Bosnia and Herzegovina

Ministry of Communications and Transport

PROJECT “CORRIDOR Vc MOTORWAY”

LOT No. 3 - Section Sarajevo South (Tarčin) - Mostar North

ENVIRONMENTAL IMPACT STUDY (EIS)

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LIST OF EXPERTS FOR EIS

1.0 NON-TECHNICAL SUMMARY

1.1 Purpose and objectives of the Project

The Corridor Vc motorway is a part of trans-European network of terrestrial corridors, connecting, with its ending points, central part of Adriatic Sea coast with Budapest in Hungary. Trough B&H, 330km-long Corridor Vc alignment is leading in direction north-south in the central part of the country (valleys of the rivers Bosnia and Neretva) which has the most favourable natural conditions.

Transportation Corridor Vc trough B&H includes:

- Road E-73 Šamac-Doboj-Sarajevo-Mostar-Čapljina-Doljani, exiting on Adriatic Sea in the port of Ploče with connection in Budapest at the north,
- Railway Šamac-Doboj-Sarajevo-Mostar-Čapljina-Metković
- Airports Sarajevo and Mostar,
- Navigation routes and ports on the rivers Sava, Bosna and Neretva.

UNDP from Geneva had launched an initiative and plan for improvement of European road network. Project comprised also the motorway Baltic Sea-Adriatic Sea (Baltic-Adriatic) named TEM.

On the third Pan-European conference on transport, representing countries of European Union and International Organisation on Infrastructure Development in Europe, held in Helsinki in 1997, adopted was the Helsinki Declaration that predicted a need for 10 additional pan-European corridors that also include motorways.

With that Declaration it had been also established directions of those 10 Trans-European corridors and their branches.

Route alignment through B&H was defined in the Item Vc of the pan-European Corridor (Budapest-Osijek-Sarajevo-Ploče). Connection of B&H with Europe is a decisive factor and Corridor Vc motorway construction has the same aim.

Purpose of this project is better connection of Bosnia and Herzegovina with the neighbouring countries and regions, what would at the same time enable stabilisation and support to the overall country development. Better transportation conditions bring better living and working conditions for the local population.

Bosnia and Herzegovina Council of Ministries has decided to construct the national section of the Pan-European Corridor Vc motorway. The B&H section of Corridor Vc is estimated to cost roughly 5 billions Euro.

According to that decision, the B&H Ministry for Communication and Transport launched an international Tender for the supply of consulting services for the "Preparation of Planning and Study Documentation (PPSD)" for the Corridor Vc, divided into 6 different Lots. The PPSD will aim at defining the optimal technical solution for Corridor Vc, its economic and financial feasibility and the most viable procedure for involving private financing in the motorway investment and management.

In order to facilitate the construction financing and take also advantage of the private sector efficiency, the Council of Ministries will also evaluate the recourses of Public-Private-Partnership (PPP) financing in the form of a DBOT (design, build, operate and transfer) to be established by the planning and feasibility studies of the Preparation of Planning and Study Documentation (PPSD) underway.

The Preparation of Planning and Study Documentation should confirm the economic feasibility of construction of motorway sections as well as the motorway in general, and to determine under which conditions this project will be profitable, so that the feasibility study can be used to examine the interest for concession for the entire route of the motorway through Bosnia and Herzegovina by launching an international competitive bidding.

The PPSD should also serve as background of request for issuance of urban planning approval for sections of the motorway.

Secondary goal is attraction of foreign investments, beginning of innovation cycle through starting construction works on several points, as well as development of supporting activities along the alignment of the motorway constructed.

Preparation intensification and beginning of construction of this motorway will be a key initiator of economic activities, enabling inclusion of B&H in the main transportation flows and global European economic system.

Motorway construction will enable efficient connection of Bosnia and Herzegovina with the neighbouring countries and regions and provide stabilizing and developing effect for the country. Improved transportation conditions will improve quality of life that will manifest through the following:

- reduction of transportation time of goods and passengers in comparison to the existing routes,
- reduction of transportation costs,
- reduction of negative environmental impacts through directing part of the traffic from the existing relevant network to the future motorway
- employment increase,
- valorisation of geographical and transportation position of B&H,
- increase of economy competitiveness in the area gravitating towards the Corridor,
- launching new projects and enlargement of private investments within the regional economy.

Environmental impact study, thus, represents one of very important segments of PPSD and enables comprehensive evaluation of the motorway project from the aspect of environmental impact.

1.2 Objectives of Environmental Impact Study

Environmental Impact Study (EIS) is aimed at systematic identification and evaluation of real and potential impacts of the proposed Corridor Vc motorway project on physical, chemical, biological, cultural, social and economical components of the entire environment. The base goal of EIS is to encourage incorporation of environmental aspects in planning and decision-making process, what eventually should result in more environmentally acceptable activities.

EIS is a process and a tool for project planning and decision-making.

Purpose of Environmental Impact Study is:

- Integration of environmental aspects in planning of development activities;

- Taking in account properly all environmental and other costs and benefits of economic development project;
- To provide avoiding or reduction of unexplainable negative impacts in early phase of planning process;
- Identification and strengthening of potential benefits from the project;
- Enabling preparation of environmental and social-economic studies along with analysis of technical and economic justification of the project;
- Providing decision-makers with all data on environmental cost, conflicts and benefits of the projects along with the data on its technical and economic justification in the key stages of project development;
- To insure project transparency;
- To insure involvement of all interested parties (local communities, government, investors, NGOs, donors etc.) in the EIS process;
- Establishment of mitigation of negative impacts and monitoring systems;
- Improvement of relations among the sectors ; and
- Preservation of social, historical and cultural values of people and their communities.

1.3 Socio-economical significance of the Project

Bosnia and Herzegovina is making great efforts in becoming a part of European and global economic and transportation system. One of the ways for achieving this goal is involvement in Pan-European transportation integrations. The first step on that path is made by verification of Corridor Vc through Bosnia and Herzegovina that will, in north-south direction connect B&H with Croatia and Hungary, meaning Central Europe. The road is to be routed via Osijek in Croatia and to cross into B&H over the Sava River, north of Odžak. The alignment through B&H will connect the major industrial centres of Doboj, Zenica, Sarajevo and Mostar.

Transport and the improvement of transport infrastructures generally have an important role for sustainable social and economic growth of the society.

Road transportation in Bosnia and Herzegovina accounts for over 95 % of all goods and passenger movement in the country. Efficient and low cost road transport is therefore essential to facilitate local, regional, and international trade and economic exchange. It is also an important factor in promoting integration of ethnically divided country. The development of road transport corridors in B&H is very important for the improvement of the population's standard of living and poverty reduction. The Corridor Vc construction is for many reasons deemed justified from the aspect of its social and economic importance. In the Corridor zone lives 50% of B&H population, making 60% of total GDP. Better conditions of transport services mean better living and working conditions for local population, what means improvement of social structure.

The new alignment will, thus, impact intensifying of many activities within the Corridor Vc motorway and wider area. Therefore, it is important to take care of real development prerequisites for the economic activities set as priorities in the Mid-term development plan of B&H, such as: agriculture, tourism, energy sector, wood processing industry, as well as of the prerequisites related to a local area, such as water management, electricity distribution and forestry that demand special attention. It will also enable more adequate utilisation of natural and created, as well as cultural-historical values of the area.

Transport provides intermediate services to facilitate interactions between productive activities. The micro-economic mechanisms through which the benefits of transport investment are turned into income growth are quite well recognized. Transport investment reduces the cost of assembling inputs for production (raw materials, energy, labour, other intermediate products, and information) from different locations, directly reducing the cost of production. Reduced production cost and improved quality in transport services also reduce the delivered price of products and hence promotes regional and international trade, making it possible for agriculture to commercialise, for industry to specialize, and for production and employment to expand by exploiting different economies.

Transport investment contributes to economic diversification as well, which enables exploitation of economies of scope and increases the economy's ability to handle risks. In a multitude of ways through these mechanisms, transport contributes to economic growth.

The development of Corridor Vc motorway will have an impact on the various aspects of economy on local, regional and national level. The development of economy here is related to better road connection and consequently to the improvement of economic and social environment. The improvement of traffic connection will occur on inter-municipal, inter-regional (canton) and national level, as well as on international level, taking into consideration the realisation of the whole Trans-European Corridor Network in future.

The Corridor Vc motorway alignment is a new capital development possibility that will, in the forthcoming period, takeover the role of economic development generator. The motorway, will not only enable more adequate use of natural and created resources of this area, but will also enable structural transfer and development of those functions and activities that are compatible to the motorway and have immediate impact to economic development.

Considered area in the Corridor Vc is seen as an area over which the European flows of people and goods are channelled. This area is also seen as the area of intensive development of numerous economic activities and cooperation with the neighbouring production and consumer centres, what will enable the area covered by the Lot 3 to become one of the more developed parts of B&H, as well as important development initiators and holders of general Bosnia and Herzegovina economic development.

Area in the Corridor will be connected to other tourism and agriculture areas that are leading in degree of common investments of domestic and foreign partners.

The Corridor will also obtain economic development of the wider area along its entire length. In that way, the living conditions and population standard will reach the level of developed regions, meaning European Union countries.

1.4 Description of the environment that could be affected by the Project

1.4.1 The affected population

The affected population corresponds to the population in the direct and indirect area of influence. While effects on the population living in the vicinity of the motorway to be constructed are mostly negative (impacts due to noise and air pollution), effects on the population in the indirect area of influence are anticipated to be positive due to better transport services and cost and timesaving.

The population in the indirect area of impact has been defined to be the population in the municipalities crossed by the motorway.

Table 1 Population in the area of indirect impact

MUNICIPALITY	TOTAL
Jablanica	13,065
Konjic	30,040
Mostar-total	105,454
Hadžići	20,169
Total - Indirect Area of Influence	**168,728**

According to the corridor defined for the area of direct influence (2km-wide strip), the proposed alignment affects directly the population of the settlements, villages and towns. The villages and settlements directly passed by the adopted Alignment 3 are presented in the table below and accordingly the total number of people living in the area of direct influence is about 22,000.

Table 2 Population in the area of direct impact

<table>
<tr><th>FROM KM</th><th>TO KM</th><th>LENGTH (KM)</th><th>NAME OF SETTLEMENT / VILLAGE PASSED</th><th>POPULATION</th></tr>
<tr><td rowspan="4">0+000</td><td rowspan="4">1+825</td><td rowspan="4">1.83</td><td>Tarčin</td><td rowspan="4">2,245</td></tr>
<tr><td>- Do</td></tr>
<tr><td>- Smunica</td></tr>
<tr><td>- Vrbanja</td></tr>
<tr><td rowspan="3">2+750</td><td rowspan="3">6+000</td><td rowspan="3">3.25</td><td>Raštelica</td><td>811</td></tr>
<tr><td>Vukovići</td><td rowspan="2">2,649</td></tr>
<tr><td>- Džanići</td></tr>
<tr><td rowspan="5">7+250</td><td rowspan="5">9+325</td><td rowspan="5">2.08</td><td>Ivan Sedlo Area</td><td>639</td></tr>
<tr><td>Bradina</td><td rowspan="4">1,448</td></tr>
<tr><td>- Gornja Bradina</td></tr>
<tr><td>- Polje</td></tr>
<tr><td>- Gradac</td></tr>
<tr><td rowspan="14">12+375</td><td rowspan="14">23+825</td><td rowspan="14">11.45</td><td>Podorašac (km 12,3-15,…)</td><td rowspan="8">1,487</td></tr>
<tr><td>- Ribići (km 13.5)</td></tr>
<tr><td>- Vrbljani (km 14.5)</td></tr>
<tr><td>- Podkanjina (km 15.5)</td></tr>
<tr><td>- Kanjina (km 16)</td></tr>
<tr><td>- Borovac (km 16.5)</td></tr>
<tr><td>- Živašnica</td></tr>
<tr><td>- Ovčari (km 17.5-18.5)</td></tr>
<tr><td>Donje Selo Area (up to bridge over Lake Jablanica)</td><td rowspan="6">1,288</td></tr>
<tr><td>- Repovica (km 19)</td></tr>
<tr><td>- Galjevo (km 18)</td></tr>
<tr><td>- Čovici (km 18.5)</td></tr>
<tr><td>- Jurići (km 20)</td></tr>
<tr><td>- Gredina (km 19.3)</td></tr>
</table>

FROM KM	TO KM	LENGTH (KM)	NAME OF SETTLEMENT / VILLAGE PASSED	POPULATION
			- Cerići	
			Pokojište	285
24+075	31+250	7.18	**Čelebići (km 24.07)**	1,416
			- Matići	
			- Ušanovići	
			- Seljani (km 26.75)	
			Ostrožac (km 31)	1,525
			- Zakaljača (km 28)	
			- Vode (km 28.5)	
			- Ribići (km 28.7)	
			- Ćosići (km 29)	
			- Osište (km 30)	
			- Jasike (km 29.8)	
32+175	34+500	2.33	**Jablanica**	5,954
			- Dobrigošće	
			- Donje Paprasko	
			- Gornje Paprasko	
			- Donja Jablanica	
39+000	42+625	3.63	**Djevor**	1,282
			- Glogošnica	
			- Šanica	
50+375	52+750	2.38	Bijela	400 *
53+125	53+750	0.63	Grabovica	200 *
54+500	60+000	5.50	**Mostar North Area**	500 *
			- Lajpur	
			- Zeleni Dol	
			- Bresnica	
			- Vala	
			- Lijeska	
			- Makanovina	
TOTAL				**22,129**
** = estimated population*				

1.4.2 Climate and meteorological characteristics

In the project area, the yearly average **temperature** ranges from 7.2 °C (Ivan Sedlo) to 14.6 °C (Mostar) with absolute maximum of 33.6 °C (Ivan Sedlo) to 40.8 °C (Mostar) and absolute minimum of –26.2 °C (Ivan Sedlo) to –10.9 °C (Mostar).

The **precipitations** in the area are recorded at 11 rainfall stations. The average number of rainy days on the project area varies between 117 per year in Sarajevo, 170 days at Ivan Sedlo, up to 134 days in Mostar. The annual precipitations are ranging from 1,000mm (Sarajevo) up to 2,300mm (Grabovica).

Snow is the heaviest during the winter time, and there is not snow at all from June to September. Snowing regime varies by the different areas. Average yearly number of days with snow cover ≥10cm is increasing with elevation above sea level and it is, therefore, smallest in Mostar (1.6 days) and highest on Ivan Sedlo (76 days).

In the area of Hadžići, this number amounts to 50 days and than, through the river Zujevina river, over Tarčin and further to Ivan Sedlo, the number of days with snow cover ≥10cm is gradually increasing, 8 days more on every 100m.

Number of days with snow cover ≥50cm is ranging from 0 in Mostar, over 1.9 in Konjic, up to 19 on Ivan Sedlo, while, going from Ivan Sedlo to Hadžići, it is decreasing to 5 days.

The Mostar city area is extremely **wind**y. Calm weather lasts over only 20% of the year, while windy weather lasts over 80% of the year. Average annual strength of wind is force 3, e.g. approximately 4m/s. Extremely predominant wind is the wind of the north quadrant known as “bura”. Within the year, during 170 days there is presence of a strong wind and during more than 50 days there is a storm wind.

In the wider region of Salakovac 50% of the year is windy. There are mostly winds of the north quadrant; the second by appearance frequency is south wind. The average speed of wind is 4m/s.

North wind predominates in the larger region of Grabovica, and secondly, a wind from the south quadrant. Wind blows during more than 60% of the year and the strength of wind is 3 degrees by Beaufort scale or 4-5m/s. There is a strong wind over 100 days per year. In this number of wind appearance the storm wind lasts over 30% of the year.

Winds from direction of the southeast and the northwest predominate in the region of Konjic, while other directions are less present and they are only a result of a daily wind alternation. Wind takes less than 30% of an average year, and calm weather takes more than 70%. Average strength of wind is a force 3.

During 95% of a year there is a wind on the top of Bjelašnica, and calm weather is during only 5% of the year. Winds from the north and the south quadrant are predominant. The north wind is a force 6 in average and south wind is a force 7.

Eastern as well as west winds predominate in the region of Sarajevo, while other directions are less present and they are only a result of a daily wind alternation. Within average year, calm weather takes less than 30%, and a wind more than 70%. Average wind strength is approximately 3 degrees of Beaufort scale.

1.4.3 Geology and Hydrogeology

The geomorphological composition of the ground along the terrain under consideration is very much diverse and morphometrically uneven due to great variations in the lithofacial composition of geological formations, complex tectonic relations, neotectonic activity and different behaviour of rock masses in the surface weathering zone under the action of exogenous agents. Based on this, it can be established that the geomorphological composition along the corridor under consideration varies in terms of time of origin, composition, strike direction, spread, form and height, which is from the engineering-geological perspective, extremely important for the accurate categorization of the investigated area according to the degree of complexity of the engineering-geological conditions.

Generally, about 90% of the investigated area accounts for the highland-relief, with altitudes of up to 500m and over 500m, while only about 10% of it accounts for the lowland-relief, with altitudes of up to 500m.

In the studied area all rocks can be divided in two main groups: hard and soft rocks and cohesion-less soils.

Hard rocks make large area at the studied zone, occupying north and south parts. They form stabile parts of the terrain.

Soft rocks occupy the central area. Soft rocks and soils form stabile-conditionally stabile and unstable parts of the terrain. Solis-detritus are generally shallow, small thickness. Due to linear character of the structure; the majority of the alignment will be placed in it.

The erosion processes have been registered within the Neogene and Verfenian polyfacial complex and in Triassic dolomites.

Based on the analysis of the ground composition along the corridor under consideration, its morphological and morpho-metric characteristics, the following ground categories can be identified from the stability perspective: stable ground, conditionally stable ground and unstable ground.

The stable ground has been identified in the major part of the motorway alignment, in low-land parts of the terrain, on flat saddles, on hilly-mountainous terrains composed of hard carbonate rocks of Mesozoic period and in other lithofacial areas with substratum on the ground surface or the surface cover less than 2m-thick. It is estimated that about 50% of the road alignment accounts for this category.

The conditionally stable ground is present in sloping areas where on the surface there are Quaternary covers of eluvial-deluvial and deluvial origin, composed of sandy clay, mixed with the underlying substratum debris and thick deposits of debris in the foots of steep slopes.

The unstable ground is found in the zones of identified dormant and active landslides, where morphological setup of the sliding process is less expressed. Such phenomena are easy to identify on the aerial photographs by their characteristic geometry and undulating ground. These are the areas where the sliding process could be re-actuated during the execution of earth works.

The largest part of the zone passed through by the adopted alignment belongs to the Neretva river water stream basin, e.g. to the Adriatic Sea basin. North and Northeast parts of the Lot 3 area belong to the Bosnia river catchment (e.g. to the Sava river and Black Sea basin). Watershed between these two catchments is orographic, placed on the mountain Ivan. From the ecological aspect, waters of the upper river courses are clean. Due to dissolved limestone, the waters are hard. Although being abundant with water, this area if known as “dry and thirsty” area. The main reason for this is uneven precipitation distribution, in spite of the fact that they amount to 1,500 mm (almost 50% more than average in B&H).

All underground waters and surface streams are directed towards the Neretva river canyon, as the deepest erosion basis of the considered zone. From the right side the Neretva river accepts Trešanica near Konjic, Doljanka near Jablanica, and downstream Diva Grabovica and Drežanka. The more important left affluent rivers are: the river Bijela (Konjička), the river Idbar, Glogošnica and Mostarska Bijela. On the Neretva river, three hydroelectric power plants (HPP) have been built: HPP Jablanica, HPP Grabovica and HPP Salakovac.

Underground water exposures temporary and perennial springs in the north part of the studied area are mostly of the less capacity, seldom exceeding 10 l/sec, what indicates that in the considered area there are not significant accumulations of the underground water.

1.4.4 Flora

Bosnia and Herzegovina has not yet prepared a Red Book of Flora, but only the List of rear, endangered and endemic vegetation species (Šilić1996), according / IUCN 1983,1994/.

As a vegetation decoration we can frequently find Mistletoe. In the lower strata we can find Raspberry, while on the meadows, pastures, along a forest margins and near the streams we find various endangered, sensitive and attractive plants as well as the species that did not inhabit these areas before (neophyte).

At the station near Konjic, i.e. in the parts close to the tunnel, through dolomites, characteristic is drastic degradation of thermophile deciduous forests.

Going towards Jablanica water reservoir, there are Herzegovina forests of Hungarian Oak and Bitter Oak.

Going further south towards the part surrounded by Herzegovina mountains: Prenj, Čvrsnica and Čabulja which belong to the High Prenj area, it is necessary to mention endemic stands of sub-mountainous White-bark Pine appearing on the mountains close to the Neretva river. It also appears in different ecosystems of distinguished phytocenosis of White-bark Pine.

In the wider surrounding of Middle and Upper Neretva canyon, according to recent authors (Lovrić et al., 2002) mentioned are more important thermophile plant species. In the limestone rocky areas of karst in sub-Mediterranean zone there are stands of Welden's Laburnum, protected by Law on forest protection of F B&H 02.

With its ending part (connection point to Lot 4) it is entering to sub-Mediterranean part, characterised by communities of Downy Oak and Oriental Hornbeam. Communities of Viper Grass and Gold-beard Grass are connected to sub-Mediterranean and Mediterranean -mountainous area, e.g. the area of Downy Oak.

1.4.5 Fauna

Different habitat types are present in the area of future motorway section: groves, meadows, rocky grounds as well as several types of aquatic habitats.

In respect of habitat variety, there is a large number of different faunistic species what makes the area extremely rich in sense of biological variety and very vulnerable and sensitive in respect of any future fragmentation of the area.

Reptiles

In a wider area of the future motorway fauna of reptiles is relatively abundantly represented. Thus, in this document only the most typical representatives are presented.

Amphibian

Out of amphibians, there are: Lake Frog, Green Toad and Black Salamander as a remaining of ancient glacial fauna.

Fishes

In a wider surrounding of the researched area of the future alignment, especially on the foothill of Prenj massif, the Neretva river, as a main receptor of all surrounding waters, as well as artificial water reservoirs (Jablaničko Lake, Grabovičko Lake and Salakovac) are characterised by specific piscine fauna with few endemic species characteristic only for Adriatic Sea catchment. Family /Salmonidae/-

out of trout, there is Soft-mouth Trout and Marble Trout that are endemic and Brown Trout, as well as an introduced Grayling and Bull-head.

Mammals

Particular importance among the mammals is given to big carnivores, such as Wolf and Brown Bear. It is also important to mention Chamois.

1.4.6 Protected parts of nature

According to the Law on nature protection (Official Journal FB&H, 33/03, Article 27 and Article 30) the motorway's 2km-wide corridor (analysed corridor) encompasses the area protected by the mentioned law.

