1,6	149,0
4	41,3	75,0	6,3	11,3	7,6	13,7	55,2
5	48,7	40,4	64,1	53,1	7,8	6,5	120,6
6	136,5	71,4	49,0	25,7	5,5	2,9	191,0
7	281,4	71,9	95,6	24,4	14,2	3,7	391,2
8	208,2	95,7	0,9	0,5	8,4	3,8	217,5
9	169,9	97,9	3,7	2,1	-	-	173,6
Total	1630,0	82,8	291,5	14,8	47,1	2,4	1968,7