Mountainous area of Prenj, Čvrsnica and Čabulja, with the river Neretva, by the strictest scientific criteria, represents an extraordinary natural value. Geomorphologic characteristics, hydrological specificity, glacial phenomenon, flora and fauna with great number of endemic species are just a part of values, ranking this area high at the scale of strict criteria for proclamation of this area to be the National Park.

Presently, this area has a status of important space of natural heritage (parks of nature Prenj, Čvrsnica, Čabulja). According to the Article 30 of the Law on protection and use of cultural-historical and natural heritage (Official Gazette SR B&H, 20/85) each asset recorded as a natural heritage has got a treatment of protected asset.

By the Law on physical arrangement (Official Journal FB&H, 52/02, Article 16 and Article 80) and the Law on nature protection (Official Journal FB&H, 33/03, Article 27 and Article 30) the proposal was given for establishment of the area ″Prenj-Čvrsnica-Čabulja″ as an Area of importance for Federation of Bosnia and Herzegovina, as well as declaration of the area to be protected area, e.g. National Park.

By the Draft of the Spatial plan of Bosnia and Herzegovina for the period 1981-2000, cave Kuhija received the status of natural heritage.

1.4.7 Noise

On base of the traffic data along the present M17, the calculated theoretical noise level for the different road sections are:

Table 3

Section		Average traffic (veh/h)	Average speed (km/h)	Leq dB(A)			> 50 dB(A)
				25 m	50 m	100 m	m
Tarčin	Konjic	297	45	60.95	56.09	51.23	115
Konjic	Ostrožac	264	45	60.49	55.63	50.77	110
Ostrožac	Jablanica	290	45	60.85	55.99	51.13	115
Jablanica	P. Jablanica	250	45	60.27	55.41	50.55	105
P. Jablanica	Potoci	250	45	60.27	55.41	50.55	105

On base of those data the present main noise critical areas, in the sense of areas with human sensitive receptors (as residential buildings, schools, hospitals) far less of 50 m from the present M17 alignment, are:

- Isolated buildings along the road near: Smucka and Prosnica; Donja Raštelica; Rosulje; Lijeha; Jabuke; Šiljovine; Okruglovača; Podorašac; Živašnica; Lokve; Ostrožac; Donje Seline;
- Settlement areas in correspondence of Vukovići; Barakuša/Njiva; Bradina; Kartinac; Česme/Kruševica; Radešine; Prisoje/Bašča;
- Urban system areas of Konjic; Čelebići/ Vrtla; Jablanica.

1.4.8 Landscape

The main landscape elements of the analyzed area are:

- Natural system (forest);
- Human-created system (agricultural land, settlements and infrastructures)

The settlement system is deeply connected to the transportation system and, trough this, to the natural morphology.

In general, the landscape of the interested area looks like being in continuity and unified with the present natural environmental characteristics. Therefore, this landscape is in a very sensitive balance with characteristic values (natural and human-created).

1.4.9 Game and hunting

The alignment of the TEM-Corridor Vc in the area of Bosnia and Herzegovina is passing over the areas different to each other by natural characteristics. The hunting areas formed there are occupying different biotopes inhabited by a stable wolf and bear populations on the top of the food pyramid, as well as of Balkans chamois sub-species.

By the Law on hunting that is based on the ownership principles, hunting economy is defined as one of the land use categories, complementary to agriculture and forest management. This is particularly important in the wider area of the motorway where all the three activities are in a very important interactive relationship.

The wider area, cut by numerous natural watercourses and other water elements, with abundance of forestland and other natural features is very quality for hunting and hunting economy.

In the Project area, the hunting areas have been established on the territorial principle within the municipal boundaries, as formed after the Dayton Peace Accord, as follows:

- In the area of Hadžići municipality:
  Hunting area ″Ormanj″ (11,388 ha)
- In the area of the municipalities of Konjic and Jablanica:
  Hunting area ″Tetrijeb″ (27,600 ha)
- In the are of Mostar north:
  Hunting area ″Divojarac″ (50,000 ha).

1.4.10 Cultural-historical heritage

Favourable natural and geographical conditions in the wider area of the Neretva River are, positively, the main reason why, in that area, we can follow continuity of people settlements from ancient times until today. Numerous material remaining witnesses about that - both so far discovered movable findings and small archaeological material and existing ‘in situ’, remaining of architecture heritage, cult or tombstones.

As an illustrative example we can state that bigger number of archaeological localities processed in this Study represent **multilayered** sites, on which it is sometimes possible to find above-ground structures – more or less preserved assets of **architectural heritage** or **tombstones**. After ubicating the certain elements, it is possible to outline specific areas of spatial continuity, with noticeable extremely high concentration of individual, dot-distributed sites, remaining of architectural heritage and cemeteries from the different periods. It clearly proofs that these zones, during different time periods, were continuously being a places where people were living, building, respecting their cults and dying.

Having that in mind, it is logical that, apart diversity in **chronological categorisation** of material remaining, in the considered zone we can register also the most different **kinds of cultural heritage** – from archaeological localities, over cemeteries and necropolis to individual objects of architectural heritage.

Also, concentration of material remaining is not even in different areas - it significantly varies by zones. Thus, for example, in the Neretva river valley, within the alignment section passing through Donje Selo, Breber, Pokojište, Čelebići, and close to Orahovica, Ribići, Radešina, Ostrožac, we found significant spatial presence of heritage property. However, in the zone of Mostar North, encompassing the Suhava river valley, southwest slopes of Prenj and the river Bijela valley, the motorway is mostly avoiding settlements. Therefore, it is logical that no architectural monuments or other historical structures exist in the area of consideration. In the tables enclosed, one can easily follow very uneven spatial distribution of heritage property along the alignment sections, as a result of geographical heterogeneousness and natural specificities of micro-regions that consequently cause the different genesis of human settlements from prehistory until today.

1.5 Main potential environmental impacts

1.5.1 Social impacts (population and settlements)

Impacts during construction period

The investigation on the socio-economic status along the motorway shows that direct impact on population is a critical issue related to indirect impacts on residential areas as noise, impacts on landscape, historical and archaeological sites and impacts on air quality.

The further analysis of impacts on the socio-economic environment during the construction period presented hereinafter included the field analysis and the consultation of literature, statistical data and other reports and documentation. The potential impacts of the road project on the socio-economic environment during construction period have been identified and analysed regarding: *type of impact* *(positive or negative); nature of impact (direct of indirect); magnitude and significance (low, medium, high etc.) extend/location of impact.*

The indicators evaluated for the construction period are:

1. Population and settlements:
   - *Impact on settlement development prospects*
   - *Population directly affected by construction works*
   - *Resettlement/ displacement of people*
2. Social structure and cultural values
   - *Social disturbance*
3. Property values
   - *Removal of houses and other buildings*
   - *Loss of agricultural land*
4. Safety
   - *Accidents due to construction works/machinery*
5. Economic development

Impacts during operation period

The analysis of impacts on the socio-cultural environment included the field analysis and consultation of literature, statistical data and other reports and documentation. The potential impacts on the socio-economic environment during operation of the motorway have been identified and analysed regarding: *type of impact (positive or negative); nature of impact (direct of indirect); magnitude and significance (low, medium, high etc), extend/location of impact*

The indicators, which have been evaluated for the operation period, are:

1. Population and settlements:
   - *Population directly affected by motorway operation*
2. Social structure and cultural values
   - *Social disturbance*
   - *Impacts on cultural heritage sites*
3. Access to public services
   - *Improved access to education facilities, health facilities, transport, urban centres*
4. Safety
   - *Reduction of accidents due to upgrading of road and improved design*
   - *Increasing number of accidents due to increasing motorisation and travel speed*
5. Economic Development

1.5.2 Impact on air quality

The proposed motorway will strongly reduce the air pollutant caused by traffic on M17. In fact, the emissions of M17 in 2013 with construction of new road will be like 30.95% of present emission for PM10 and like 31.05% for the other pollutant.

It represents a very important improvement for local population since M17 crosses the urban settlements and the villages actually affected.

However, an increasing air pollution can be expected along the forest and agricultural areas crossed by the new road. The computed emissions for the new road are lower that the present emission of M17 for all pollutants except for NOx. The values are not so high to expect any remarkable impact on plants present in the predicted National Park area.

At the same time, by adopting the Law on air protection in Federation of B&H (Official Journal of FB&H, 33/03) and implementation regulations related to this Law, significant improvement can be expected in the system of air quality management. It is also expected that air pollutant emissions will be decreased in the coming period, as a result of engine technology development and decreased fuel consumption, optimised combustion and treatment of exhauster gases in catalytic converters. In addition to the mentioned, legal limitations will be changed, i.e. diesel will be forbidden as a fuel for motor vehicles from January 1, 2010 if the content of sulphur per weight is higher than 0.2%, and from January 1, 2015 if the sulphur content is higher than 0.1%. Lead emissions will decrease as a result of lead-free gasoline use, as prescribed by the Law on air protection. This law will forbid use of leaded gasoline from January 1, 2010.

1.5.3 Impact on geological environment

During the field research (core drilling and geophysics) there were found the zones of geologically unfavourable characteristics for foundation of specific structures. One of these sections is the section in the village Džanići-borehole S-03. On this borehole, in the interval from 15.3 to 18.0m, the drilling tool has dropped due to cavern and mud occurrence. These findings caused the alignment dislocation. Apart that, it is necessary to mention the landslides, which in relation to the alignment length have a small spread. Most of the landslides are in a wider area of Donje Selo, in polifacial Neogene complex.

Majority of these occurrences is characterised as dormant landslides. Based on this fact, active and potential endangerment in the motorway construction phase has been defined. In the case of linear structures, depending on the alignment position, the dormant landslides should be treated as unstable areas

Talus is widely spread and was formed at the steep slopes. Talus – colluvium, in respect of stability under natural conditions are in status of limitation balance. Therefore, cutting and loading of such terrains can cause instability occurrences, especially in the river Bijela canyon.

In carbonate rocks that are more tectonically damaged and cavernous, e.g. in fault zones, possible are occasional short-lasting penetrations of significant quantities of underground water in the tunnels. It happens in a certain hydro-geological periods, with estimated quantity of 10-100l/sec, but generally underground water level is lower than the motorway grade line.

1.5.4 Impact on water

Opening of the big construction sites always has some negative environmental impacts. Certainly, Contractor must comply with all technical regulations, especially in respect to the water. Fundamental requirement is to avoid endangerment of underground and surface water quality which would have permanent consequences to water supply systems, as well as to flora and fauna of open watercourses.

Also, it must be taken care of the excavated material in order not to endanger a flow profile of the open water courses. Similarly, during the bridge construction, strict attention must be paid to both temporary and permanent protection of the open watercourses.

During the motorway operation period, adequate measures for pollution prevention of both surface and underground waters are the primary task. Technical solution must provide precipitation water treatment (which are polluted by heavy oils and lead and washed of the pavement) so it wouldn't contaminate natural water streams.

1.5.5 Impact on flora

The evaluation of the impacts on the relevant area was carried out in respect the following factors: 1) the impact on the whole natural system along the land corridor and 2) the potential impact on plants and habitats (during the different construction stages).

Impacts during the construction period

The main direct impacts are represented by the cutting and destruction of vegetation cover both in the areas where the motorway passes through and places of the construction sites operation, as well as at the material storage places.

However, there will be many indirect impacts: damage to vegetation caused by different agents (oil, oil derivatives from heavy machinery, different chemicals and other waste, as well as dust from basement excavation- both where the motorway runs parallel to the ground and where viaducts will be constructed-vaporizing organic compounds during the motorway asphalting), increased impact of air pollution on the surrounding vegetation, contamination of the vegetation in the watercourses, possible negative effects on the water-bearing layers following the tunnel construction, possible fire etc.

Impacts during the operation period

A series of impacts were identified, such as permanent impact of air pollution due to the traffic and its consequences on the neighbouring or farer surroundings; reduction of land quality along the motorway (quality status of pastures, orchards and surrounding forestlands), with negative effects on the vegetation thinning out and reduced biodiversity within the area near the motorway; constant danger from the leaking out of oil and oil derivatives (especially in case of accidents and fire).

1.5.6 Impact on fauna

The evaluation of the impacts on the relevant area was carried out in respect of the following factors: 1) the impact on the whole natural system along the land corridor and 2) the potential impact on animal species and habitats (during the different construction phases).

Impacts during the construction period

Reduced biodiversity of fauna along and around the area of interest (as a consequence of the destruction of habitats, disturbance of ecological balance, the interruption of the natural corridors used by fauna, the visual impact of the construction work and the noise produced), impact on water fauna of the watercourses, on pedofauna (small animals living in the soil), impact of tunnel construction on possible underground fauna**.**

Impacts during the operation period

Impacts can be summarized as follows: injuring and killing of animals due to traffic, noise, air and water pollution, reduced biodiversity in the area near the motorway.

1.5.7 Impact on protected parts of nature

According to the Law on the nature protection (Official Journal FB&H, 33/03, Articles 27 and 30) the motorway Vc 2km-wide corridor (the analysed corridor) covers also the area protected by the mentioned law.

The motorway alignment's south and middle parts are passing through the area proposed to be pronounced a National Park and which currently have status Park of nature. The alignment is passing close to the Kuhija cave.

Assumed negative impacts are minor, since the alignment in this area is mostly passing through the tunnels.

1.5.8 Impact on noise

Impacts related to the noise during the construction can be considered from two aspects:

- Noise produced by equipment at the construction site during the construction works (heavy machinery, possibly blasting at tunnel construction sites) such as works in borrow pits and quarries;
- Noise produced by the machinery and trucks in relation to the construction works.

As presently there is no information on the work areas, equipment and work schedules available, it is not possible to make predictions on construction site related noise emissions and possible impacts on communities.

In the operational period, the insertion of the new motorway alignment (in 2013) will involve two different situations:

1. Reduction of the noise levels, due at the reduction of the traffic flow along the present M17 alignment. In fact, the average traffic will be reduced from a maximum of 297 vehicles/ hour to 112 vehicles/ hour in the section Tarčin – Konjic and from a maximum of 250 vehicles/hour to 24 vehicles/ hour in the section P. Jablanica – Potoci. This traffic reduction involves a noise levels reduction that will upgrade the noise pollution situation of the present M17 alignment.
2. The traffic increase on the new alignment will cause pollutant noise emissions in some areas that now don't have this kind of problem (rural areas, natural zones), due to the assumed maximum average load of 477 vehicles/hour (section P. Jablanica – Potoci). On base of the foreseen noise levels, the main critical humans' receptors are these localised far less than 100 m from the alignement.

1.5.9 Impact on landscape

Impacts during construction period

Besides the landscape changed by the new structures, erected during construction, also construction activities impact the scenery, however only temporarily. During the construction work of the project, some areas will be temporarily used for implementing the construction sites and for the road works. Although only temporary used, the areas will lose their cover vegetation, the soil productivity and the original morphology.

Localized significant impacts on the scenery are most likely to occur at construction sites of interchanges, bridges, viaducts and the tunnel entrances. In fact, local borrow areas, storage and dumping of surplus excavated material will also have an adverse impact on the scenery.

Furthermore, the construction work will bring about a series of unfavourable impacts on landscape, among which, the following two points are the most prominent:

- The temporary camps of construction workers, construction access road and construction sites will damage the existing landscape in the areas, affecting its harmonization and producing visual disfiguration;
- Noise, dust and wastewater generated from construction works and construction vehicles will pollute the local roads and buildings, thus affecting landscape and sightseeing.

Impacts during operation period

While establishing the layout of the motorway the maximum attention should be paid not to divide and not to interfere with the valley settlement and agriculture systems, as well with natural system of the hilly and mountain areas.

The landscape system of the valleys is very delicate. This is the result of the old and permanent culture of the local communities; that is a combination of residential settlements, cultural-historical heritage, agriculture activities and natural vegetation. Also, after having suffered remarkable transformations and intense processes of decline, those areas represent a decisive factor for the development of a sustainable local economy. This is because they guarantee the environmental quality and development and they can help the tourism economy.

The other principal resource of this territory is represented by the natural systems of the forest areas and of the river habitats. For those ecosystems the motorway insertion is a factor of high risk. Then the alignment and its structures will have to be evaluated on base of the general impacts on the landscape, especially in the way of its ecological efficiency.

1.5.10 Impact on game and hunting

The impact on the hunting areas will be expressed by greater or smaller reduction of hunting surface in the specific hunting areas.

Total reduction of the hunting area along the entire alignment (for the zone of 300m) amounts to 2,212ha.

Furthermore, a negative impact is present in the hunting areas unfavourably cut in two or more fragments by the motorway in a way that the remaining part can not be efficiently included in the main hunting area. If the surface of the separated part is larger, it is necessary to obtain a good connection between such parts. This kind of negative impact exists to a certain measure in almost all hunting areas.

Apart the direct loss of the hunting area due to the motorway itself, one has to have in mind also the areas of fenced in protective strip along the motorway, not encompassed by the hunting area. Furthermore, the motorway is directly disturbing ecological conditions of the habitat, determining numerousness of the game that can inhabit the considered area without having bigger impact on environment and other animal species.

In the other hand, the motorway alignment is cutting centuries-old natural migration paths of some game. In that respect, the most important is chamois which is, biologically and ecologically characteristic by having tenths and hundreds of kilometres wide movement area. Since the best habitats of this game are located on the mountains Prenj, Čabulja and Čvrsnica, and since this game seasonally leaves them, it is very important to determine their migratory routes.

It practically means that, after the final alignment is set out, it will be necessary to redefine the existing hunting area boundaries, in order to maintain them as one rounded continuous entity.

Generally, in case of the motorway passing through the hunting areas, especially through the enclosed hunting areas and game rising areas, there are the following problems: game migrations (daily and seasonally), game disturbance, physical endangerment and theft. There is also a problem of game injuries due to the traffic, which will exist in spite of fence installation.

Impact on the game will result in decreased living area (habitat surface, surfaces for feeding, watering and movement) and more difficult communication during daily and seasonal migrations.

Gas stations, e.g. rest areas do not bring major negative impacts on the game, although they should not be designed near bigger watercourse complexes.

1.5.11 Impact on cultural-historical heritage

Potential negative impacts

For quantitative and qualitative evaluation of negative impacts on identified property due to the motorway construction and operation, relevant are the following data:

- Spatial relationship-closeness to the alignment (distance measured in horizontal and vertical direction);
- Kind of property (above-ground structure, underground structures and findings);
- Property condition (good, structurally unstable etc.);
- Kind of the motorway structure (tunnel, bridge, viaduct etc.).

Among the mentioned information, cultural heritage vulnerability is strongly determined by distance from the motorway. Therefore, we have defined "the highest risk" strip – the first zone of impact, determined by physical contact and by range of all kinds of physical, dynamic and chemical impacts that can cause material degradation. That strip is also determined by possibility of direct contact and identification within a joint view ("visual pollution") and devastation of cultural-historical ambient (character). The "high risk" zone encompassed the zone of 200-300 m on both sides of the motorway alignment, depending on the specific terrene morphology, kind of the motorway structure and property kind.

Generally speaking, the negative impacts on the registered assets can be divided in two main groups:

- Impacts on physical structure-material degradation
- Impacts on aesthetical/visual quality, historical and cultural character of the property.

Conditionally, the third group of impacts can be also defined, which, by mechanism of its degradation can belong to each of the mentioned groups. It would include an impact on ambient and environment that is frequently an integral part of heritage property. This is particularly important in cases of natural, architectural or rural entities, or vernacular architecture, since space quality results from natural and artificial component and/or their full complementation.

The most potential and the strongest negative impacts in the "risky zone", during construction period are the ones directed to degradation of physical composition of a recorded property. During operation period, however, relevant are negative impact belonging to the second group, related to a visual quality, historical and cultural character of property, locality or entity. Damaging effects in operation period are getting their weight in archeological observation. If we take in account a time factor, we can conclude that long-term motorway operation can cause effects that are initially harmless, becoming more and more serious in time.

It is important to mention that all statements concerning possible negative impacts on a recorded or categorised property are also applicable on so far unexplored and non-recorded property. Possibility of discovering new archaeological sites during construction works is not small, thus, this segment is separately treated in the chapter on mitigation measures and recommendations.

Positive impacts / potential improvements

Evaluation of positive impacts was not done in detail for each individual case, since potential improvement of the heritage status, conditioned by the motorway construction does not require design solutions that are the scope of this Project. In addition to a detailed analysis, evaluation and elaboration, this evaluation can be used as an input and base for some aspects of future development, spatial and urbanistic plans or other projects.

Positive effects are, generally, expected during the motorway operation period.

One of the most important positive effects is *physical accessibility*.

Major part of the registered cultural heritage localities is presently accessible only through long and tiring local roads of low category.

From the aspect of heritage preservation, non-existence of communications have a negative implication, since it can cause development stagnation, increased migration of younger population and be favourable to absence of any control by the bodies authorised for protection. Villages in picturesque natural environment, in vicinity of medieval tombstones and remaining of fortification structures, thus, usually just vegetate, weakening economically, what is very far from principles of revitalisation and modern integrated protection.

In the settlement zones, the motorway construction will certainly cause development of service activities, catering, trading and other supporting activities. That makes the second positive effect-*economic development effect*.

Economic strengthening and general social-economic development of the area are directly proportional to the operational aspects of promotion, popularisation and presentation of cultural-historical heritage. If we intend to actively protect a cultural property, to include it in a modern living, to present and to use it, we have to ensure appropriate economic base and environment, as well as tourist attractions for the visitor/user.

The third effect is the *information and communication* effect.

1.6 Main mitigation measures proposed

1.6.1 Population

Population and settlements:

Impact on settlement development prospects:

- Measures should be planned prior to commencement of construction works and in order to establish new communication structures for settlements where traditional ways of communication are interrupted by the motorway. This could be done through the provision of overpasses/underpasses;
- The municipalities/towns with motorway intersections (Konjic and Jablanica) should update their urban plans and adopt expansion areas according to the location and the possible effects of the intersection and the connection to the motorway. Development plans for industrial/residential areas should be revised and updated.

Population directly affected:

- The sites of construction camps must be selected in a way to not create conflicts with present settlements;
- Local Authorities should undertake measures to avoid that camps turn into permanent settlements;

Resettlement / Displacement of People:

Where displacement is unavoidable, resettlement plans have to be developed. The main steps of a resettlement plan should include the following:

- Clarification of organizational responsibilities;
- Organisation of community participation;
- Field survey;
- Analysis of legal framework;
- Valuation of and compensation for lost assets;
- Land tenure, acquisition, and transfer;
- Implementation schedule, monitoring, and evaluation

Social structure:

Social disturbance due to construction camps

In general, the construction camp site should be located in less vulnerable areas. Furthermore, the contractor must be obliged to meet the local regulations and location of construction plants and camps must be planned in co-operation with the local community.

Local regulations for the construction of camps must be respected.

To ensure that construction camps, temporary works and lifestyle of construction workers do not negatively affect adjacent communities, workers should be prevented from using resources held in common by local population.

Social disturbance due to traffic congestion

Implement traffic management measures in locations where crossing the existing road.
Movement of material has to be planned accordingly.

Property values

Removal of houses and other buildings

The following steps required under Bosnian legislation for expropriation have to be followed:

- Detailed site surveys, showing the locations of all properties potentially affected by the project;
- Detailed design of the project is prepared, to the level that the extent of land requirements can be defined;
- Preparation of allotment plans, showing the relationship between the motorway scheme and the land or structures to be expropriated;
- The Federal Ministry of Physical Planning and Environment has to accept the proposal;
- Copy of the Land Plan has to be obtained from the Cadastre/Register of Municipality. This should be checked against the latest survey information from the field;
- Detailed allotment numbers affected have to be submitted
- The Government of F B&H declares a public interest and provides the means for expropriation
- Municipalities have to be informed about the construction of the project and the Municipalities have to be requested to provide teams for execution of the expropriation process for land and buildings;
- Site surveys to be carried out by values
- Municipal authorities enforce resolutions
- Request is made for premature entrance onto the property before statement on validity of the claim is issued by the Federal Ministry of Planning and Environment
- Entrance onto the property is obtained for representatives of the responsible authorities
- Arguments before the municipal authorities on compensation
- Arguments before the courts on compensation

Loss of agricultural land:

Expropriation of agricultural land has to follow the procedure as described above. Furthermore, during construction the following measures should be implemented:

- The contractor must be obliged to carry out works so as not to interfere unnecessarily or improperly with the access to, use and occupation of public or private roads and footpaths to and from properties.
- Private property shall not be used for storage purposes, detour roads and other construction facilities and plants without written permission of the owner or lessee and payment to him if necessary.
- The contractor shall also select, arrange for and if necessary pay for sites for detours, for the storage of equipment or other uses necessary for construction works.
- After completion of works, the area used must be cleaned up and restored to the satisfaction of the landowner.
- Any long-term loss of agricultural land has to be compensated according to Law. If land is occupied for more than one cropping season, loss of crop has to be compensated accordingly.
- In case of usage of grazing land, reseeding immediately to minimize disturbance and losses should rehabilitate the area.
- Access roads to local agricultural property should be guaranteed after completion of the motorway.

Safety

Accidents due to construction works/machinery

In general, safety rules for construction sites have to be fixed through contract obligations.

- To reduce risks of accidents during construction (detour roads etc.) warning signs specifying speed limits, fencing of construction sites, lighting at night if necessary must be installed also at detour roads, access roads to base camp, quarry and other construction related sites. Detour and access roads must be regularly maintained to an adequate standard (provide speed bumps where necessary).
- Speed limits have to be fixed on construction traffic, fencing of quarries and borrow pits, exclusion of the public where heavy machinery is working, appropriate safety training for workers.
- Storage and construction activities have to be regulated and indicated clearly in the contracting documents to avoid danger or obstruction to passing traffic.

Economic development

To ensure availability of employment opportunities for local population, the contractor should maximize the use of local labour. It must be made sure, that the contractor recruits as large proportion of local labour force as possible and provides training when necessary. This includes consultation with local authorities on establishing local labour relations.

1.6.2 Air quality

The area interested to the new road is characterized by mountainous orography scarcely populated. In fact, there are only few buildings in the neighbourhood of the project. They are present mainly in tree points:

1. In proximity to Smucka (from km 0+950 to km 1+150);
2. In proximity to Jablaničko Jezero (from km 21+150 to km 22+150);
3. In proximity to km 24+700

Some infrastructures are already present in these zones, in particular the existing road from Sarajevo to Konjic and the railway.

For receptors no.1, 2 and 3 is not necessary to take any mitigation measures because the installations of phono-absorbent panels or creation of green screens for reduction of sound transmission is enough for to contain the air pollutant.

Moreover, the proposed motorway is located in the predicted National Park area characterized by forest and agricultural zones.

The computed emissions for the new road are not so high to expect any remarkable impact on plants present in this Park.

1.6.3 Geology

At the motorway alignment where a slope height is more than 8-10m, one or more 3-4m-wide bermes have to be predicted. Slope in the polifacial complexes can be done with an inclination 2:1, while in the limestone it can be 3:1. In deluvial-aluvail deposits, e.g. on the last 2-5 m, the slope inclinations should be reduced to 1.5: 1.

Whole slopes should be covered with wire netting, since, apart the deluvial-aluvail deposits, softer complex members are also non-resistant to water and frost, e.g. they are easily weathered and washed off. It is here important to mention that a deeper weathering zones of a base rock of Perm, Perm-Triassic, Verfenian and Miocene sediments cohered with clayey cohesive material have been found during exploratory works of drilling and geophysics, thus in these environments, a slope instability can occur due to a large cutting.

Also, aiming at slope protection, an edge channels should be predicted for collecting and controlled drainage of surface waters from the background slopes to the closest water collector. If predicted, slopes steeper than the proposed ones, should be additionally secured with retaining walls, anchors, reinforced concrete ribs etc.

Portal slopes in limestone are much more favourable, since they are less physically and mechanically degraded. There are deluvial-eluvial and talus cover lying over them or they do not have cover at all. With careful explosions, the portal slopes can be performed with the inclination of 3:1 to 4:1. Upper slope edges are to be performed with smaller inclination and protected against weather agents, e.g. washing and falling off. If necessary, slope inclinations can be even steeper if minimum protection measures are applied.

1.6.4 Water

The motorway construction does not endanger surface watercourses since the designed bridges are so high above the floodwater levels that their structure does not change hydraulic flow conditions. Situation is the same with the proposed culverts which enable undisturbed flow of smaller watercourses through the designed embankments. Certainly, some changes of flow conditions can occur in the construction period.

Some legal measures have to be undertaken in respect of pollution prevention. Periodical water system contamination, e.g. surface and underground waters can occur (strictly controlled) only within the construction site and only during specific construction phases.

The main aspects in terms of water pollution prevention within the construction area during the operation phase of the project to be analysed are the following:

1. Prevention of water system contamination by chemical substances used within the construction site;
2. Prevention of contamination by disposal of waste at the temporary disposal sites;
3. Recommendations concerning fuel distribution to the construction sites and refuelling;
4. Waste water drainage and treatment facilities;
5. Construction machinery maintenance.

For the operation period, the main measures for the control and prevention of the water pollution are:

- The presence of water drainage and wastewater treatment facilities;
- The periodical check-up of the collection, treatment and discharging system of the precipitation waters;

1.6.5 Flora

Mitigation measures aim at minimizing and eliminating the negative effects of the project (both during the construction phase and when the infrastructure is operating). They are important in order to identify the proper measures capable of ensuring the full merging of the project into the pre-existing environmental context.

The said mitigation measures contain the following: planting of autochthonous vegetation (trees, bushes and grasses) along the motorway and the surrounding areas, in order to also compensate vegetation cutting, improve visual effect of the surrounding area and to protect from dust; safeguard of older trees in the construction sites and in the secondary roads leading to them and along water courses; renaturation of the construction areas and the secondary roads leading to the construction sites; air pollution control and monitoring of vegetation status; monitoring of the biological and chemical status of surrounding watercourses, including flora and vegetation and soil status checking; fire protection measures.

1.6.6 Fauna

Mitigation measures aim at minimizing and eliminating the negative effects of the project (both during the construction phase and when the infrastructure is operating). Identification of the proper measures can ensure the full merging of the project into the pre-existing environmental context.

Planting of autochthonous vegetation along the motorway and the surrounding areas, in order to recreate proper habitats for fauna; building of protection fences in the places where wild animals cross the motorway; noise control by planting additional vegetation (rows and edges) in the places where the impact on animals proved to be negative; sufficient number of fauna passages, their maintenance in order not to disturb game passing under the motorway; Providing protection of the open water courses along the alignment (water construction works with the help of bioengineering techniques; reforesting of riparian strips in case of cuttings, avoiding muddying up the stream, creating passages for water in case of transversal barriers), monitoring of biological and chemical status of surrounding watercourses in order to protect water fauna; well-planned intervention measures in case of accidents; maintaining records on places and how people and animals were injured, so as to improve protection measures and timely avoid such accidents.

1.6.7 Protected parts of nature

Within the strip, width of 1.00 km on both sides of the planned motorway axes, there is the area protected by the Law on nature protection.

The areas, evaluated as extraordinary natural values should be preserved as such and protection is to be provided in order to avoid disturbance of their original status with bringing the project impact to an optimal minimum.

Already in the designing phase, the foreseen negative impacts are brought to the minimum, by the design solution of the motorway passing through this area mostly through the tunnels. This area, recorded as a natural heritage asset was treated as a protected asset.

1.6.8 Noise

Beside the respect of Bosnian regulations, the following recommendations for the construction period may be added:

- The itinerary of the transport track must be carefully studied in order to avoid as much as possible noise and vibration disturbances and than strictly respected;
- In particular the dumpers must be operating as far as possible from the existing human settlement;
- Working activities must be developed at distances lower than 200m from populated areas and works should be undertaken only during the day (6 a.m.–10 p.m.) or screened by anti – noise screens;
- The arranging of the activities in the construction site should be studied in the way that noisy activities would be protected;
- The stocking of materials in the construction site should be located in such a way to act as a noise barrier toward the settlements;
- The noise absorption system provided for the machinery should be regularly maintained.

For the operation period, the noise reduction systems could be necessary in correspondence the isolated buildings in correspondence of:

- km 1+425; km 2+050;
- km 2+400;
- km 7+950 – km 8+250;

Construction of a special pavement i.e. so called drain asphalt which provides a smooth surface and thus reduce noise emissions from rolling, is significantly more expansive than the standard asphalt concrete pavement and it also more costly than the installation of sound barriers. The spatial noise reducing smooth road surface can reduce the noise emissions for about 2 to 3 dB(A) compared to the standard pavement.

1.6.9 Landscape

During construction period

As said before, in this phase of the project the exact locations of the construction sites are not identified yet, and it is thus impossible to indicate the mitigation measures related to the landscape impacts. However, in general:

- Visible nuisance like dust clouds from construction can be mitigate by good site management practices like spraying water on unpaved sections and work roads and sites;
- Open cuts shall be re-vegetated as soon as possible. That is also desirable to prevent soil erosion;
- Wasteland will retrain with green plantation or agricultural use.

During operation period

The nature of alteration of topography by a road project in general is permanent. However, landscape impacts can be mitigate to some extent by green shielding of structures and architectural design to integrate structures into surrounding environment. TEM standard recommended that where possible undesirable visual effects of the surroundings should be enhanced or corrected by implementing suitable landscape measures.

While seeding of grasses and scrubs show short-term effects in covering open soil areas and exposed slopes, planting of trees and bushes will not show immediate scenery effects. These require about 10 years of growth until significant green shielding effects are noticeable.

For the section of the Prenj Park area, educational measures aimed at informing the travelling public about the existence and importance of the protected area and the reasons for not feeding wildlife, removing plants, littering, etc. are to be foreseen.

Land rehabilitation

In the agricultural areas, the realization of the infrastructure could cause an alteration of the continuity of the agricultural soils with a consequent possible alteration of the soils use conditions from the farmers. The continuity in the managing of the soils, especially in regard to the operating of the agricultural machineries, it is kept foreseeing in the next phases of the project and realizing flyover and underpasses that allow the continuity of the farm road network.

Concerning the problems related to the potential impacts on the parcelling agricultural fund system interventions will be underlined and analyzed only in the next definitive detailed phase, based on a precise reconnaissance of the current land structure and organization of the farms currently working on the territory. In fact, the projects and expropriations studies in depth of the next planning phases, considering the special features of the crossed agricultural landscape, could be individuate mitigation measures or of environmental compensation that, not strictly or necessarily linked with motorway layout, would especially refer to the division of land system of the agricultural land.

The specific reference to the farm structure present in the organization of the mitigation or compensation activities will allow the use of residual areas of the agricultural funds, directly interfered with the route, avoiding the creation of marginal areas for the agricultural activity and the segmentation and an extreme alteration of environmental ecosystems existing along the crossed territory (watercourses system of the reclamation, the system of fences between the fields and along the road infrastructures).

In connection with the individuation of the compatible uses that produce a benefit, in terms of compensation, on the territory crossed, it will be necessary, with priority, to verify the possibility of interventions of fund reunification and/or of reattribution of funds to the neighbouring properties finalized to control the parcelling of the properties system. For the other residual areas (km 1+250 – km 2+750; km 7+750 – km 7+900; km 21+600 – km 21+950; km 28+550 – km 28+625; km 38+800 – km 39+887) the morphological situation could be mitigated with fill interventions, using the residual materials of excavation activities.

1.6.10 Game and hunting

In order to eliminate negative impacts resulted from isolation of smaller and bigger parts of hunting area, it is necessary to rearrange the hunting area, in order to mitigate cutting the area off on the opposite side of the motorway. It is necessary to provide an adequate connection between the parts of the hunting area in the case of the hunting area divided to larger parts;.

In order to reduce negative impact on game, it is necessary to provide acceptable condition of game movement along present and future migration directions. Thus, it is recommended to establish the corridors for game's crossing the motorway, in order to mitigate habitat degradation and provide for as good as possible possibility of daily and seasonal game migration. It is, therefore, recommended, for the watercourses cut by the motorway alignment to form the zones in which the game could undisturbedly move. It is necessary to establish good communication along direction east-west and vice versa.

Base structures for establishment of necessary communication corridors are: culverts for water, underpasses and overpasses for movement of people and vehicles, viaducts and bridges and special structures for enabling movement of animals.

1.6.11 Cultural-historical heritage

Potentially endangering effects – concerning both material degradation of cultural property or reduction of visual quality and devastation of its cultural-historical character, must be avoided, neutralised or minimised (brought to the measure at which they can't represent any risk to the property) through implementation of protection measures that encompass technical solutions, instructions, recommendations and monitoring. In the implementation phase of the Project, protective measures, according to the analysis stated hereby, for each specific case should be elaborated in detail at the operational level and implemented.

Protection measures are divided in three groups:

- Protection measures during designing period
- Protection measures during construction period
- Protection measures during operation period

General protection measures

These measures imply application of all, by the different laws prescribed measures for a construction site protection, protection of people and structures, as well as application of prescribed standards and regulations in order to avoid negative effects during the motorway operation period.

Partially, application of these measures is described in the other chapters of this study or in specific segments of the main design of the motorway. This ensure that levels of noise, vibration and air pollution are maintained within the range allowed, without a negative consequences and to make safety on work, as well as organisation and technology of a construction site complying with the applicable laws.

The measures are applied in the first zone of impact, and if deemed necessary, also at the other specific positions or in the whole area of consideration (1 km on both sides from the alignment)

General protection measures are regulated, in the other segment, by the applicable legislation in the field of cultural-historical heritage protection. In that sense, general protection measures include, in first place, prohibition of destruction or damaging to a heritage assets or to potential heritage assets.

Therefore, we can consider the following as a general protection measures:

- prohibition of direct crossing of the alignment over a heritage assets,
- prohibition of all activities in connection to technical-technological requirements of work performance, that can destroy or damage a heritage asset (formation of an access roads, material depositing, heavy machinery deployment, cranes and similar at archaeological localities)

These measures are applied in the whole area of consideration (1 km right and left of the alignment).

Specific protection measures

These measures are related to mitigation and elimination of the harmful impacts in the First zone of impact.

As stated earlier, in the First zone of impact, certain number of archaeological sites had been registered such as cemeteries and objects/architectural heritage entireties. However, we always have to count on possibility that, during construction works, some so far unknown (covered) archaeological sites or other potential heritage assets are discovered, inaccessible during the research. In that sense, necessary protection measures can be divided to:

Specific protection regime-specific measures

Mitigation measures in the frame of a specific protection regime encompass elimination or neutralisation of **concrete harmful effects** to be expected at the specific, recorded (known) locations and are given for each conflict point separately. They are applied in the First zone of impact.

Specific protection regime-preventive measures

These measures encompass a general protection procedures to be complied with in order to prevent degradation of unknown (non-recorded) archaeological sites, objects (or entireties) of architectural heritage, tombstones, as well as degradation of known (recorded) assets that might happen in the case of the alignment dislocation after this study is completed.

Measures of preventive regime include:

- Control archaeological and conservatory survey after the alignment is set out, using the method of fast reconnaissance (“rapid survey” method)
- Informing bodies authorised for cultural heritage protection about all archaeological findings discovered during earthworks and stopping the works until an insight and further instructions by the authorised body.

Repetition of procedure for identification of conflict points and prescription of mitigation measures for each alignment correction/dislocation, until the alignment is finally adopted. Practically, it is necessary to check each time whether or not the alignment correction endangers some location within the strip of 1 km right and left of the alignment.

1.7 Monitoring system

Monitoring the environmental protection measures during construction mainly concern the impact mitigation and enhancement and the construction activities that are required of the contractors, that include rehabilitation or protections of borrow pits, re-vegetation of barren areas, and bush clearance with minimal ancillary damage to the landscape, proper waste management and other obligations. An aim is for the environmental team to help the contractors maintain sensitivity towards environmental concerns, meet their contractual responsibilities and have flexibility in response to environment-related issue.

The effects of the project road upon surrounding environment has both short-range and long-term dimension. The short-range effects mainly involve construction-related activities.

Monitoring these events requires attention to the following:

- Appropriate data collected by government agencies;
- Suitable institutional arrangements and communications;
- Necessary staff to get tasks done;
- Adequate financial and technical resources;
- Capacities to compile process and analyse information in a timely fashion.

The kinds of effects to be monitored:

- Population displacement;
- Resettlements and compensation;
- Construction-related pollution;
- Land and water uses;
- City infrastructure.

In addition to construction-related concerns, the environmental management team will establish systems to monitor long-range, mainly development-related effects.

It will be necessary to assess the capacities of organizations to collect the required data and perform appropriate analyses.

2.0 INTRODUCTION

2.1 Basis for realisation of Environmental Impact Study

Environmental Impact Assessment (EIA) is aimed at systematic identification and evaluation of real and potential impacts of the proposed Corridor Vc motorway project on physical, chemical, biological, cultural, social and economical components of the entire environment. The base goal of EIA is encouragement and incorporation of environmental aspects in planning and decision-making process, what eventually should result in more environmentally acceptable activities.

EIA is a process and a tool for project planning and decision-making.

Purpose of Environmental impact assessment is:

- Integration of environmental aspects in planning of development activities;
- Taking in account properly all environmental and other costs and benefits from an economic development project;
- To provide avoiding or reduction of unexplainable negative impacts in early phase of planning process;
- Identification and strengthening of potential benefits from the project;
- Enabling preparation of environmental and social-economic studies along with analysis of technical and economic justification of the project;
- Providing decision-makers with all data on environmental cost, conflicts and benefits of the projects along with the data on its technical and economic justification in the key stages of project development;
- To Insure project transparency;
- To insure involvement of all interested parties (local communities, government, investors, NGOs, donors etc.) in the EIA process;
- Establishment of mitigation of negative impacts and monitoring systems;
- Improvement of relations between sectors; and
- Preservation of social, historical and cultural value of people and their communities.

Environmental impact assessment for the project of Corridor Vc motorway, Lot 3-section Sarajevo-South (Tarčin) – Mostar-North was prepared in two phases:

- Preliminary environmental impact assessment
- Environmental impact study.

Preliminary environmental impact assessment is to determine a necessity for undertaking a complete EIA procedure and preparation of Environmental Impact Study (EIS) for the motorway construction project.

Scope of Preliminary environmental impact assessment, having in mind that it was prepared in the early designing phase, when the alignments considered were not at the required level of technical elaboration, was a spatially wider area of the Base corridor. Preliminary environmental impact assessment considered seven possible alternatives (Including the Zero alternative – without intervention). Goal of Preliminary environmental impact assessment encompassed:

- Review of the environment status in the Corridor Vc motorway area of Lot 3,
- Review of potential environmental impacts and possible losses of environment qualities,
- Identification of impacts that must be avoided due to legal requirements or valuable qualities of natural and cultural heritage,
- Mitigation of impacts that don't have to be avoided.

The motorway project, according to the Articles 3 and 4 of the *Book of regulations on the plants and installations for which the environment impact assessment is compulsory and which can be put in operation only if they have an environmental permit* (Official Journal FB&H, 19/04) is on the list of those projects for which the Environment impact assessment is compulsory condition for issuing Environmental permit. Environment impact assessment procedure comprises consultations with public, businesspersons and community activists, selected leading persons and NGOs. Public consultations are organized during all phases of environmental assessment and are conducted from the reason of possible interest of interested parties in the Project. In the frame of Preliminary environmental impact assessment procedure, complying to the Article 36 of the Law on environment protection, documentation of Preliminary environmental impact assessment of the Corridor Vc motorway project, Lot 3, was available to all interested parties on the web site of the Federal ministry of physical planning and environment (http://www.fmpuio.gov.ba) and submitted for review to all bodies stated in the Decision on preparation of Environmental impact study.

Federal ministry of physical planning and environment, in cooperation with the Ministry of communication and transport of Bosnia and Herzegovina, has organized public consultations about Preliminary environmental impact assessment of the Corridor Vc motorway project, Lot 3 in the municipalities influenced by the Project (Hadžići, Konjic, Jablanica and Mostar). Following the public consultations the Federal ministry has issued the Decision on Environmental impact study preparation, number UPI/03/02-23-4-52/05 dated 20.7.2005, attached as the Attachment 12.1. The Decision was issued based on the Articles 58 and 59 of the Law and Articles 3 and 4 of the Book of regulations.

Results of multi-criteria analysis, opinion of citizens and institutions obtained during the public consultations about Preliminary assessment and the Decision of the Federal ministry represent a base for preparation of Environmental impact study.

EIS defines requirements and recommendations for environmental standards fulfilment in a phase of motorway construction and operation, as a condition for obtaining Environmental permit from the authorized ministry (Federal ministry of physical planning and environment) for the project realization. Environmental permit is aimed at impact prediction and proof of the undertaken measures.

Environmental impact study was being prepared simultaneously with preparation of Preliminary design, what enables environmental requirements to be fully incorporated in the design.

2.2 Legislation

This Environmental Impact Assessment EIA was prepared in accordance with the Terms of Reference and with relevant legislation and following the methodological approach offered, as summarized in the following paragraphs.

2.2.1 EU Directives in the field of environment protection

EU legislation exists mainly in a form of directives and not in a form of laws. That means that it mainly does not concern authorities or public of EU countries, but mainly represents the objectives to be transferred into the legislation of member states (state, entity, canton etc.)

Since it had started to develop an environmental policy (1972), European Community, and than European Union have issued around 200 legislation documents. The major part has been issued in form of directives, and far less number in a form of regulations.

Field of environment protection, in usual technical sense, is divided in several environmental sectors (air quality, waste material, water, nature). Therefore, in the same way the respective legislation can be systematized. However, the specific legislation can be only divided theoretically, since the environment protection is a unified-indivisible system. It can be for the purpose of more clear and systematic insight.

Unlike the legislation concerning specific sector, horizontal legislative of environment protection encompasses so called horizontal measures related to the different issues, extending through the different environmental sectors. It does not regulate specificities of the different sectors but is more of the procedural character and related to all sectors.

The most important EU directives in the field of environment protection are:

- Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment;
- Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control, (IPPC Directive);
- Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances – so-called Seveso II Directive;
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programs on the environment;
- Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC;
- Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programs relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC–Statement by the Commission.

2.2.2 International Conventions and Protocols

The international multilateral agreements directly related to the environment, joined by Bosnia and Herzegovina are:

- UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, Rio de Janeiro 1992

Effective from: 21.03.1994 (Gazette B&H 19/00)

The parties are obligated to mutual cooperation for the purpose of prevention of damaging climate changes and their possible impacts to the environment. The signers are also obliged to limit anthropogenic and green house gasses emissions, in a way of having them limited in a first step, and than reducing concentration of CO_2 to the level that enables normal development.

- CONVENTION ON LONG-RANGE TRANS-BOUNDARY AIR POLLUTION, Geneva, 1979

Effective from: 16.03.1986 (Gazette R B&H 13/94, Gazette SFRJ MU 11/86)

Transmission of pollutants at big distances, acid rain issues and forest degradation pointed out the need of harmonized international action, resulting in issuance of this Convention. Convention is governing common action of all members aiming to gradual reduction of pollutants (SO_2, NO_x and VOC) in the atmosphere. Convention is followed by four protocols: EMEP, NO_x, SO_2 and VOC Protocol.

- BASEL CONVENTION ON THE CONTROL OF TRANS-BOUNDARY MOVEMENTS OF HAZARDOUS WASTE AND THEIR DISPOSAL, Basel, 1989

Effective from: 05.05.1992 (Gazette B&H 31/00)

The Convention is a respond of the international community to the problems caused by global waste material production, endangering people and environment because it is dangerous, poisoning, explosive, corrosive, inflammable, eco-endangering or infectious. The Convention has arisen from the concern regarding transportation of dangerous waste from industrially developed countries to the developing countries. It is mostly devoted to establishing the control system on the exceeding traffic of hazardous waste material. The convention is offering the frame for identification, information about and a control of the hazardous waste material in an environmentally acceptable way.

- CONVENTION ON BIOLOGICAL DIVERSITY, Rio de Janeiro, 1992

Effective from: 29.12.1993 (joined by B&H at 26.08.2002, ratified at 04.10.2002).

This is a base convention that establishes a new environment protection concept, extending this activity to the preservation of the overall biological diversity and a provision of sustainable use of the natural resources. The convention determines biological diversity (within species and ecological systems). This, therefore, encompass all forms of life that by themselves represents values to be preserved, regardless if they possess some other particular values ascribed to them by the human being.

- CONVENTION ON WETLANDS OF INTERNATIONAL IMPORTANCE ESPECIALLY AS WATERFLOW HABITAT, Ramsar, 1971.

Coming to effect in 1975

This convention represents the framework for an international cooperation aiming to “reasonable” use of wetlands. The Convention is obliging the member countries to general preservation of the wetlands in their territory as well as to special obligations concerning the wetlands listed on the List of Wetland of the International Importance. In addition, the countries must implement wetland protection by establishing natural reservations out of which at least one should be proposed for the Ramsar List.

- CONVENTION FOR THE PROTECTION OF THE WORLD CULTURAL AND NATURAL HERITAGE, Paris, 1972.

Coming to effect at 17.12.1975

The primarily objective of this convention is the identification, protection, preservation popularisation and transferring of the cultural and natural heritage to the future generations.

The international multilateral agreements (conventions, protocols) of a greater environmental importance not signed by B&H are:

- CONVENTION ON ENVIRONMENTAL IMPACT ASSESSMENT IN A TRANS-BOUNDARY CONTEXT, Espoo, 1991.
  Effective from 1997

This convention concerns undertaking measures for prevention, reduction and regulation of significant negative trans-boundary environmental impacts of the planned activities.

- UNECE CONVENTION ON ACCESS TO INFORMATION, PUBLIC PARTICIPATION IN DECISION-MAKING AND ACCESS TO JUSTICE IN ENVIRONMENTAL MATTERS, Aarhus, 1998

The convention regulates the following elements of access to information: definition establishment, environmental information from the authorities, basic principles of the free access to the information on the environment, obligations of the authorities of collecting and updating these information's, obligation of making environmental information more transparent, reasons of holding the environmental information back, information costs.

- KYOTO PROTOCOL, Kyoto, 1997

Kyoto Protocol regulates obligations of the specific member states, parties of the Framework Conventions on Climate Changes, based on the mandate of the Berlin Conference on decreased CO2 emission in the period from 2008 to 2012, comparing to the level from 1990.

2.2.3 Environmental legislation in Bosnia and Herzegovina

Constitution of Bosnia and Herzegovina has been adopted in the Annex 4, of the Frame Peace Agreement adopted in Dayton in November 1995, and signed later, in January of 1996 in Paris. According to the Constitution, Bosnia and Herzegovina consists of two entities: Federation of Bosnia and Herzegovina (FB&H) and Republic of Srpska (RS). The Constitution of B&H does not explicitly regulate right to environment, but the Article III.3 says that all functions and authorizations that are not explicitly stipulated as responsibility of the authorized state-level institutions shall be implemented at the entity level. Federation is a compound entity, consisting of ten cantons, each one administrated by different municipalities. Each canton has its own constitution, laws, parliament and government. Republic of Srpska has no cantons but it is divided in a Republic and some Municipalities.

According to the Constitution of FB&H (adopted at March 30, 1994), the environment protection and natural resource utilization policies are responsibility of the entities (FB&H and RS) and the cantons (Article III.2). The authority can be realized jointly or separately, or by the cantons with the coordination of the Federal Authority. In both entities there is a ministry competent in environment: in FB&H, it is the Federal Ministry of Spatial Planning and Environment, and in Republic of Srpska it is the Ministry of Spatial Planning, Construction and Ecology. Ten cantons of FB&H, has a ministry of environment and both the Federation and cantons are responsible for it.

2.2.3.1 The new legislation in the field of environment

According to the Dayton Peace Agreement all the law regulations that were valid in ex Socialistic Republic of Bosnia and Herzegovina, and that are not opposite to the Constitution, remains still valid until it is differently decided by competent government agency of Bosnia and Herzegovina.

A new set of environmental protection laws, defined by modern law framework based on European Union standards (financially and technically helped by European Commission) are the followings:

1) Law on Environment Protection
2) Law on Nature Protection
3) Law on Water Protection
4) Law on Air Protection
5) Law on Waste Management
6) Law on Environmental Protection Fund

A set of environmental laws is adopted in Republic Srpska: Gazettes RS 50/02, 51/02 and 53/02 and on Federation, announced in Official Journal of Federation Bosnia and Herzegovina number 33/03 from 19.07.2003. In this way B&H entities obtained the primary legislation in the environmental field.

Apart from laws, it is important to mention that, inter entities National Activity Plan in environmental field (NEAP) for B&H, is adopted. The document is the result of the work of two respectable expert groups from the whole B&H, and it is adopted on both entity parliaments in the same text.

In addition to the set of environmental laws in the territory of the Federation, in the frame of spatial planning and construction, the following laws related to the environment protection, have been issued:

- Law on spatial planning, (Official Journal FB&H, 52/02);
- Regulation on the unique methodology for making spatial planning document (Official Journal FB&H, 63/04);
- Law on spatial planning (Official Journal Canton Sarajevo, 7/05);
- Law on physical arrangement and land use at the level of Federation of Bosnia and Herzegovina (Official Journal F B&H, 18/06)

Both entity ministries started the preparation of implementing regulations (sub-laws acts) that will enable the implementation of adopted laws. The following are the implementing regulations issued up to date.

2.2.3.2 Implementing regulations concerning the set of environmental laws:

Law on Environment Protection

- Book of regulations on the plants and installations for which the environment impact assessment is compulsory and which can be put in operation only if they have an environmental permit (Official Journal FB&H, 19/04)
- Book of regulations on the conditions and criteria to be fulfilled by Environmental Impact Study preparation holders and amount of the fee and other expenses rising in the process of environmental impact assessment (Official Journal F B&H, 68/05);

- Book of regulations on the deadlines for submission of the Request for the Environmental Permit issuance for plants and machineries that had a permits issued before the Law on the Environment Protection became effective (Official Journal F B&H, 68/05);
- Book of regulations on the conditions for submission of the Request for the Environmental Permit issuance for plants and machineries that had a permits issued before the Law on the Environment Protection became effective (Official Journal F B&H, 68/05);
- Book of regulations on preparation of annual/semi-annual environment protection inspection programs (Official Journal F B&H, 68/05);
- Book of regulations on the content of the security status report, content of security measures report, and content of internal and external intervention plans (Official Journal F B&H, 68/05).

Law on Waste Management

- Book of regulations on the conditions for transferring waste management obligation from the producer and the consumer to the operator of the waste material collecting system operator (Official Journal FB&H, 9/05);
- Book of regulations on issuing permission for activities of the small enterprises in the area of waste management, (Official Journal FB&H, 9/05);
- Book of regulations on the waste material categories (Official Journal FB&H, 9/05);
- Book of regulations on handling the waste material that is not on the list of dangerous waste materials or the content of which is unknown (Official Journal FB&H, 9/05);
- Book of regulations on the content of the plan of waste material management adjustment for the existing plants for waste material treatment or disposal and on the activities undertaken by the authorised body (Official Journal FB&H, 9/05);
- Regulation on financial guaranties that may assure the trans-boundary waste traffic (Official Journal FB&H, 41/05).

Law on Air Protection

- Book of regulations on air quality monitoring (Official Journal FB&H, 12/05);
- Book of regulations on monitoring of the polluting materials emission in the air (Official Journal FB&H, 12/05);
- Book of regulations on limiting values of air quality (Official Journal FB&H, 12/05);
- Book of regulations on vaporizing organic materials emission (Official Journal FB&H, 12/05);
- Book of regulations on the operation conditions of plants for waste material burning out (Official Journal FB&H, 12/05);
- Book of regulations on the limiting values of the emission in the air coming from the plants for burning out (Official Journal FB&H, 12/05);
- Book of regulations on the limiting values of the emission of the polluting materials in the air (Official Journal FB&H, 12/05).
- Book of regulation on the emissions in the air from biomass burning plants (Official Journal FB&H, 34/05);
- Book of regulation on gradual exclusion of substances damaging ozone layer (Official Journal FB&H, 39/05).

Law on nature protection

- Book of regulations on establishment of monitoring system of intentional holding and killing of protected animals (Official Journal FB&H, 46/05);
- Book of regulations on establishment and control of information system for nature protection and monitoring implementation (Official Journal FB&H, 46/05);

2.2.3.3 Other important legal documents concerning environment

- Book of regulations on special regime of activities control that endangers or can endanger environment (Gazette SRB&H, 2/76, 26/88);
- Law on utility services (Gazette SRB&H, 20/90);
- Law on utility services (Official Journal Canton Sarajevo, 31/04)
- Book of regulations on the minimum requirements for removing and final disposal of public, industrial and other type of waste (Gazette SRB&H, 34/91);
- Law on cultural-historical and natural heritage protection, (Gazette SRB&H, 20/85);
- Law on protection of goods proclaimed as national monuments of B&H by decisions of the Commision for national monuments protection (Official Journal FB&H, 2/02);
- Law on modifications and supplementation of the Law on protection of goods pronounced a national monuments of B&H by decisions of the Commision for protection of national monuments (Official Journal FB&H, 8/02, 27/02);
- Decision on modification of the criteria for pronouncement of goods a national monument (Gazette SR B&H 15/03);
- Commision for national monuments protection – Decisions (Official Gazette B&H, 43/03);
- Law on forest, (Official Journal FB&H, 20/02);
- Law on modifications and supplementation of the Law on forest (Official Journal FB&H, 29/03);
- Law on modifications of the Law on forest (Official Journal FB&H, 37/04);
- Law on agricultural land, (Official Journal FB&H, 2/98);
- Instruction on establishment of allowed quantities of damaging and hazardous materials in soil and methods of their examination (Official Journal FB&H, 11/99);
- Decision on agreement to ratification of international convention for vegetation protection (Official Gazette B&H, 10/03);
- Law on air quality, (Official Journal of Sarajevo Canton, 10/99);
- Law on noise protection (Official Journal of Sarajevo Canton, 10/99);
- Law on modifications and supplementation of the Law on noise protection (Official Journal of Sarajevo Canton, 32/01);
- Law on waters (Official Journal FB&H, 18/98);
- Decision on setting boundaries of basic river basins on the territory of the SR B&H (Gazette SR B&H 7/77);
- Decision on basic river basin boundary, (Official Journal FB&H, 37/98);
- Book of regulations on kinds, methodology and scope of measurement and testing of used water, outlet waste water and the material exhausted from watercourses (Official Journal FB&H, 48/98, 36/00; correction 35/01, 20/03, 56/04);
- Book of regulations on conditions for establishing zones of sanitary protection and protective measures for water sourses used or planned to be used for drinking water (Official Journal FB&H, 51/02);

- Regulation on classification of waters in interrepublic watercourses, interstate water courses and off-shore sea of Yugoslavia (Gazzete of SFRJ, 6/78);
- Decision on maximum allowed concentrations of radionucleides and hazardous materials in interrepublic watercourses, interstate water courses and off-shore sea of Yugoslavia (Gazzete of SFRJ, 8/78);
- Regulation on the classification of waters and waters of the of-shore sea of Yugoslavia inside the borders of SR B&H (Official Gazette of SR B&H, 19/80);
- Regulation on the Classification of Waters (Official Gazette of SR B&H, 42/67);
- Law on roads of Federation B&H (Official Journal FB&H, 6/02);
- Law on protection and rescuing of people and material assets from natural and other disasters (Official Journal FB&H, 39/03);
- Law on hunting (Official Gazette of SR B&H, 7/77);
- Law on modifications and supplementation of the Law on hunting (Official Gazette of SR B&H, 30/90)
- Law on hunting (Official Journal FB&H, 4/06).

2.2.4 Assessment standards

Law on Nature Protection *(Official Journal of FB&H, number 33/03*

The law is based on the EU legislation in the field of environment protection and on the approach used by EU members in environment protection regulation and management. By preparation and issuance of this law Bosnia and Herzegovina took over necessary steps towards international cooperation.

This Law regulates ways and conditions of the restoration, protection, conservation and sustainable development of the following issues: landscape, natural areas, plants, animals and their habitats, minerals and fossils and of other components of the nature on the area of Federation of Bosnia and Herzegovina, competent bodies which will cover nature protection, planning of nature protection, the general and special measures for nature protection, information system, supervision, funding of nature protection and sanctions for legal and natural persons. The law is predicting general measures of environment protection (protection of the landscape, protection of wild animals and plants, "Red List", protection of habitats) and special measures for natural protection (protected areas, protection of wild species and protection of minerals and fossils), management of protected areas, activities in and effects on protected areas, joining unified international ecological network – NATURA 2000 Program.

Law on Water Protection *(Official Journal FB&H, 33/03)*

The main reasons for adopting Law on Water Protection are:

- Need for adjustment of water protection regulations to the new trends in environment protection and general changes in economic and legal system, as well as the need for adjustment to EU requirements;
- Application of the measures aiming to provision of sufficient quantities of an appropriate quality water for needs of inhabitants and the industry;
- Application of the measures aiming to prevent water quality decrease.

This Law shall govern the protection of waters, watersides and water lands: water protection planning and programming, organization, supervision, financing and penalties for each legal and natural person. Protection of waters, watersides and water lands shall comprise the preservation, adjustment and maintenance of water quantities and the adoption of decision on the use and loading of waters.

The objective of the Water Protection Law is to ensure the sustainable use of water (in order to preserve and improve their quality), to ensure the preservation of natural process and the natural balance, aquatic and semi-aquatic ecosystems and the landscape properties, and – in cooperation with the bodies responsible for water management – to preserve and adjust quantities for various types of use in order to realize their economic, social and ecological functions.

The section referred to the bans and limitations regulates the following:

- Discharge of wastewater (Article 22);
- Restriction on the use of fertilizers and agents for plant protection (Article 23);
- Depositing or disposal of substances or objects (Article 26);
- Construction for the transportation, reloading and storage of hazardous substances (Article 27);
- Restriction of loads to water to provide for the protection of aquatic and semi-aquatic organisms (Article 29);
- Ecologically acceptable flow (Article 31);
- Removal of material (Article 32);
- Water protection regime (Article 36)

The Articles 43 to 46 of the Law on Water Protection define issuance procedure for Water Protection Consent. Water Protection Consent is a legal document issued by the body authorized on the direct utilization of water and water resources.

Water protection consent is one of the conditions for issuing permit for load, according to the spatial planning and construction regulations, as well as for issuance of environmental permit and other permits predicted by other laws. In the event of fire fighting protection, which calls for immediate and sanitary measures, waters can be used for collection without water protection consent.

Detailed tests have been made for the purpose of water categorization. Based on the Regulation on the Classification of Waters and Waters of the Seaside Sea of Yugoslavia inside the Borders of SR B&H (Official Gazette of SR B&H, n°.19/80), according to use and level of cleanness, waters are divided in 4 classes:

Table 4 Review of parameters with the limiting values for the specific classes of waters, characteristic for the surface waters from the above-mentioned Regulation on the Classification of Waters

N.	PARAMETER	Class			
		I	II	III	IV
1.	Dissolved oxygen mg/l minimum	8	6	4	3
2.	Saturation with oxygen in %	90-105	75-90	50-75	30-50
3.	Five-days biological consumption of oxygen BPK5 u mgO_2/l, up to	2	4	7	20
4.	Chemical consumption of oxygen (HPK) from $KMnO_4$ in mgO_2/l , up to	10	12	20	40
5.	Suspended materials in mg/l, up to	10	30	80	100
6.	Dry residuum of filtrated water in mg/l, up to	350	1000	1500	1500
7.	pH	6.8-8.5	5.8-8.5	6.0-9.0	6.0-9.0
8.	Visible waste materials	none	none	none	none
9.	Colour	none	none	barely visible	-
10.	Smell	none	none	barely visible	-
11.	The most probable number of coliform germs, up to	1,000	100,000	200,000	> 200,000
12.	Tocsic materials, temperature change and other harmfulness indicators	Must not be found above the prescribed value in any class			

Law on Air Protection *(Official Journal FB&H, 33/03)*

This law defines technical conditions to prevent, or where that is not practicable, to reduce the emissions into the environment, air from anthropogenic activities which have to respect for production process on territory of Federation of Bosnia and Herzegovina, planning of air quality protection, special emission sources, emission inventory, ambient air quality, monitoring and sanctions for legal and private entities and natural persons.

The law, apart the basic regulations, concepts and definitions of the air protection, contents regulations on the following:

- air protection planning,
- special emission sources,
- emission inventory,
- air quality.

The Air Study is an integral part of the permitting documentation in the permitting procedure of emission sources. The operator of emission sources for which the environmental permit is required shall describe in detail their expected emissions into the ambient air and its impact on the environment in a separately prepared Air Study. No additional Air Study is required for the operator who has acquired the environmental permit on the basis of Environmental Impact Study, under the condition that the study processes also the data required by the Study about air.

For the operators of emission sources that an environmental permit is not required, the allowed emissions should be established in urbanites, construction or use permission.

The following table contains the set of air quality standards adopted by Canton Sarajevo, Federation B&H and European Commission.

Table 5 The applicable air quality standards set by the Canton of Sarajevo, Federation of B&H and the European Commission.

Polluting substance	Averaging Period	Air Quality Limit Values		
		Canton Sarajevo*	Federation B&H**	European Commission
Sulphur dioxide (SO_2)	Annual average 24-hours average	50 $\mu g/m^3$ 125 $\mu g/m^3$	20 $\mu g/m^3$ (eco) ** 90 $\mu g/m^3$ (hu) **	20 $\mu g/m^3$ (eco)[1)] 125 $\mu g/m^3$ (hu)[1)]
Nitrogen dioxide (NO_2)	Annual average 1-hour average	50 $\mu g/m^3$ 300 $\mu g/m^3$	- 60 $\mu g/m^3$ (hu)**	40 $\mu g/m^3$ (hu)[1)] 200 $\mu g/m^3$ (hu) (18x)[1) 3)]
Nitrogen oxides (NO_x)	Annual average	-	30 $\mu g/m^3$ (eco)**	30 $\mu g/m^3$ (veg)[1)]
Carbon monoxide (CO)	8-hours average	10 mg/m^3	-	10 mg/m^3 (hu)[2)]
Black smoke (BS)/PM_{10}#	Annual average 24-hours average	50 $\mu g/m^3$ 125 $\mu g/m^3$	- 30/50 $\mu g/m^3$ (hu)**	40 $\mu g/m^3$ (hu) [1)] 50 $\mu g/m^3$ (hu) (35x) [1) 4)]

* Law on air quality; (Official Journal, Canton Sarajevo, 10/99). According to this law, limit emission value is a total polluter concentration in the air that, by present knowledge, does not have negative effects to human health and capability or to environment in qualitative and quantitative sense.

** Book of regulations on limiting values of air quality; Official Journal FB&H, 12/05

Protected environmental factor: human health, eco-ecosystems, and vegetation

1) Council Directive 1999/30/EC
2) Council Directive 2000/69/EC
3) (18x) not to be exceeded more than 18 times a calendar year
4) (35x) not to be exceeded more than 35 times a calendar year
\# PM_{10} – particles below 10µm aerodynamic diameter

Law on Waste Management *(Official Journal FB&H, 33/03)*

The objective of this law is to encourage and provide the basic conditions for prevention of production, recycling and processing waste for re-use; the extraction of secondary raw materials and possibly of energy and safe disposal.

The scope of the present law implies:

- all waste categories (regardless of radioactive waste, gaseous effluents atmosphere and waste water),
- all kinds of waste management activities, operations and installations.

Regulations of this law are applied to:

- waste resulting from prospecting, extraction, treatment and storage of mineral resources and the working of quarries,
- liquid waste,
- animal wastes and other non hazardous materials of a natural origin, which may be utilized for agricultural purposes,
- defused explosives, only in case, if there is no specific legal regulation for such wastes.

Law on Environmental Protection Fund *(Official Journal FB&H, 33/03)*

This law, established of Environmental Fund of Federation Bosnia and Herzegovina, regulates structure, organization, management and supervision for fund property and functioning of fund, sources, utility and methods of using fund financial means, and other issues concerning financial management of fund.

Fund is financial organization, which has the status of legal entity and for that reason should be registered at the court. Function of Fund is to collect and distribute financial means for environmental protection in the territory of Federation of Bosnia and Herzegovina.

Law on Noise *(Official Journal, Canton Sarajevo, 10/99)*

This law regulates the following issues: noise level allowed, noise protection measures and measurements modalities; limiting noise levels adjusted to space purpose and time of a day, in a way that does not interfere with life and work of humans, especially their health; monitoring on the application of this law, as well as other relevant for noise protection.

Standards for noise impact levels

Up to date, the Government of Bosnia and Herzegovina did not specified the standards for noise impact levels. The only defined standards concerning noise are given in Law on noise protection of Sarajevo canton. Respective standards are given in the following table:

Table 6 Allowed levels of outdoor noise

Area (zone)	Purpose of the area	The highest allowed noise levels dB(A)		
		Equivalent levels L_{eq}		Peak Level
		day	night	L1
I	Hospital-sanatoriums	45	40	60
II	Tourist, recreation, curative	50	40	65
III	Purely residential, educational and health care institutions, public green and recreation areas	55	45	70
IV	Market, business, residential and residential near *communication corridors*, warehouses without a heavy transportation	60	50	75
V	Business, administrative, trading, service (utility services)	65	60	80
VI	Industrial, warehouse, service and traffic area without apartments	70	70	85

L_{eq} dB(A) is the average energetic noise value of the variable level, equivalent to the noise of the continuous level, measured in at least 15 minutes in periods of time from 6 a.m. to 22 p.m. (day) and from 22 p.m. to 6 a.m. (night).

L_1 represents the noise level that was exceeded in 1% of the time, with the shortest measurement time of 15 minutes.

Law on Forests *(Official Journal FB&H, 20/02)*

By this law, forest, as ecosystem, is understood as a land covered with forest trees or forest bushes whose surface exceeds 500 m^2 and which is at least 10m wide.

Forest consists of: forest nurseries, plantation of forest trees, open spaces for long distance power lines and other public infrastructure in the forests, used on a bases of right to pass over someone else's land, forest roads, and other forest transportation and fire protection infrastructure, part of lands subject to forestation, area aimed for recreation, as well as lakes, surface running waters, and other surface waters and marshes managed under the special law.

In forestland, can only be built the facilities needed for forest management. Approval from Canton ministry is required for the buildings and other facilities at the distance of 100 m from the forest edge. Articles 2 to 7 of this law are applicable on buildings, roads, long distance power lines, strip mine, and other facilities planned to be built in the forest or within 50 m from the forest edge.

Owner is obliged to obtain Building permission in accordance with applicable laws in that area (Article 4, paragraph 1-2).

Law on cultural-historical and natural heritage protection and usage *(Gazette SRB&H, 20/85)*

It is forbidden to perform the works that can endanger the monument, as well as to make any change that can damage its authenticity and essential characteristics.

Within the monument entirety, just such activities can be done which don't cause any alteration of the essential elements.

At archaeological site, no activities (apart the archaeological research activities performed by the authorised organisation) are allowed.

At the memorial monument the activities that could endanger its essential characteristics, purpose or function are not allowed.

Around the cultural monument, monument entirety and memorial monument, the protective areas are established, as necessary, with appropriate protection measures.

On the civil-engineering-architecture structures that have been established by the rules of historical restoration and on the objects of contemporary creative work that represent particular cultural, historical and scientific value, the actions that would endanger the property characteristic, are not allowed.

In national park, memorial area, park of nature and area of natural beauty, all activities that would cause significant changes of natural and other values and specificity of the entire area are forbidden. Forbidden are also the activities that are not in accordance with characteristics, purpose and function of the area.

In the natural reservations and natural sights and rarities, all activities that could disturb natural development or cause the damage of basic natural features are forbidden.

2.3 Methodology of EIS preparation

Environmental Impact Assessment for the project of the Corridor Vc Motorway, Lot 3 – Section Sarajevo South (Tarčin)- Mostar North was prepared in two phases in accordance with legislation of B&H Federation (Law on environment protection, Official Journal of F B&H, **33/03):**

- Preliminary Environmental Impact Assessment and
- Environmental Impact Study.

Scope of the Preliminary Environmental Impact Assessment, having in mind that in the early designing phase the considered alignments had not been at the necessary level of technical development, was wider spatial range of the Base corridor. Preliminary Environmental Impact Assessment had considered seven possible alternatives (including the 0-Alternative –without intervention) and was submitted to the Investor in April 2005..

The goal of the Preliminary Environmental Impact Assessment included the following:

- Insight into the environment status of the Corridor Vc Motorway area, Lot 3,
- Insight into potential environmental impacts and possible environment quality losses,
- Identification of impacts that must be avoided due to legal requirements or valuable qualities of natural and cultural heritage,
- Mitigation of the impacts for which the obligation of avoidance doesn't exist.

Environmental Impact Study (EIS) for the stated project had been prepared based on the Decision on Environmental Impact Study Preparation, number UPI/03/02-23-4-52/05 dated 20.7.2005, issued by Federal ministry of physical planning and environment, for the purpose of further environment impact assessment procedure, aiming at obtaining an Environmental permit. The Study content is harmonised with the said Decision that is partly corrected by the investor.

During the Study preparation, considered are remarks, suggestions and opinions of authorities, public companies, NGOs.

Preparation of EIS was based on several connected activities, going on in several phases:

- Research preparation including organisation of the working team (different environmental experts), organisation of field visits, methodology definition for obtaining the data from primary and secondary sources and detailed work plan of EIS;
- Analysis of the environmental legislation in Bosnia and Herzegovina, EU directives, as well as other international conventions relevant for the environment protection field;
- Analysis of the Background Documentation for Planning;
- Collection and analysis of all data relevant for environment issue and necessary for preparation of EIS;
- Definition and analyse of potential alternatives, definition of goals and choice of optimum alternative;
- Preparation of two sets of synthesis maps, scale 1:5000; The first set represents the existing status and potential impacts and the second set contains the measures for mitigation of negative impacts;
- Monitoring plan of the environment status by all aspects of impact;

Approach and methodology of EIS preparation were based on the analysis of the data from primary and secondary sources. The primary source data have been gathered during the field research and were related to the entire researched area.

Secondary source data analysis encompassed collecting and analysing available data and information from institutions and public companies relevant for the environment status, as well as the data from the previously performed studies, programs and plans, in order to have the EIS preparation based on as much as possible relevant data.

Description of environment that could be endangered by the project includes the different aspects: socio-economic, climate and meteorological, geomorphologic, geological, engineering-geological and geotechnical, hydrological and hydro-geological, pedological and agricultural, flora and fauna, forestry and hunting areas, landscape, protected areas, cultural-historical heritage, population and settlements, infrastructure, noise status and air quality, endangered by mines.

As a result of activities on the motorway construction for Lot 3, identified, analysed and valorised are positive and negative environmental impacts for the phases of designing, construction and operation of the motorway, as well as the direct and indirect impacts on: population, climate, water, soil and agricultural land, flora and fauna, ecosystems, landscape, cultural-historical heritage, hunting, air and infrastructure.

Analyse of the impact of the planned motorway on the environment has shown, that, in respect of the character and significance of the impacts, the motorway construction has negative and positive impacts on environment emerging from construction of its physical structures, construction activities and operation.

Measures for mitigation of negative impacts include wide range of the activities required in the frame of each of the impact analysed during designing phase, construction phase and operation phase of the motorway. These measures are categorised in the two main groups: general and technical measures for mitigation of negative environmental impact.

Considering the identified potential negative impacts of the motorway construction and operation, the EIS preparation methodology predicts adoption of monitoring program for long-term motorway environmental impacts and proposed environment protection measures. National organisation for the Motorway Management has a task to establish environmental monitoring. The monitoring is aimed at follow up on emission of polluting materials (in air, waters, soil), as well as at changed environmental parameters (air quality, level of noise, quality of water in the rivers, soil quality changes). Monitoring system as also aimed at verification of all systems that the environment quality is depending of (purification of waste waters that are collected on the road, maintenance of those facilities, proper maintenance in case of accidents – chemicals outpouring on the road and similar. Based on the monitoring results, additional organisational and investment measures are taken.

Environment and accidents are interconnected in a way that environment degradation has an impact on natural processes, changes fundamental resources and increases their vulnerability. In that sense, Environmental Impact Study anticipates extraordinary conditions and risk of inadequate protection measures, accident risk during construction and maintenance, risk of accidents while transporting dangerous loads, risk of natural disasters.

Although the probability of the said accidents is low and depends on several factors; their consequences are significant and serious, what is the actual reason for analysing this type of impact in the process of the motorway environmental impact assessment.

3.0 DESCRIPTION OF THE PROJECT PROPOSED

3.1 General Description of the Project

The object of the present Study is the motorway section between Sarajevo South *(Tarčin)* and Mostar North - Lot 3 (app 60 km). This section is part of the Corridor Vc which connects, with its ending points, central part of Adriatic Sea coast with Budapest in Hungary. Trough B&H, 330 km-long Corridor Vc alignment is leading in direction north-south through the central part of the country (valleys of the rivers Bosnia and Neretva) which has the most favourable natural conditions.

Transportation Corridor Vc trough B&H includes:

- Road E-73 Šamac-Doboj-**Sarajevo-Mostar**-Čapljina-Doljani, exiting on Adriatic Sea in the port of Ploče with connection in Budapest at the north,
- Railway Šamac-Doboj-Sarajevo-Mostar-Čapljina-Metković
- Airports Sarajevo and Mostar,
- Navigation routes and ports on the rivers Sava, Bosna and Neretva.

3.2 Objectives and purpose of the Project

Purpose of this project is better connection of Bosnia and Herzegovina with the neighbouring countries and regions, what would at the same time enable stabilisation and support to the overall country development. Better transportation conditions mean better living and working conditions for the local population.

Preparation intensification and beginning of construction of this motorway will be a key initiator of economic activities, enabling B&H in the main transportation flows and global European economic system.

Improved transportation conditions will then improve quality of life that will manifest through the following:

- reduction of transportation time of goods and passengers in comparison to the existing routes,
- reduction of transportation costs,
- reduction of negative environmental impacts through directing part of the traffic from the existing relevant network to the future motorway
- employment increase,
- valorisation of geographical and transportation position of B&H,
- increase of economy competitiveness in the area gravitating towards the Corridor,
- launching new projects and enlargement of private investments within the regional economy.

3.3 Project background

Corridor Vc is part of the Pan-European Transport Network that was adopted by all interested nations in the Conference of Helsinki of 1997 and re-stated in the following European Conferences. Corridor

Vc involves three national territories: Hungary, Croatia and Bosnia & Herzegovina, connecting the Port of Ploče on the Adriatic coast to Budapest intersecting the Corridor X on the Zagreb-Belgrade section.

Bosnia and Herzegovina Council of Ministries has decided to construct the national section of the Pan-European Corridor Vc motorway. The B&H section of Corridor Vc is around 330 km length and its construction cost is estimated to be roughly 5 billions Euro.

Forward to that decision the B&H Ministry for Communication and Transport launched an international Tender for the supply of consulting services for the "Preparation of Planning and Study Documentation (PPSD)" for the Corridor Vc, divided into 6 different Lots. The PPSD will aim at defining the optimal technical solution for Corridor Vc, its economic and financial feasibility and the most viable procedure for involving private financing in the motorway investment and management.

In order to facilitate the construction financing and take also advantage of the private sector efficiency, the Council of Ministries will also evaluate the recourse to Public-Private-Partnership (PPP) financing in the possible form of a DBOT to be established by the planning and feasibility studies of the PPSD underway.

3.4 Data and spatial planning documentation of the considered area

Spatial plan of Bosnia and Herzegovina for the period 1981-2000 interprets in details all important spatial characteristics and the determined future functions of space in the urban and non-urban areas. All basic spatial systems, as well as the protected values and space of the architectural heritage etc. are considered. In the mentioned plan, it was emphasized the necessity of "roads of the highest level" realization in the direction North-South, which mostly represent the major part of the current motorway of the Corridor Vc.

The spatial plans of municipalities, as the first generation of the planning documents related to the B&H spatial arrangement, mostly respected precepts related to the construction of the motorway and partially protected the corridor from illegal and other construction.

Review of spatial planning documentation encompassed status analysis of spatial planning and urbanism documentation of the municipalities the Corridor Vc is passing through.

The motorway part treated in Lot 3 passes through the entire territory of the Municipality of Konjic and Jablanica and smaller territories of Hadžići and Mostar municipalities.

At the higher level, considered was the Spatial plan of B&H for the period 1981-2000 (2015) predicting construction of the Corridor Vc motorway. Adopted and protected Corridor, incorporated also in the municipal spatial plans was, up to maximum ability complied with by the alignment analysed in this Study. At the section, stretching through the massif of Prenj, the studied alignment somewhat spatially but not conceptually differs from the Corridor alignment predicted by the Spatial Plan. Limitation factors criteria were defined and these criteria have been taken in account in the Study. They encompassed preservation of the following elements: natural values and rarities, water resources, cultural-historical heritage, urban structures, industrial complexes, energy industry facilities, high value agriculture land etc. In that way not only that spatial planning concept remains undamaged, but also the concept of environment protection of Corridor, as set in the Spatial Plan.

Beside the Spatial plan, considered were the Strategy of physical arrangement of F B&H and NEAP – National Environmental Action Plan of B&H.

At the lower level of consideration, analysed were spatial and urban plans for the specific municipalities the alignment is passing through:

- Spatial plan of Sarajevo Canton
- Spatial plan of Hadžići municipality
- Urban plan of Hadžići municipality
- Spatial plan of municipality association Konjic-Jablanica-Prozor
- Spatial plan of Konjic municipality
- Urban plan of Konjic municipality
- Spatial plan of Jablanica municipality
- Spatial plan of Mostar municipality
- Urban plan of the North valley of Mostar

Insight to this documentation enabled a good quality analysis of the proposed alignment solution in sense of comparison of elements from spatial planning documents to the real existing spatial elements, with simultaneous information verification through the field assessments.

Proposed motorway alignment is in general conformity with urban and spatial plans of the municipalities of *Hadžići, Konjic and Mostar*, what is not the case of *Jablanica* whose connection to the planned motorway was not originally predicted.

3.5 Socio-economical significance of the Project

Bosnia and Herzegovina is making great efforts in becoming a part of European and global economic and transportation system. One of the ways for achieving this goal is involvement in Pan-European transportation integrations. The first step on that path is made by verification of Corridor Vc through Bosnia and Herzegovina that will, in north-south direction connect B&H with Croatia and Hungary, meaning Central Europe. The road is to be routed via Osijek in Croatia and to cross into B&H over the Sava River, north of Odžak. The route through B&H will connect the major industrial centres of Doboj, Zenica, Sarajevo and Mostar.

Transport and the improvement of transport infrastructures generally have an important role for sustainable economic growth of the society.

Road transportation in Bosnia and Herzegovina accounts for over 95 % of all goods and passenger movement in the country. Efficient and low cost road transport is therefore essential to facilitate local, regional, and international trade and economic exchange. It is also an important factor in promoting integration an ethnically divided country. The development of road transport corridors in B&H is very important for the improvement of the population's standard of living and poverty reduction. The Corridor Vc construction is for many reasons deemed justified from the aspect of its social and economic importance. In the Corridor zone lives 50% of B&H population, making 60% of total GDP. Better conditions of transport services mean better living and working conditions for local population, what means improvement of social structure.

The new alignment will, thus, impact intensifying of many activities within the Corridor Vc motorway and wider area. Therefore, it is important to take care of real development prerequisites for the economic activities set as priorities in the Mid-term development plan of B&H, such as: agriculture, tourism, energy sector, wood processing industry, as well as of the prerequisites related to a local area, such as water management, electricity distribution and forestry that demand special attention. It will also enable more adequate utilisation of natural and created, as well as cultural-historical values of the area.

Transport provides intermediate services to facilitate interactions among productive activities. The micro-economic mechanisms through which the benefits of transport investment are translated into income growth are quite well recognized. Transport investment reduces the cost of assembling intermediate inputs for production (raw materials, energy, labour, other intermediate products, and information) from different locations, directly reducing the cost of production. Reduced cost and improved quality in transport services also reduces the delivered price of products and hence promotes regional and international trade, making it possible for agriculture to commercialise, for industry to specialize, and for production and employment to expand by exploiting different economies.

Transport investment contributes to economic diversification as well, which enables exploitation of economies of scope and increases the economy's ability to handle risks. In a multitude of ways through these mechanisms, transport contributes to economic growth.

The development of Corridor Vc Motorway will have an impact on the various aspects of economy on local, regional and national level. The development of economy here is related to better road connection and in consequence to the improvement of economic and social environment. The improvement of traffic connection will occur on inter-municipal, inter-regional (cantonal) and national level, as well as on international level, taking into consideration the realisation of the whole Trans-European Corridor Network in future.

The Corridor Vc motorway alignment is a new capital development possibility that will, in the forthcoming period, takeover the role of economic development generator. The motorway, will not only enable more adequate use of natural and created resources of this area, but will also enable structural transfer and development of those functions and activities that are compatible to the motorway and have immediate impact to economic development.

Area in the Lot 3 Corridor (Corridor Vc) is seen as an area over which the European flows of people and goods are channelled. This area is also seen as the area of intensive development of numerous economic activities and cooperation with the neighbouring production and consumer centres, what will enable the area covered by the Lot 3 to become one of the more developed parts of B&H, as well as important development initiators and holders of general Bosnia and Herzegovina economic development.

Area in the Lot 3 Corridor (Corridor Vc) is seen as an area connected to other tourism and agriculture areas that are leading in degree of common investments of domestic and foreign partners.

Area in the Corridor will obtain economic development of the wider area along its entire length. In that way, the living conditions of population will reach the level of developed regions, meaning European Union countries.

Limits of investigation area in EIS

The wider area of influence (we can assume as limits of investigation area) of the project, which is considered to be the most convenient for the Corridor Vc Motorway Project, comprises two Cantons of the Federation of Bosnia and Herzegovina:

Sarajevo Canton, comprising the 9 municipalities: Stari Grad, Centar, Novo Sarajevo, Novi Grad, Ilidža, Vogošća, Hadžići, Ilijaš and Trnovo. The Canton covers a territory of 1,277 km^2, and according to the data collected in the year of 2004, the Canton has a population of 401,687.

Hecegovina-Neretva Canton, comprising the 8 municipalities: Čapljina, Čitluk, Jablanica, Konjic, Neum, Prozor, Ravno, Stolac and the City of Mostar. It covers a territory of 4,401 km^2, and in 2004 had a population of 224,535. The economic centre of the region is Mostar, at a distance of 130km from Sarajevo, 180km from Dubrovnik, 160km from Split, 430km from Zagreb and 530km from Belgrade.

The area of direct influence for the socio-economic environment has been defined as the about 1km-wide stretch on both sides of the road alignment. This means that an area of 2km is considered to be directly influenced by the road. Accordingly, the population in the area of direct influence for the considered sections of the Corridor Vc Motorway Alignment 3, between Tarčin and Mostar North, is estimated to be about 22,000.

3.6 Alternatives examined and road characteristics

The motorway crosses mountain areas and therefore the choice of the route required the examination of several options.

For this reason, the Consultant prepared a first Multi-Criteria Analysis I, included in the Technical Study, in order to decide the most convenient corridors for the new motorway. After this analysis the best Corridors have been identified in the name of Corridor 2B and 3 and adding Corridor 4, which represents the Base solution of the Ministry and additional alignment variants have been identified inside the chosen Corridors.

Multi-criteria Analysis II was then presented in the Data for Pre-feasibility Study Report. This updating called “MCA II” takes into account that the preferred alternative 3 might have also the option of a different connection point with Lot 4, taking into consideration the 2 different connection points proposed by IGH.

The Conceptual Design Report then presented a revised Multi Criteria Analysis (MCA III), taking into consideration alignment adjustments, considering also the proposed connection points of Lot 4.

The overall objective of the studies and project documentation for the motorway is to consider the necessity for improvement of the transport quality, traffic capacity and safety in the corridor through construction of a full profile motorway.

The MCA III followed the Protocol 3, agreed by the contract managers of the four lots of Corridor Vc, which foresees four basic criteria: Technical and Operation Characteristics; Investment Costs; Spatial planning and environmental characteristics and Time and Conditions of Construction.

The MCA III has considered the results of the findings (maps and information) deriving from the Background Documentation Study and 3 possible selected alternatives.

The main data of the alternatives studied are presented in the following table:

Table 7

Alternative	Description	Length (km)	Interchanges	Bridges (number)	Tunnels (number)
2B	Follows the River Neretva after Jablanica, 70% of corridor are bridges and tunnels	62+616	Tarčin, Konjic and Jablanica	32	34 (max 4,269m)
3	After Konjic passes far from Neretva, 70% of corridor are bridges and tunnels	59+700	Konjic and Jablanica	22	35 (max 6,400m)
4	After Konjic goes into mountains, 60% of corridor are bridges and tunnels	55+700	Tarčin and Konjic	31	34 (max 8,982 m)

All the alternatives start from the same point, near Tarčin, and have the same ending point, in North Mostar.

The starting point was established in collaboration with designing company IPSA, trying to understand how the road will serve the Sarajevo zone in the future; therefore two different connections are possible by this starting point.

1) Direct connection to Sarajevo following the existing road, or maybe a new road that will be constructed, upgrading the existing road to motorways standard;
2) Direct connection to Visoko shortening therefore Corridor Vc.

The end of Lot 3 is situated in the North of Mostar, and after this point it is possible to by-pass the town on the left or on the right side of the Neretva River.

Also, in this case the coordinates of the ending point of Lot 3 and starting point of Lot 4 were agreed with IGH, but two possible connecting points were indicated, depending on the alignment of Mostar Bypass.

Taking into consideration the above, it was decided at this first stage to have Minimum Radius (R) of 700m in the open sections, and R ≥ 1,250 m in the tunnel section for corridors 2B, 3 and 4, in order to guarantee enough visibility, without widening the cross section.

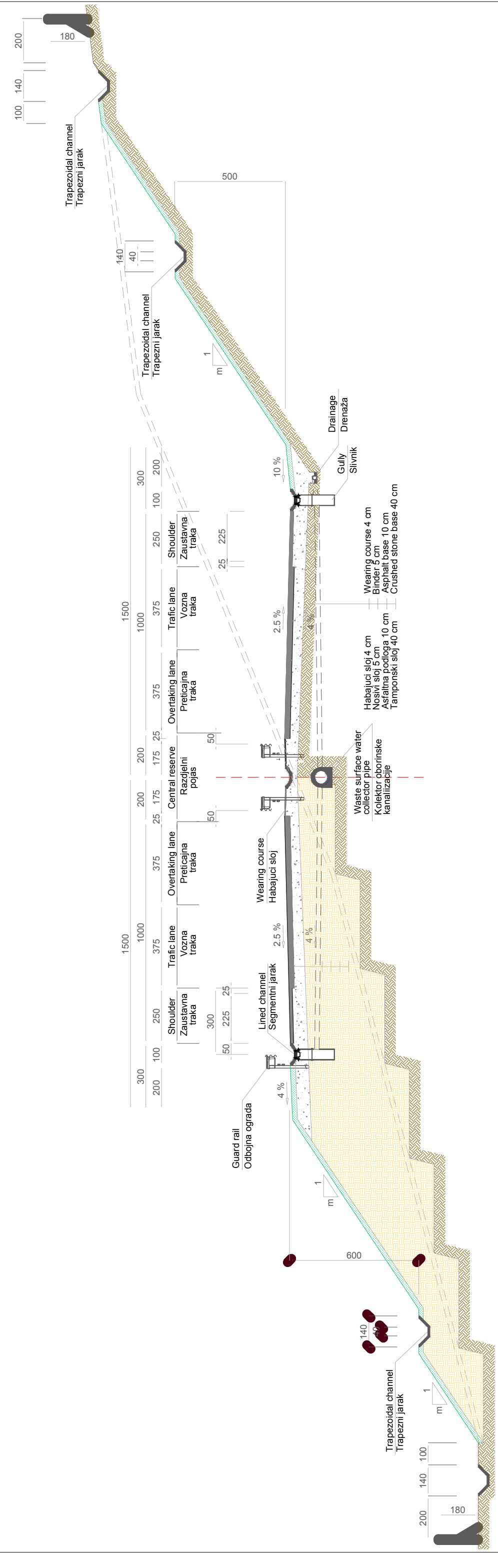
As far as tunnels concern for all corridors tube widening depends on tunnel length.

For tunnels shorter then 500m, each tube is 12.35m wide at the base (2 lanes +emergency lane), for longer tunnels each tube is 10.45m-wide at the base (2 lanes), but parking areas are provided every 500m.

In the first section, up to km 26, all the alternatives follow the same alignment and the length of the main structures (bridges, viaduct and tunnels) does not depend from the radius, since the difficult morphology of the area requires perpendicular crossing of mountains and valleys. All the design criteria follow TEM Standards.

The two separate carriageways have two traffic lanes (width of 3.75m) and a shoulder (width of 3.25m, with 2.50m paved for the emergency lane) and central reserve of minimum 4.00m with safety barriers.

TYPICAL CROSS SECTION - NORMALNI POPRECNI PROFIL



Parameters of Alignment

The following criteria, in accordance to TEM, have been adopted:

- Minimum Radius of R = 700m and R ≥ 1,250m in the tunnel section to have enough visibility;
- The Transition Curves (spiral) has a parameter (A> R/3) that is:

$r \times s = A^2$

where:
r = curvature radius in a point of the curve
s = length of the spiral

- The Gradients are less than 4%;
- Normal cross fall is between 2.5 and 7.0 %;
- The Stopping distance (Sd) is considered without the influence of the gradient, in that phase, as follow:
  - Ds = 120km/h Sd = 200m
  - Ds = 100km/h Sd = 150m
- The Minimum radius used for vertical curves are:
  - Concave R ≥ 10,000m
  - Convex R ≥ 30,000m

The Overhead clearance is always more than 4.50m.

Table 8

Structures	Number	Total Length (m)	% of total	Max Length (m)
Tunnel	35	~38,500	63%	6,400
Bridges/ viaduct	22	~3,800	6%	460
Bridges and Emb. >2m		15,868		
Cuts and Emb. < 2 m		4,229		

Municipalities crossed by the road

Tarčin

The approach in Tarčin area took into consideration the presence of two important transportation infrastructures as the M17 National Road and the railway. The starting point is located in a position that is high enough to allow the overpass of the existing road.

After km 1+500 the valley becomes narrow. The available space between the railway embankment and the national road is barely enough to allow the new motorway to pass in-between.

The most critical point is at km 2+300, where the railway embankment is wider. A sheet-pile diaphragm wall and a short cut-n-cover tunnel are proposed in this section: this solution reduces the interference with the existing railway line. Everywhere else the new embankment will be just at the side of the railway.

From km 2+800 the existing road is over-passed by viaduct and the alignment climbs on the other side of the valley.

Ivan Tunnel south - Bradina

Km 9+300 is one of the most critical points of the entire alignment: a very complicated crossing with three interfering situations at three different heights: the existing national road M17, the existing railway line, and a water stream.

Starting from this point, the alignment descends to Konjic with a 3.0 – 3.5% gradient, representing the minimum gradient required to reach the requested level for Konjic interchange. In fact a lower gradient does not give the possibility of realizing the interchange, a higher gradient increases the transport cost and reduces the design speed for climbing heavy vehicles.

Several site surveys were done in the area to better understand the environmental context, and to be sure to minimize the impacts on the most valuable areas.

Konjic

A major modification of the Conceptual Design was introduced between km 19+600 and km 21+100: the previous C.D. alignment was too close to the town of Tuk Draga, crossing some of its buildings. A tunnel by-pass has been therefore studied to avoid important demolitions.

From km 21+200 the present alignment follows the C.D. up to the area of Konjic interchange (km 21+500 – 22+000).

A relatively flat area has been chosen for the interchange, in order to reduce the works for the ramps: contacts have been taken with the municipality of Konjic in order to identify the most suitable area not too close to the town.

The motorway is kept at a raised level, in order to allow the ramps to underpass it.

A significant change is done to the position of the Jablaničko Lake bridge.

Its actual position is about 100m southern, in order to avoid a group of buildings on the left bank of the river.

Among the other advantages of this solution, the replacement of a natural tunnel with and artificial one (km 22+600 – 22+900), and the crossing of the railway bridge on land instead of on water are the most significant.

Čelebići

An important remark has been made about the impact of the Conceptual Design alignment around km 25+300.

There's a side valley with a small town in the northern part, with a couple of restaurants and fish farms close to small waterfalls, and a very environmentally remarkable rural area at the southern part of the valley with some ancient villages.

The former crossing of the valley was too close to the town. Another crossing point has been chosen, about 200m southern, where a double bend of the river and the slopes create a "blind" closed area, therefore this route reduces the visibility of the viaduct from the surroundings.

From this point to km 28+200 there is another major variant, in both horizontal and vertical alignments: a straight tunnel from km 25+400 to km 27+800 (2,400m) instead of a large curve to the north with two tunnels (1,000m and 1,400m) and a bridge in between. Obviously, the solution with a unique tunnel is less expensive and shorter.

At the same time, the viaduct at km 27+900 has been reduced, from 500m-long/90m-high to 250m-long/65m-high, in order to reduce the impact on the beautiful and uncontaminated valley to be crossed.

At km 29+100, the inlet one of the major tunnels of the project (3,600m) is met. The horizontal curve in the middle of the tunnel has been removed.

<u>*Jablanica*</u>

The alignment from km 32+700 to km 40+500 is conceptually rather simple: it mainly follows the direction of this first valley up to Jablanica, going down with a gradient of 4%, and then up again, always with a 4% gradient, along the path of another valley leading to Prenj Mountain.

An important effort was done to improve the alignment in this critical section, being the gradient equal to the maximum allowed.

In particular, the long (1,400-1,500m) viaduct shown on Conceptual Design, strongly remarked as negative by the environmental impact study, is removed by improving the alignment. The position of the Jablanica interchange has been also modified, moving it on the other side of the valley, thus crossing the river only once. The town of Glogošnica will be by-passed by a tunnel.

Another very important element pointed out by the environmental impact study is the preservation of the valley entering the Prenj Mountain. It's an unspoiled area that should be preserved as much as possible.

A possible solution could be to increase the length of the Prenj Tunnel, changing the position of the northern portal and placing it at about km 39+000. In this case the tunnel length increases to nearly 7,5 km, therefore this solution was abandoned, also because of the necessity of a viaduct crossing the valley with a negative impact. At km 40+100 the longest tunnel of the lot (6300m) begins, under the Prenj Mountain.

An horizontal curve at km 43+600 has been inserted to limit the length of the tangent for safety reasons (drivers accelerate on long tangents). The south portal is situated at km 46+400.

The major morphological landmark influencing the alignment in this area is a deep valley beginning from Bjela (about km 51+400) with an E-W direction that has to be crossed.

3.7 Technical description of the Project according to Preliminary Design

Section 1 – from Tarčin to Jablanica Lake (km 0+000 - km 24+500)

The starting point, whose coordinates have been agreed with the designers in charge for the Lot 2, is located in the northwest area of Tarčin, at the ground elevation of 661m.

For the first 2km, the alignment is in fill (average height above the ground around 8m) due to the position of Lot 2 end-point. This is not to be considered a big disadvantage, since in this section there is, in any case, the necessity of over-passing some existing roads, including the M17 main road.

For the first 3 km, the alignment follows the existing infrastructure corridor formed by the M17 Road and the railway to Ploče. Around km 3+000 the alignment overpasses the M17 Road and approaches the Ivan Mountain under-passing it through the smaller, app. 300m-long tunnel.

The inlet of Ivan Tunnel is situated at km 4+500. The total length of this tunnel is 3,190m. The vertical alignment changes its slope inside the tunnel, proceeding downhill towards Konjic, on the west side of the M 17 Road with a constant gradient of 3.39%.

Due to the morphology of the area, from km 8+500 to km 20+000 the motorway presents a sequence of tunnel and bridges (10 tunnels and 9 bridges, max. tunnel length 1,880m, max. bridge length 250m).

The crossing of the valley at km 9+300 is a critical point. The existing road and railway strongly limit the alignment. The solution chosen overpasses the existing road and underpasses the railway.

The alignment follows the Jablanica Lake on its North bank from km 20+000 to km 23+100, where it crosses the Lake with a bridge over-crossing the existing railway bridge.

Konjic interchange is located around km 21+700, on a flat area 220m northward Jablanica Lake bank.

After passing Jablanica Lake, through a 320m-long tunnel, the alignment proceeds in direction West towards Jablanica, under-passing the Karevice hill.

The total length of this section (from Tarčin to the Jablanica Lake Bridge) is 24.50km, of which 10.85km in curve. The minimum radius of horizontal curves for this section is 1,000m and the total difference of ground elevation is 339m (max. gradient i=3.93%).

Section 2 - from Jablanica Lake to the river Bijela Valley (km 24+500 – km 47+650)

From km 24+500, the motorway proceeds towards Jablanica in Southwest direction. Two long tunnels are foreseen before reaching Jablanica. The first one is 2.080m-long and the other 3.630m. At km 36+000, the alignment reaches Jablanica.

The interchange of Jablanica has been proposed, for the alignment, in the Valley of Glogošnica River, app. 5km far from Jablanica City. The related local connection roads will be studied in detail and designed in the following phase of the Project.

After Jablanica Interchange, the road precedes uphill towards the South, following the valley of the river Suhava. A long tunnel (6,400m) under Prenj Mountain starts at app. km 40+000, ending at km 46+400, in the valley of river Bijela, a tributary of the river Neretva.

The total length of this section is 33.15km, 8.45km of which in curve. The minimum radius in curve for this section is 1,000 m and the total difference of ground elevation is 43m (max gradient i=3.95%).

Section 3 - from Bijela Valley to Mostar north (km 47+650 – 60+400)

The last section follows the Valley of Bijela River for approx 3 km, and then proceeds in southeast direction with a sequence of bridges and tunnels to reach the endpoint at km 60+400.

The most important landmark in this section is a very deep valley at km 51+700. A *tunnel / high bridge / tunnel* solution is necessary to find the most suitable compromise between height and length of the bridge and length of the two tunnels.

Then:

- If the alignment goes to the north, the bridge is shorter but the length of the route and of the tunnels increases,
- If the longitudinal profile is kept lower, the bridge is shorter and lower, but the tunnels are longer.

The realization of an arch bridge is recommended in order to reduce the difficulty caused by the bridge height. The best compromise seems to be the realization a 420m-long arch or similar "special" bridge (see sketch below), with 2,150m and 1,050m-long tunnels.

The total length of this section is 20.50km, 3.47km of which in curve. The minimum radius in curve for this section is 1,000 m and the total difference of ground elevation is 141m (max. gradient i=3.95%).

<u>*Interchanges*</u>

Two interchanges are foreseen by our study, in order to serve the main urban areas situated along the motorway alignment:

Konjic

The interchange of Konjic (km 21) is located in the Northeast of that town, in a zone scarcely populated and hidden by hills to the viewpoints of the Jablanica Lake.

Some infrastructures are already present in the area, in particular a local road and the railway. The zone selected for the interchange is almost flat, no hydraulic problems are foreseen and it is possible to connect that interchange with the town with a small viaduct on the Neretva River.

Jablanica

The interchange of Jablanica (km 37) is located in the South of that town, in a zone scarcely populated and covered by hills to the viewpoints of the Neretva River.

Some infrastructures are already present in the area, in particular the existing road from Jablanica to Mostar and the railway. The zone selected for the interchange is almost flat, no hydraulic problems are to be foreseen and it is possible to connect that interchange with the town and the existing road by a overbridge crossing the railway.

<u>*Characteristics concerning motorway operation*</u>

Further to the Client's instructions and to the agreement with the Consultants in charge for the design of the other Lots, the cross section in tunnel is different for short tunnels (total length < 500m) and long tunnels (total length > 500m).

The tunnel cross section should provide sufficient space for necessary traffic installations and technical equipment. The ventilation and other equipment as well as signs must not reduce the traffic area.

The cross section in short tunnels has the same characteristics of the typical open air cross section with two 3.75m traffic lanes and a 3.25 m emergency lane, while in long tunnels, in order to reduce the construction costs, the emergency lane has been replaced with 1.75m shoulder.

Overhead clearance of minimum 4.50m must be assured in tunnels during their full life cycle.

The geometrical characteristics for both tunnels are shown in the following picture. For short tunnels, the internal radius on the top of the section is 7.00m, the internal radius on the sides of the section is 6.40m, and the sub-arch radius is 18.00m. The total internal area is 98m^2.

Long tunnels have an internal radius of 5.67m and a 17.50m sub-arch radius. The internal area is 80m^2.

The next table summarises the length of the structures by their types.

Table 9

	m	% of total
Total length of structures	~3,800	6%
Total length of tunnels	~38,500	64%
Total length of alignment without structures and tunnels	~17,400	29%

The following Tables 10 and 10a contains the main proposal structures:

Table 10 Breakdown of bridges

Bridge mark	~Station	~Bridge Length (m)
M1	2+900	210
M2	4+050	200
M3	8+000	90
M4	9+400	60
M5	10+100	120
M6	10+900	230
M7	12+700	140
M8	15+800	170
M9	16+300	110
M10	17+700	80
M11	18+500	170
M12	19+700	190
M13	22+500	120
Jablaničko Lake	23+200	390
M14	25+300	90

M15	27+900	230
M16	28+500	60
M17	28+900	180
M18	33+800	90
M19	48+900	130
The river Bijela	51+300	460
M20	58+900	310

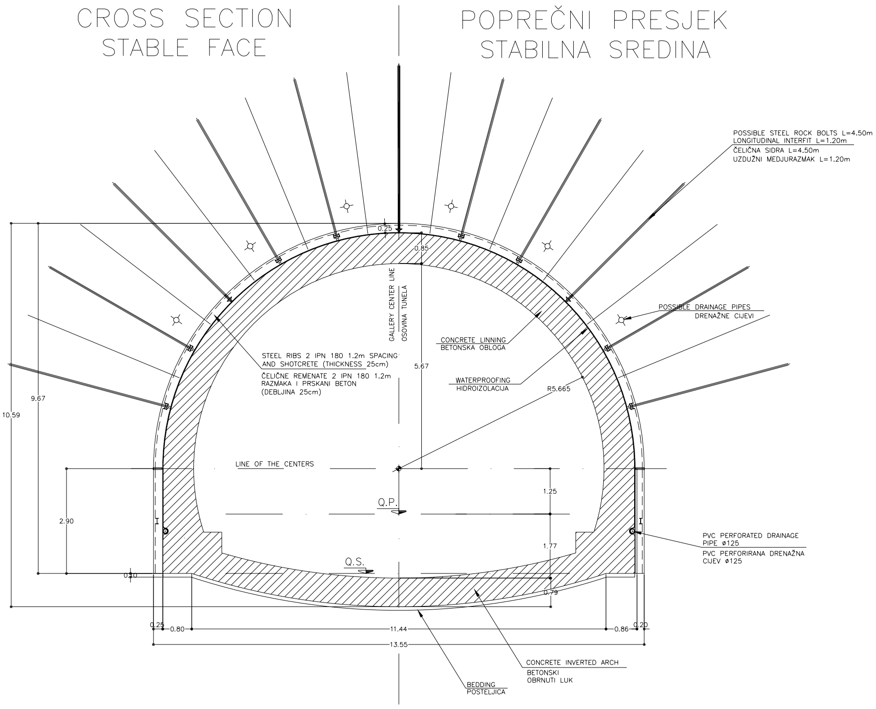
Table 10a Breakdown of tunnels

Number of tunnels	~Station	~Tunnel Length
T1	3+300	300
T2	4+530	3,190
T3	8+250	1,090
T4	9+400	600
T5	11+070	1,550
T6	12+800	1,880
T7	14+850	810
T8	15+800	280
T9	17+200	1,220
T10	17+900	500
T11	18+650	930
T12	19+840	1,270
T13	22+250	180
T14	22+650	230
T15	23+500	310
T16	23+900	670
T17	24+750	510
T18	25+430	2,350
T19	28+070	150
T20	28+500	270
T21	29+200	3,670
T22	33+000	340
T23	33+400	120
T24	34+300	540
T25	35+500	400
T26	36+890	140
T27	37+300	1,050
T28	39+180	790
T29	40+100	6,360
T30	48+400	500
T31	49+540	1,610
T32	51+650	1,140
T33	53+550	2,150

T34	56+100	670
T35	56+950	770

Support system and tunnelling

Two different support systems are designed to guarantee an adequate resistance against rock stresses and deformations. The excavation of tunnels in “Hard rocks”, since the soil is stable and therefore work conditions are generally favourable, are done with the support system represented in the following figure (Cross section called “Stable Face”).

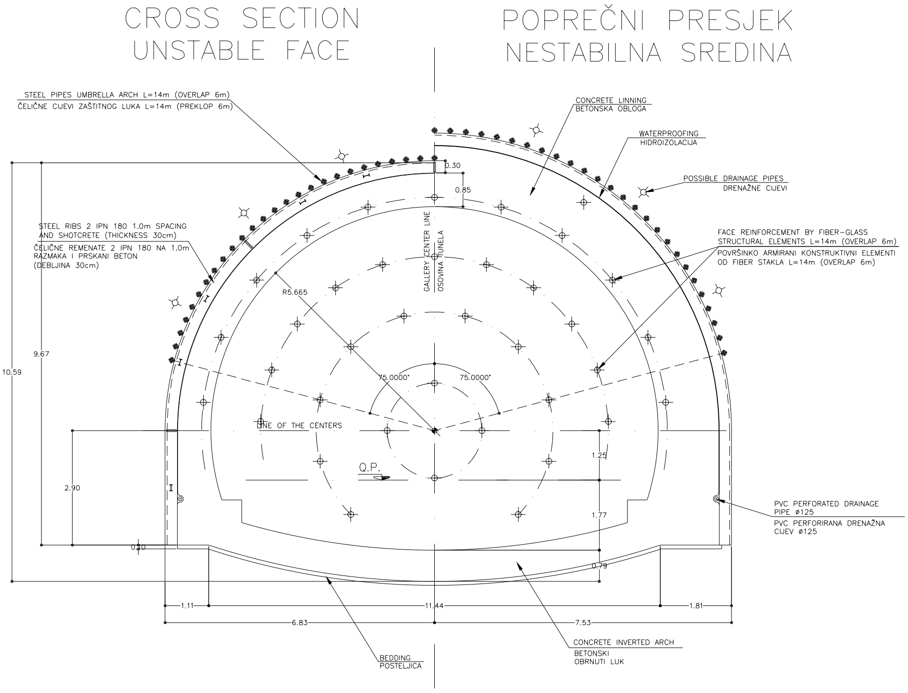


The main support designed to assure the necessary safety in all the phases of the tunnel life are:

- Short Term (Tunnel Excavation)
  - STEEL RIBS 2 IPN 180 (1.2m spacing)
  - SHOTCRETE (Thickness 25cm)
  - POSSIBLE STEEL ROCK BOLTS (L=4.5m, interfit L=1.2m)
  - POSSIBLE DRAINAGE PIPES
- Long Term (Motorway Life)
  - CONCRET INVERTED ARCH (Thickness 85cm)
  - CONCRETE LINING (Thickness 85cm)

The excavation of tunnels in “Soft rocks and Soils”, considered stable/conditionally stable and unstable soils, is executed with the support system represented in the following figure (Cross section called

“Unstable Face”). Construction conditions are relatively less favourable if compared to the mentioned “Hard rocks”.



The main support designed to assure the necessary safety in all the phases of the tunnel life are:

- Short Term (Tunnel Excavation)
  - STEEL RIBS 2 IPN 180 (1.2m spacing)
  - SHOTCRETE (Thickness 30cm)
  - STEEL PIPES UMBRELLA (L=14m, overlap L=6m)
  - FACE REINFORCEMENT BY FIBER-GLASS STRUCTURAL ELEMENTS (L=14m, overlap L=6m)
  - POSSIBLE DRAINAGE PIPES
- Long Term (Motorway Life)
  - CONCRET INEVRTED ARCH (Minimum thickness 85cm)
  - CONCRETE LINING (Minimum thickness 85cm)

Method of work

The excavation of the tunnels will be done taking into account the safety risks during the works for all the people involved in the construction and the good performance of the structure during the whole life of the motorway.

The construction of all the parts of the tunnels indicated with cross section “Stable Face” must be done in the following way:

1) Execution of 6 drainage pipes if necessary (in presence of water)
2) Start of the excavation of the full cross section (fields of 1.2-2.4m)
3) Supply of steel rock bolts if required (it depends of the conditions of the rock)
4) Execution of the shotcrete (thickness 5cm)
5) Insertion of two steel ribs IPN180 every 1.2m
6) Execution of the shotcrete (thickness 20cm, for a total width of 25cm)
7) Execution of the inverted arch
8) Installation of the waterproofing
9) Execution of the concrete lining

The construction of all the parts of the tunnels indicated with the cross section “Unstable Face” must follow this methodology:

1) Execution of the shotcrete at the head of the excavation (thickness 10cm)
2) Performing of the holes to put fiberglass structural elements
3) Supply of the fiberglass structural elements
4) Consolidation of the terrain boundary by steel pipes umbrella
5) Execution of 6 drainage pipes if necessary (in presence of water)
6) Start of the excavation of the full cross section (minimum of 1m but it depends of the conditions of the rock)
7) Supply of steel rock bolts if required (it depends of the conditions of the rock)
8) Execution of the shotcrete (thickness 5cm)
9) Insertion of two steel ribs IPN 180 every 1.2m
10) Execution of the shotcrete (thickness 25cm, for a total width of 30 cm)
11) Execution of the inverted arch
12) Supply of the waterproofing
13) Execution of the concrete lining

Design standards

As mentioned in the Technical Study General Report, the TEM standards were proposed and agreed with the Client and the other parties participating to the Project (IPSA and IGH).

The highlights of the agreement to follow for the design are the following:

a) Speed Standards

Design speed Vp and max. longitudinal slope:

- 120km/h for 4% slope (Rminkv = 12,000m tab 3B STANDARDS)
- 100km/h for 5% slope (Rminkv = 6,000m tab 3B STANDARDS)

If the longitudinal slope is 5%, it is necessary to explain the reason of the choice and to study the eventual necessity of the third lane.

- design speed Vr min = Vp
Vr max = the highest speed allowed by B&H Law for Motorways

- chosen speed Vr max = 120km/h

b) Standards elements for the designed speed

transversal slope of pavement:	straight stretch q = 2.5% curves q = 2.5 – 7% (towards the curve center) reverse slope in curve : when R>4,000m (for Vr=120km/h) when R>2,500m (for Vr =100km/h)
visibility (min)	
emergency lane Pz	200m (Vr = 120km/h) item 3.1.9.4 TEM 150m (Vr = 100km/h) item 3.1.9.4 TEM
speed lane	P1 400m (Vr = 100km/h) or better 600, but only for min radius of circular curves with transition Rmin = 650m (Vp = 120km/h) according to the Item 3.1.5.1 of the TEM Rmin = 450m (Vp = 100 km/h) according to the Item 3.1.5.1 of the TEM
Miscellaneous	Circular curves without transition curve can be used if: R>3,000m (Vp = 120km/h) R>2,000 m (Vp = 100km/h).

c) Motorway cross sections- details:

- width of the traffic lane = 3.75m,
- width of the road edge = 0.25m,
- width of the emergency lane = 2.50m (asphalt road),
- width of slow-speed lane =3.50m (min), min L=1,000m,
- width of central reserve = according to TEM standards (4.0m /3.0m),
- width of embankment = min. 1m + side drain or trapezoidal ditch for designed dimensions,
- berme min 2.5m (depending on drainage and geo-mechanical characteristics of material),
- berme in cuts min 3.0m (depending on geo-mechanical elements, it could be wider if required),
- berme on slopes of embankments depends on its design. Drainages on side slope of embankments should be avoided in case of poor geo-technical conditions of the material.
- free profiles min 4.50 + 0.20m.

d) Tunnels Standards

- cross section of tunnels includes emergency lane for the tunnels with max length of 500m,
- tunnels with min length of 500m have no emergency lane, but emergency widening every 500m,
- Transfers passages are placed on every 500m for vehicles (on passage) and for pedestrians are placed every 250m, connecting the two pipes,
- for each tunnel, design speed is 120km/h and all design elements should be done accordingly,

- for tunnels in difficult construction conditions and in curves (huge spatial limits and mountain terrains) alternative option should be given in conceptual designs (speed limitations or widen section because of lower visibility), and approval by the Investor must be required.

e) Bridges and Viaducts

- Emergency lanes should included on every bridge and viaduct on the Motorway
- Semi-prefabricated construction system should be provided
- Drainage system should be provided
- Sidewalks should be designed for each flyover and underpass near settlements.

The other elements of design are the following:
- Motorway: according to TEM Methods and Standards (February 2002)
- Other roads: according to national Regulation from 1981.

Design of Structures

According to ToR, the design of different structures as bridges, retaining walls, culverts, etc. will comply with the following norms.

EUROCODE 1	Basis for design
EUROCODE 2	Design of reinforced concrete and pre-stressed concrete structures
EUROCODE 3	Design of steel structures
EUROCODE 4	Design of composite structures
EUROCODE 5	Design of wooden structures
EUROCODE 6	Design of brick-laid structures
EUROCODE 7	Geotechnical design
EUROCODE 8	Seismic design
EUROCODE 9	Design of aluminium structures

Materials to be incorporated

The quality of materials to be incorporated must follow the European Standards (see CEN Construction Directive 89/106/EEC).

Land use conditions during construction and operation of the motorway

Because of the importance of the works, the construction of Sarajevo-Mostar should be divided into three lots; therefore three different Contractors will probably operate in the area.

The first necessity will be the installation of the main site for each lot, housing the offices, the workshops and warehouses, the plant (crusher, concrete and asphalt) and the prefabrication yard.

It is evident that each Contractor must find a flat area of approximately 2 ha, not far from the existing M 17 road.

For the section between Tarčin and Konjic, the most suitable place is at the beginning of the lot, not far from Tarčin.

For the section between Konjic and Jablanica the research is not so easy because of the nature of the area.

For the section between Jablanica and Mostar, the most suitable area will be at the end of the lot, in the plain north of Mostar.

The second necessity will be the organization of the movements along the construction site, in order to assure the communications of the equipment and materials between the main installation and the construction site.

For this purpose the Contractor should use as much as possible the existing roads and tracks, opening connecting points with the road to be built, from where to proceed to the different construction sites, using the same road under construction.

It is also possible that temporary tracks must be built, in case the existing ones are not sufficient, but, to our mind, no impact on the environment can be caused by this activity, since the existing situation can be easily re-established.

At each tunnel inlet and viaduct, working platforms must be created to allow the construction. The size of these areas is limited (from 200 to 500sq.m.); in any case the Contractor must propose a working plan assuring the re-establishment of the existing situation after the completion of the works.

3.8 Drainage system and water treatment

Waters from road will be collected through gullies designed according to hydraulic analysis of gully. Further on, water will be treated through the drain, placed in dividing zone, up to the place of exhaust. Nearby water flows are most often used as recipients.

Water collected by this method contains huge quantities of contaminants. The most often are solid particles that are outcome of car brakes and various petroleum products (engine oil and motor fuel) which are, due to the various different causes, present at the road.

All above require treatment of water in corresponding manner in order to improve its quality before final exhaust.

Therefore, water treatment plants and separators are foreseen along opened alignment according to calculated quantities of water.

Also, rainfall on the bridges will be collected from the surface by bridge gullies and further on through vertical and horizontal pipe system carried out to the separators located on corresponding places along bridge poles.

It is necessary to foresee settlement tanks for separators, in case it is not integrated in separator. Settlement tanks volume should be 10 to 20 times bigger then flow, on which separator is dimensioned. Separator capacity is defined according to calculated quantities of water. Level of water treatment (purification) through removal of oiled particles is defined by classes. Separators of classes I and II will be used for water treatment from asphalt. They should be equipped with tapholes for control sampling.

Separators and settlement tanks are made of reinforced concrete, and obtained as finished (completed) elements. It is necessary to dig a hole in natural material and fill with layer of sandy material, grading 0-4 mm and thickness 10-15 cm. Further details on incorporation and connection to drainage system should be taken from manufacturer instructions.

Water treatment plants are foreseen nearby settlement that is improved measure of water treatment. Flows for all levels of treatment are calculated for designed water treatment plant type. Besides part for removal of oil derivatives, the lagoon owns settlement tank. Design flow for this type of water treatment is approx. 120 l/s.

3.9 *Waste materials and emissions*

3.9.1 Works description

The different works to be carried out during the construction period and that will produce waste materials and emissions are presented below, separated into different categories.

- *Tunnel excavated material quantity*

The estimated quantity of tunnels excavation work material is the follow:

Table 11

		Tarčin	**Konjic - Jablanica**	**Jablanica - Mostar**
Tunnel stable face				
Tunnel L< 500 m	m^3	288,750	351,175	175,175
Tunnel 500< L< 3,000 m	m^3	1,484,736	1,690,752	1,448,032
Tunnel L>3,000m	m^3	-	-	1,557,907
Tunnel unstable face				
Tunnel L< 500 m	m^3	203,775	-	-
Tunnel 500< L< 3,000 m	m^3	229,992	-	-
Tunnel L>3,000m	m^3	795,648	-	-
Total excavation for section	$\mathbf{m^3}$	**3,002,901**	**2,041,927**	**3,181,114**
Total excavation for tunnels	$\mathbf{m^3}$	**8,225,942**		

- *Earthworks*

The first operation consists in the removal of the topsoil through excavation with the bulldozer, materials stockpiling, loading into means of transport and removal from the site.

Excavation in very hard cutting soil is carried out with the excavator with direct loading in the tip lorry and transport to the filling areas. Excavation in average soil cutting follows the same method.

Earth fill requires the levelling of the earth unloaded from tip-lorries with a bulldozer and then compaction with plane roller hauled by a bulldozer.

The covering of embankments with grass consists in the laying of vegetal soil on the embankment with the excavator bucket and levelling with the bulldozer.

The estimated quantity of soil excavation is:

Table 12

		Tarčin	Konjic - Jablanica	Jablanica - Mostar
Category of soil				
I - IV	m^3	990,801.78	5,622,573.58	1,000,833.72
V - VI	m^3	843,830.53	7,398,850.06	667,288.04
Total excavation for section	**m^3**	**1,834,632.31**	**13,021,423.64**	**1,668,061.76**
Total excavation for earthworks	**m^3**	**16,524,117.71**		

- Road superstructure

The laying of the ballast (capping layer) consists in its discharging from the trucks, levelling with the bulldozer and compaction with the roller. The crushed stone layer in the foundation will follow the same procedure. The cement stabilized aggregate layer consists of the preparation of the mix in the concrete batching plant, storage and placement using the same method. Protection with cationic emulsion of the areas can be done with a tanker and spray attachment.

Hot rolled base layer is form from asphalt mixture with bitumen and crushed aggregates. The mixture will be prepared off - site and will be brought to site with lorry trucks equipped with a warming system, discharged in distributors and then compacted with specific rollers for asphalt. The base course made from filler binder and crushed aggregates will follow the same method. The wearing course from bituminous concrete will be made under the same technology.

- Side roads

The crushed stone layer in foundations is executed by leveling with the bulldozer and compacted with a roller hauled. Tanker and spray bar will carry out surfaces priming with cationic emulsion.

The base layer made from asphalt mixture will follow the specific technology presented above. It will be applied in the intersections with the side roads.

- Ditches and Drainage Canals

Precast drainage channels will be carried out with the help of a crane installed on an excavator. Unlined ditches require machine excavation.

The paved ditches with precast elements require mounting of with a crane equipped with an excavator.

- Guardrails and barriers

The guardrails and barriers will be erected with a crane on wheels with easy access.

- Road signs and marking

The following will be erected: signposts, boundary markers (km), traffic indicator post, and road markings. A crane on wheels and a marking machine will be used.

- Bridges and viaducts

The bridges and the passages generally have a double span and the superstructure is constituted principally from precast pre-stressed beams. The construction methodology will be as follows:

- bed clearing to assure the discharge of waters
- installation of cofferdams on one or both banks at the same time from fill or with short sheet-piles
- excavation under direct dewatering of the foundation until the designed level is reached
- forming, reinforcing and casting of abutments from reinforced concrete
- setting of bearing blocks
- mounting of pre-stressed beams of reinforced concrete
- removal of the cofferdam
- deck concreting, carrying out of the roadway, of sidewalks and guardrails
- bed protection by the abutments with concrete slabs
- preparation of approaches

Regarding the bridge execution it is required:

- to carry out the cofferdams and the excavation for abutments in shallow waters
- to remove the cofferdams at average water levels in order not to increase too much the river silt charge
- to prepare concrete off site
- to prepare precast beams in specialized workshops from the area.

- Culverts

For the construction of the new culverts will be necessary pouring of the reinforced concrete using the standard technologies, such as: excavation, formworks, reinforcements and concreting.

During the construction phase the following organizational measures would have to be imposed within the Technical Specifications:

- Marking-out the site cadastre limits in order to define the perimeter assigned to the construction;
- Adequate arrangement of the access roads to the work places, using as much as possible the present roads as roadway for the equipment;
- Preparation of works schedules that take into consideration the running time and the time for placing the materials prepared off site (concrete, asphalt mixture) in order to synchronize the works schedules of production bases with those of the equipment on the road location; the purpose of this action is to prevent the possibility of rejection of the material charges already prepared, taking into consideration the areas sensitivity;
- Provision of guard and security for the equipment and installations in the working area;
- Provision of the equipment necessary for correct execution of the works.

3.9.2 Material management

For the realization of the road section two groups of materials will be used:

- Local materials;

- Construction materials.

A special group is the fuel and the lubricants for the equipment and transportation means which the owners of the mechanized means will provide outside the works.

The measures for the correct management of materials will be grouped into:

- Measures for quality assurance consisting of quality certificates and documents, soil determinations sampled on site;
- Measures for providing the necessary quantities consisting in transport documents, weighing or measurements on samples or the total supply;
- Specific measures to avoid degradation by adequate covering or storage;
- Measures to avoid theft by systematic record keeping;
- Measures to provide efficient handlings using in practice only the specific devices: truck loaders, stackers, cranes etc.;
- Measures for labour protection in all operations of transfer, loading, unloading to be carried out according to the specific training and with protective equipment;
- Measures for the permanent maintenance and cleaning of regional roads and of site ways by levelling them with motor graders, sealing with ballast, watering;
- Measures for avoiding pollution with dust and powder by using covered means of transport.

- Working Traffic

The working traffic will include the vehicles necessary for the transport of construction materials, for the transport of wastes resulted during the execution period as well as for other related activities (transport of fuels for the equipment, transport of water and food for the execution personnel, transport of passengers for supervision and control, etc).

The working travel is designed and assessed in relation with the following elements:

- the volume of materials necessary to be transported on site;
- the categories of materials necessary to be transported: earth, ballast, cement, cement concrete, bituminous emulsion, asphalt concrete, precast elements, dye for markings etc.;
- the categories of existing vehicles (capacity) and the specific consumptions of fuel;
- the time intervals affected by the execution of different categories of works;
- the average traffic speed allowed: 40km/h;
- the time intervals necessary to the operations of loading/unloading: between 5-10 minutes.

- Material management

At the present planning stage an indicative bill of quantities including estimates on the construction materials is going to be prepared. A certain quantity of excavated material will be reused for the construction of the embankments. The expected reuse material quantities are:

Table 13

		Tarčin	**Konjic - Jablanica**	**Jablanica - Mostar**
Total tunnels excavation for section	m^3	3,002,901.00	2,041,927.00	3,181,114.00

Total soil excavation for section	m^3	1,834,632.31	13,021,423.64	1,668,061.76
Foreseen quantities for embankment formation from excavated material	m^3	2,390,035.50	181,243.80	667,954.00
Balance	**m^3**	**2,447,497.81**	**14,882,106.84**	**4,181,221.76**

The total surplus material quantity is 21,510,826.41 m^3. For this quantity a right location or reutilization will be foreseen.

At the same time it is necessary to determine potential quarries and borrow pit locations.

The embankments role is to support the road structure. Embankments are to be fixed, durable and easily maintained.

Embankment's durability and stability is provided by:

- high quality of foundation soil;
- adequate materials utilization;
- surface water removal;
- backfill achievement, so that, the road bed to be placed over the underground water or over the stand level, along the route rivers placed into the area;
- necessary drainage works during execution;
- adequate soil compaction.

The majority of the embankments will be constructed from general fill, and not from rock fill, from the local borrow pits located in the analyzed area.

As can be derived from the initial available information about construction, substantial volumes of excavation residual material (21,510,826.41 m^3) will be foreseen from the operation of soil excavation and tunnel constructions.

At this stage of the project, in order to consider the impacts of this big quantity of earthwork material, the Study proposes different solutions. Those alternative solutions are:

1. Re–use of the material in other section of the alignment in order to make concrete material for the tunnel lining or for the viaduct piles;
2. Re–use of the material in order to organize the next landscaping interventions:
   - along the new alignment as in case of the fill operation in Tarčin area (km 1+150 – km 2+700)
   - in case of earth shaping in correspondence of Jablanica Interchange (km 36+530) or of foreseen parking area near Bradina (km 7+700 – km 8+000);
3. Re – use of the material in the construction of other sections of the Lot 3 or in other Lot construction. In this case a proper organization had to be arrange in collaboration with the Ministry of Communication and Transport;
4. Use of the residual material for the upgrading of the borrow sites in the interested area as in case of Podorašac area. In this case, a proper organization had to be arranged in collaboration with local administrations and borrow pit owners and in accordance with Federal law.

- *Waste production. Waste management*

The wastes resulted from the road construction and operations are assessed separately for the two stages as follows:

1. During the construction period
2. During the operation period

1. Construction period

Inert and Non-hazardous Wastes

The construction of the road foundation and of the tunnel excavations will require the evacuation from the site of inadequate earth, marl earth or earth with a high amount of biodegradable material. This material, have to be transported to the residuary landfill, wastes pits in the area in order to fill them.

For the road pavement and the other constructions granular materials will be placed – ballast, crushed stone, and sand – as well as other products such as cement or asphalt concrete, brick, other precast elements.

The General Contractor of the works will have to conclude contracts with local sanitation operators for deposition.

The domestic wastes resulting from the site personnel such as: paper, bags, plastic, bottles, personal wastes, will be deposited in containers being evaluated at 0.3kg/person/day.

Management of solid wastes during construction period recommendations are the followings:

- the waste stores from the construction of the embankments must be reused after a screening;
- the waste remaining will be transported in the existing landfills where fertilizing works must be provided and reclaim such areas for production. In alternative, the waste could be used as cover material in municipal urban waste stores for reduce the emissions to the atmosphere and prevent animals and human access;
- the metal waste should be reused, as possible;
- The used electrolyte solutions will be first neutralized then disposed of the closest municipal waste facilities;
- Waste oils will be recovered and taken on by oil and gas company on a bidding basis, according to the law.

Toxic and Hazardous Wastes

Toxic and hazardous substances can be: fuels (diesel oil), lubricants and sulphuric acid, necessary to the equipment operation, as well as the dye used for the road marking.

The equipment supply with fuels will be carried out with auto tanks whenever necessary.

The equipment to be used will be transported on site in appropriate operation conditions, with all technical overhauling and lubricant changes made. The lubricant change will be executed after each working season in specialized workshops where the changes of hydraulic and transmission oils will be performed too.

In the case when maintenance or auto accumulator change is required these operations will not be performed on site, but in a specialized workshop where the tires changes will take place too.

The dye for markings will be brought in sealed containers and unloaded in the respective working devices. The empty tanks will be given back to the producers or distributors.

2. Operation period

Inert and Non-hazardous Wastes

During the operation a series of wastes specific to road traffic will result, but also wastes coming from an inadequate behaviour of the participants to the road traffic such as littering from cars in transit or especially in arranged parking areas. These wastes are residuary wastes. The wastes from the roadside as well as the ones collected from parking areas will have to be evacuated by the bodies in charge with the road operation. Based on the traffic data, these wastes estimated at about $4m^3$ yearly.

Following the discharge of waters from the carriageway, especially on the occasion of the first rain, various traffic residues will be washed (fuels and lubricants leakage, powder traces from tires, brakes, etc.) and then discharged in side ditches and separator-interceptors. A solution is to be established by the designer in the Detailed Design, as they require detailed elements such as longitudinal slopes of the route, points of decanted water discharge etc. For the interceptors:

- The material collected in them is similar to the mud coming from the waste water treatment and the toxic potential is induced by the great concentration of heavy metals;
- These interceptors are to be emptied and cleaned periodically and the mud evacuated in the end localities in an ecological dump or in one of the treatment stations nearby;
- The mud decanted yearly can be evaluated at about $68m^3$ all along the route under the traffic conditions in 2010.

- *Toxic and Hazardous Wastes*

The maintenance works for the road section require the use of certain categories of materials that can be included in the category of toxic and hazardous substances.
The most frequently used products are:

- Diesel oil – fuel used for the equipment and by most of the transport vehicles;
- Gas;
- Lubricants (oils, vaseline);
- Varnish and dyes, thinners – used for the maintenance, protection and road markings works.

Problems may appear during the handling and utilization of these products by companies specialized in road maintenance and repairing works. The employees of these companies must comply with the specific working norms for the development of the respective operations under full security conditions. The containers used have to be recovered and handled appropriately.

4.0 DESCRIPTION OF THE ENVIRONMENT AFFECTED BY THE PROJECT

4.1 *Settlements and population*

4.1.1 Background

The wider area of influence of the project, which is considered to be the most convenient for the Corridor Vc Motorway Project, comprises two Cantons of the Federation of Bosnia and Herzegovina:

Sarajevo Canton, comprising the 9 municipalities: Stari Grad, Centar, Novo Sarajevo, Novi Grad, Ilidža, Vogošća, Hadžići, Ilijaš and Trnovo. The Canton covers a territory of 1,277km^2, and according to the data collected in the year of 2004 the Canton has a population of 401,687.

Hecegovina-Neretva Canton, comprising the 8 municipalities: Čapljina, Čitluk, Jablanica, Konjic, Neum, Prozor, Ravno, Stolac and the city Mostar. It covers a territory of 4,401km^2, and in 2004 has a population of 224,535. The economic centre of the region is Mostar, at a distance of 130 km from Sarajevo, 180km from Dubrovnik, 160km from Split, 430km from Zagreb and 530km from Belgrade.

MUNICIPALITIES OF SARAJEVO CANTON

MUNICIPALITIES OF HECEGOVACO-NERETVANSKI CANTON

The wider area of interest covers the municipal areas of: Hadžići, Jablanica, Konjic and Mostar.

4.1.2 Population and Demography

In 2004, the total Federation of Bosnia and Herzegovina has a population of 2.3 million persons. The wider area of influence for the alternative considered includes Hadžići, Jablanica, Konjic and Mostar North Municipalities and they together constitute a population of about 168,000 persons (7.2 % of total FB&H) on a total surface of 2,900 km^2. The four Municipalities embrace a total of 327 settlements /towns and show an average population density of 58.2 persons per km^2, which is slightly above the federal average of 57.8 persons per km^2.

Table 14 Population in the wider area of interest 2003 / 2004

Municipality	No of settlements	km^2	Inhabitants		Population density	
			(2003)	(2004)	2003	2004
Hadžići	62	273	20,055	20,169	73.5	73.9
Jablanica	33	301	13,047	13,065	43.3	43.4
Konjic	168	1,169	29,908	30,040	25.6	25.7
Mostar	64	1,175	105,357	105,454	89.7	89.7
Total wider area of influence	**-**	**2,918**	**168,367**	**168,728**	**58.0**	**58.2**
FB&H	**-**	**25,947**	**2,317,842**	**2,324,712**	**89.3**	**89.6**
SOURCE: Federation of Bosnia and Herzegovina-Federal Office of Statistics, 2003, 200						

The direct area of influence for the socio-economic environment has been defined as the about 1km-wide stretch on both sides of the road alignment. This means that an area of 2km is considered to be directly influenced by the road. Accordingly, the population in the direct area of influence for the considered sections of the Corridor Vc Motorway between Tarčin and Mostar North is estimated as follows: The populated area in the direct area of influence of the selected alternative is presented in the table below and the population directly affected by the project is estimated to be about 22,000.

Table 15 Population in the direct area of interest

FROM KM	TO KM	LENGTH (KM)	NAME OF SETTLEMENT / VILLAGE PASSED	POPULATION
0+000	1+825	1.83	**Tarčin**	2,245
			- Do	
			- Smunica	
			- Vrbanja	
2+750	6+000	3.25	**Raštelica**	811
			Vukovići	2,649
			- Džanići	
7+250	9+325	2.08	**Ivan Sedlo Area**	639
			Bradina	1,448
			- Gornja Bradina	
			- Polje	
			- Gradac	
12+375	23+825	11.45	**Podorašac (km 12,3-15,…)**	1,487
			- Ribići (km 13.5)	
			- Vrbljani (km 14.5)	
			- Podkanjina (km 15.5)	
			- Kanjina (km 16)	
			- Borovac (km 16.5)	
			- Živašnica	
			- Ovčari (km 17.5-18.5)	
			Donje Selo Area (up to bridge over Lake Jablanica)	1,288
			- Repovica (km 19)	
			- Galjevo (km 18)	
			- Čovici (km 18.5)	
			- Jurići (km 20)	
			- Gredina (km 19.3)	
			- Cerići	
			Pokojište	285
24+075	31+250	7.18	**Čelebići (km 24.07)**	1,416
			- Matići	
			- Ušanovići	
			- Seljani (km 26.75)	
			Ostrožac (km 31)	1,525
			- Zakaljača (km 28)	
			- Vode (km 28.5)	

FROM KM	TO KM	LENGTH (KM)	NAME OF SETTLEMENT / VILLAGE PASSED	POPULATION
			- Ribići (km 28.7)	
			- Ćosići (km 29)	
			- Osište (km 30)	
			- Jasike (km 29.8)	
32+175	34+500	2.33	**Jablanica**	5,954
			- Dobrigošće	
			- Donje Paprasko	
			- Gornje Paprasko	
			- Donja Jablanica	
39+000	42+625	3.63	**Djevor**	1,282
			- Glogošnica	
			- Šanica	
50+375	52+750	2.38	Bijela	400 *
53+125	53+750	0.63	Grabovica	200 *
54+500	60+000	5.50	**Mostar North Area**	500 *
			- Lajpur	
			- Zeleni Dol	
			- Bresnica	
			- Vala	
			- Lijeska	
			- Makanovina	
TOTAL				**22,129**
** = estimated population*				

- Structure of resident population and demographic trends

After signing the Dayton Peace Agreement, the population structure in the project area has significantly changed. During the war there were forced migrations within the area as well as in and out of the area. The total number of population has decreased in some areas while the natural growth has been slowed down due to unfavourable situation, high unemployment rates and economic situation. At present predominantly three nationalities, Croats, Serbs and Bosnians live in the project area. The present situation is the result of the last war (1992-1996); changing the population structure, killing large number of the population and leading to migration of refugees form one region into the other, depending on ethnic affiliation.

Figures from 2004 show that the wider project area, comprising Jablanica, Konjic, Hadžići and Mostar Municipalities, have a total population of about 169,000 persons. Bosnians are the significantly predominating nationality; only Mostar Municipality as a whole shows a nearly balanced distribution of Bosniaks (47.4%) and Croats (48.3%).

In 2004 within the territory of the wider project area 20.7% of the population belong to the age group 0-14 years, 70.0% are in the age group 15-64 years, which represents active population, and 9.3 % of the population are over 65 years old. The main demographic and ethnic characteristics in comparison to cantonal and federal level are presented in the table below:

Table 16 Population and population structure (30.06.2004)

Municipality	TOTAL	Age Structure			Nationalities (%)			
		0-14	15-64	65 +	Bosnians	Croats	Serbs	Other
Jablanica	13,065	1,978	9,180	1,907	*97.5*	*1.5*	*0.9*	*0.2*
%		*15.1*	*70.3*	*14.6*				
Konjic	30,040	5,422	21,103	3,515	*90.8*	*6.2*	*2.9*	*0.1*
%		*18.0*	*70.2*	*11.7*				
Mostar-total	105,454	18,377	73,051	14,026	*47.4*	*48.3*	*3.5*	*0.8*
%		*17.4*	*69.3*	*13.3*				

Hadžići	20,169	4,166	14,092	1,872	*92.4*	*2.0*	*3.5*	*2.1*
%		*20.7*	*70.0*	*9.3*				
Total - Wider Area of Influence	**168,728**	**30,004**	**117,661**	**21,364**	***64.6***	***31.7***	***3.2***	***0.8***
TOTAL FB&H	**2,493,440**	**453,467**	**1,752,663**	**287,310**	**1,796,594**	**561,146**	**111,572**	**24,128**
%		***18.2***	***70.3***	***11.5***	***72.1***	***22.5***	***4.5***	***1.0***
SOURCE: Federation of Bosnia and Herzegovina-Federal Office of Statistics, June 2004								

Vital characteristics: In 2003 the rate of natural increase per 1000 inhabitants in the project area was 2.4. The highest increase is recorded in Hadžići municipality with a rate of 4.3 per 1,000 inhabitants, while the lowest is in Jablanica with only 0.5 per 1,000 inhabitants.

Table 17 Population natural growth rates, FB&H

Year		Births and deaths per 1000 inhabitants			Infant deaths per 1000 live births
		Live births	Deaths	Natural increase	
FB&H	1996	12.8	6.9	5.9	14,0
	1997	12.9	7.5	5.5	12.4
	1998	12.3	7.9	4.5	11.0
	1999	11.4	7.7	3.7	10.1
	2000	10.5	8.1	2.4	9.7
	2001	9.9	8.0	1.9	7.6

Table 18 Population natural growth rates in the Project Area

Jablanica	2003	0.5
Hadžići		4.3
Konjic		2.3
Mostar		2.3
Average Project Area		2.4
SOURCE: Federation of Bosnia and Herzegovina-Federal Office of Statistics, June 2004		

Migrations: The project area has been facing high level of migration during the last 10 to 14 years since the war had started. There are several types of migration recorded in the past period: forced migration of non-Serb population to FB&H since mid of 1992 and throughout the war; migration of domicile population from Sarajevo City; forced migration of Bosniak population from Central Bosnia to Zenica-Doboj Canton within FB&H and vice-verse for Croat population. After signing of the Dayton Peace Agreement the opposite process of movements started: the return of refugees and displaced population to their pre-war homes. However, in some cases it seems to be one-way return or no return at all, due to those who were returning just to sell or rent out their property.

Another type of migration started in the after war period: the young and educated people are searching for better opportunities and living conditions. This led to an extensive “brain-drain”. Once having left the country, it’s very unlikely that those young people will return.

Furthermore, there is an increasingly evident migration from rural areas and smaller cities to urban centres. In particular Sarajevo City attracts people and they leave from where they used to live without basic living conditions, without proper employment and opportunities for the generation of income.

4.1.3 Settlement System

The main characteristics of the municipalities and their urban settlements in the project area are described below:

Hadžići Municipality: Hadžići Municipality consists of 62 settlements with a population of 20,16 inhabitants. The number of households is about 5,572 and the average density is 73.8 inhabitants/km^2.

Considering the age and sex structure there are about 4,169 inhabitants under 14 years (2,228 males and 1,941 females), 14,092 inhabitants between 15 and 64 years old, and 1,872 inhabitants over 65 years. In this number included are 429 families with 1,344 displaced persons, (386 families with 1,233 displaced persons from other area of the B&H, and 43 families with 111 members that are internally displaced persons).

Hadžići municipality consists of Hadžići, Pazarić and Tarčin as urban areas, composed by smaller urban zones around these settlements. The settlement structure shows a trend of individual building with density of 40-120 inhabitants per ha and mixed building with density of 120-220 inhabitants per ha. On several attractive locations from Mostar's crossroads to Tarčin, many industrial and building warehouse capacities have been developed. After the war a number of refugees have decided to stay in the area and new individual objects for living were constructed. Beside that, some small settlements were built around the urban settlements of Hadžići as educational, economical and social centre.

The northern and north-eastern parts of Hadžići municipality are the areas with the highest density of population. The urban settlement of Hadžići is located in a valley along Zujevina River and in this area together with suburban settlements has more than 2/3 of all population of this municipality. High density of population we have also in the valleys along the tributaries of Bijela River (Lepenica), where Tarčin is situated.

This settlement structure is a consequence of the natural and economical opportunities of the population, as well as the impact of socio-economic processes from industrialization, over the transfer from agricultural to non-agricultural activities and the following increase of urbanization.

Construction of factories, private firms, health, education, cultural and other institutions in pre-war and post-war period stimulated the population concentration. This led to the depopulation of mountainous areas, while the lower areas and the valley are more and more populated, thus leading to socio-economical prosperity of the municipality

Konjic Municipality: With a surface of 1,300km^2 Konjic is the biggest municipality in the Federation of B&H. According to the last Census in 1991, Konjic Municipality had a population of 43,634. This number decreased to 30,040 in the year 2003, with population density of 25,7 persons/km^2. The number of displaced persons in 2004 was 2.559.The 5,420 inhabitants are under 15 years old and around 24,600 inhabitants are over 15. The sex structure is balanced with a surplus of male population. In the urban zone of Konjic municipality there are 5,400 households with 11,500 inhabitants.

Regarding its position, its demographic and economic development, Konjic represents the sub-regional centre of the Mostar region. It is located between the two bigger city centres- Mostar and Sarajevo. It has various possibilities for dynamic development, considering the extensive area of gravitation, natural and created values, density of the river network and human and other potentials.

The Municipality area is located at the border between Sarajevo and Mostar region, between the highest mountain massifs of Prenj and Bjelašnica. The Municipality area is belonging to Dinarides and it is characterised by a developed relief. 37% of the Municipal area is covering the land with the elevation between 1,000-1,500m a.s.l. Slightly smaller surfaces are covered by elevations of 50-1,000m a.s.l., or 30 % of the territory. The low level of 200-50m a.s.l. takes only 18 % of the area. These parts are mainly limited to the river course of Neretva.

The spatial and urban plan of Konjic Municipality is determined by basic designations related to the space, its use and function, the directions of urbanisation and spatial planning with particular emphases on existing and future road directions between Sarajevo and Ploče.

The settlement system, along with the infrastructure systems, is a very complex and dynamic system of specific structure, which is formed by the spatial disposition of cities and municipality centres, along with the extensive number of small and dwarfish settlements. These complex systems are determined and influenced by various circumstances, composed and decomposed by their structure, magnitude and spatial determination. The extremely fragmented settlement network characterizes the Konjic Municipality, where magnitude categories up to 400 inhabitants were created. 46% of the total municipal population lives in these settlements. The extremely monocentric development with the military industry as basic factor for development, caused an extensive polarisation towards the Municipality Centre.

In order to decrease concentration of population on the city of Konjic, three secondary municipal centres are foreseen: Glavatičevo, Buturović Polje and Bradina/Odžak (as centres of the local communities).

Considering the limited possibilities for expansion, the conditioned geomorphologic characteristics and the extremely big migration pressure on the city of Konjic, it is necessary to intensively develop secondary centres: Butrović Polje, Glavatičevo and potentially Bradina, which as per the conception of the settlement system, have the task to relieve the municipality centres, provide the function dispersion and the equalised development of the complete Municipality in accordance with their importance.

Jablanica Municipality: According to the 1991 Census, Jablanica municipality had a population of 12,891 inhabitants. In 2003 there were 2,980 households with 13,074 inhabitants. 947 of them were displaced persons. Around 70 families with 199 members live in a camp, out of which 78 young people between 14 and 26 years of age. Population density is the 43 inhabitants per km^2. In respect of age-sex structure, there are 1,979 inhabitants under 14 years and 11,095 inhabitants over 14 years old. Around 250 homes which haw been devastates during the war were rebuilt and 200 more houses need to be reconstructed.

The municipal area of Jablanica is located in the centre of B&H. The most important land traffic routes of B&H (railway Sarajevo-Ploče and road Sarajevo-Adriatic Sea) cross this area. Jablanica is located on the important road leading to Zagreb over Banja Luka. The geographical and traffic position of Jablanica is very favourable.

Settlements with a small number of inhabitants are dominant. The total number of 4,012 inhabitants lived in settlements with 400 inhabitants in 1991. On the contrary, the population concentration in the city centre is reaching approx. 30 % out of the total number of inhabitants.

The Municipality's mono-centric development caused extensive polarization movements by migration directed towards the centre. This phenomenon caused the formation of a high number of small villages with mainly immobile older population.

The narrow valley of Neretva conditioned the longitudinal shape of the municipal centre Jablanica. The city is expanding along Neretva River, following the traffic route Mostar –Sarajevo and Mostar – Prozor.

Northern Part of Mostar City (Mostar North): According to the 1991 Census, Mostar municipality had a population of 126,628. In 2003 there were 103,751 inhabitants. The area of interest belongs to the north–western rural area. It includes part of Salakovac, Donja Drežnica, Jasenjani, Gornje Ravne and Prigradjani, and at present has 574 inhabitants and population density is very low.

Other collected informations refer to the much wider area of Mostar and are not considered here, as not belonging to the study area.

According to the orientations adopted in the B&H Spatial Plan polycentric development was foreseen for this area. In accordance with the morphologic and other features, the spatial Plan focuses on the area of the Mostar basin with the highest concentration of population.

In this context, population and functions for the municipality are planned as follows:

- The northern basin of Bjelo Polje, with an estimated number of 36,000 inhabitants in 2015.
- Central basin of Mostar with an estimated number of 103,200 inhabitants in 2015.
- The South basin of Bišće Polje and Jasenice with an estimated number of 36,000 inhabitants in 2015.

The Northern basin of Bijelo Polje reached by the motorway is foreseen for agricultural development, hydro energy small-scale economy, housing and recreation.

The settlements network is fragmented and not differentiated as limitation factor of the development and the aggravating component of the non-economic activities. Thus, the supply of settlements with the necessary infrastructure network and necessary rational organisation of the municipality area become difficult. The economic power and the material background achieved by Mostar before the war bear extensive costs of the communal supply, which comes out from the extremely fragmented network of settlements.

4.1.4 Access to education, health and other services

Hadžići Municipality: The municipality of Hadžići has no hospital but only has one policlinic and two day-clinics. Part of the population use medical facilities in Sarajevo.

In this municipality there are seven primary schools (3 central and 4 branch schools) with 87 classes (3,577 pupils) and one primary school for pupils with special needs (4 classes, 51 pupils). In primary schools employ 136 persons and the school for pupils with special needs has 13 employees. Besides that, in Hadžići there is one secondary school with 31 classes.

In primary schools the classes contain in average 10 pupils more than it is allowed according to pedagogical standard. This situation is caused by material poverty.

In Hadžići Municipality there are the cultural centres in Tarčin and Pazaric, where social and cultural activities take places. Besides that, there are two sport halls, 3 school sporthalls, one socker field and several smaller sport fields for sport and recreation activities. Especially young people often use cultural/recreational/sports offers in Sarajevo.

Konjic Municipality: Konjic Municipality provides a general hospital and 8 day-clinics employing 30 doctors, 4 dentists, 1 biochemist, 184 medical staff and 59 other. Beside that there is 1 private policlinic and 10 private ordinations.

Konjic municipality has 30 primary schools with 144 classes employing 202 staff members. There is one secondary school, as well as a nursery with 10 employees. The total education sector employs 300 workers.

Cultural activities in Konjic are practiced in a cultural centre; the cinema can be used in summer, where theatre performances take place. In the sport hall Konjicanka the different cultural manifestations take place. The library is part of People's University and contains around 35,000 books and provides place for exhibitions. Regarding sport and recreational activities, there is a football field and a sports hall.

Jablanica Municipality: In Jablanica municipality there is one policlinic with two day-clinics (Ostrožac, Glogošnica) for primary health care. Beside that, there are three pharmacies.

Around 1,300 pupils go to 6 primary schools, from which one is central and the others are branch schools. Furthermore, there is one secondary school. Around 300 pupils from Jablanica study outside their municipality.

In Jablanica municipality there is one museum ("Battle on Neretvi") and one cinema hall. Jablanica has a football field, a handball field, small playgrounds (village play ground and play grounds in secondary school) and a sport hall in primary school.

Northern Part of Mostar City (Mostar North): In the area which belongs to the municipality of Mostar-North there is only one ambulance in Donja Dreznica and two primary schools (in Donja Dreznica and in Prigradjani). There are no data about cultural activities, just about existing sports fields in Salakovac and Drežnica.

There is no University in the project area; the nearest Universities are the two universities in Mostar and the Universities of Sarajevo.

4.1.5 Sectors of economic activities

Before the war economic development of the country was determined by the planned method of the former political system. In that system B&H was the main supplier of raw products and energy and, based on this, the processing industry was built up in the last two decades. As such, B&H was a less developed area in former Yugoslavia with production volume per capita below the world average by about 15%.

Nevertheless, its industry was very highly export-orientated and it had positive net exports by exporting 2/3 of its production, with 65% of it going to highly developed European countries.

The Project Area is an economically well-integrated region located at the south and southwest of the Bosnia and Herzegovina. It covers about 3,000 km^2, while the number of inhabitants has been estimated at 168,000. The biggest economic centre in the region is Mostar (with 105,000 of inhabitants) located in the geographic centre of the region. Other important economic centres are Trebinje, Konjic, Jablanica, Livno and Široki Brijeg.

The trademark of the region is the Neretva River, which creates a beautiful valley and a natural bond of the mountainous north and Mediterranean south. It does not have only hydrographical but also energetic potential. Along its course the existing road M17 and a railroad run from the north towards the south. The climate is good for rising Mediterranean cultivations (citrus fruits, figs, pomegranates, peaches, cherries, apricots, quince, kiwi etc.), early-season vegetables, horticultural plants and flowers. In the mountainous region, the most common fruits are apples, pears and plums. Medical herbs in this area are of good quality with a high content of ethereal oils. Honey is also known to be of good quality.

Cattle's breeding is the typical activity for the mountainous region although it is reduced nowadays. The rivers and lakes are good for the development of fisheries and recreation as well as fishponds and fish cages.

The post-war period has been characterised by the development of SMEs with significant levels of local and international investment, facilitated by a range of NGOs, EU, USAID and other donor supported initiatives.

Administrative Structure

The strategic position of B&H is determined by the north-south transversal (continent-Adriatic Sea or Budapest-Zenica-Sarajevo-Mostar-Adriatic Sea of international importance (Corridor Vc). Access to the sea goes through the Neretva River and the port of Ploče. Generally, B&H has and always had a very important strategic position and it is devided in different administrative units.

- Macro-Economic characteristics

The national Gross Domestic Product of the Federation of Bosnia and Herzegovina over the last years shows a steadily increase with an average growth of 8.1% between 1998 and 2003, with the highest increase between 2001 and 2003.

Table 19 Gross Domestic Product at current prices for the last 5 years B&H

	1998	1999	2000	2001	2002	2003
Gross domestic product in 000 KM	5,606,073	6,142,147	6,722,631	7,273,874	7,942,665	8,268,120
Gross domestic product in 000 USD	3,182,737	3,348,496	3,172,699	3,328,090	3,824,473	4,769,611
GDP PER CAPITA IN POWER PURCHASING STANDARDS (PPS)						
Gross domestic product per capita, in KM	2,001	2,187	2,400	2,577	2,805	2,912
Gross domestic product per capita, in USD	1,136	1,192	1,133	1,179	1,350	1,680
Annual Average Growth of GDP						
	9.6	9.5	8.2	9.2	4.1	8.1
SOURCE: FEDERATION OF BOSNIA AND HERZEGOVINA - FEDERAL OFFICE OF STATISTICS						

The structure of GDP by kind of activities shows a decreasing contribution from the agriculture sector, a slight increase in the mining and transport and communication sectors, while the industrial sector shows only a slightly varying trend. However, the share of agricultural sector in respect of other sectors is high in FB&H.

Table 20 Gross Domestic Product FB&H by kind of economic activity (gross value added by activities and gross domestic product – in %)

SECTION OF ACTIVITY	1998	1999	2000	2001	2002	2003
A Agriculture, hunting and forestry	10.9	9.2	7.2	7.2	6.9	6.5
B Fishing	0.0	0.0	0.0	0.0	0.0	0.0
C Mining	1.9	2.1	2.3	2.1	2.3	2.3
D Manufacturing industry	12.4	10.6	11.2	11.8	11.5	12.0
E Electricity, gas and water supply	5.8	6.4	6.0	6.2	5.2	5.5
F Construction	5.9	5.0	4.6	3.8	3.5	3.7
G Trade; repair of motor vehicles, motorcycles, personal and household goods	9.8	9.8	8.7	9.8	10.4	10.5
H Catering trade	1.8	1.9	1.8	1.7	1.7	1.8
I Transport, storage and communication	8.1	9.2	9.0	9.3	9.0	9.3
J Financial intermediation	3.3	3.1	3.6	3.3	3.6	3.9
K Real estate, renting, business services	2.3	2.2	2.3	2.1	2.2	2.5
L Public administration, defence, compulsory social security	11.5	11.4	12.6	12.6	13.2	11.2
M Education	5.0	5.6	5.5	5.2	5.2	5.1
N Health and social welfare	4.0	4.7	4.8	4.6	4.8	5.0
O Other social and personal services	2.0	2.0	2.0	2.0	2.0	2.0
Total by activities	84.8	83.3	81.5	81.5	81.5	81.4
FISIM (-)	1.9	1.8	2.0	2.0	2.4	2.8
Gross value added (basic prices)	82.9	81.5	79.6	79.5	79.1	78.6
Taxes on products and services and import less subsidies (+)	17.1	18.5	20.4	20.5	20.9	21.4
Gross domestic product (GDP) at market prices	100.0	100.0	100.0	100.0	100.0	100.0
SOURCE: FEDERATION OF BOSNIA AND HERZEGOVINA - FEDERAL OFFICE OF STATISTICS						

The Gross Domestic Product achieved in the project areas municipalities is shown in the table below. Shown in comparison to FB&H, Jablanica and especially Mostar show a DGP per capita over national average.

Table 21 Gross Domestic Product by Municipality

GROSS DOMESTIC PRODUCT BY MUNICIPALITY (2003)			
GDP (2003)	**GDP in KM**	**GDP per capita (KM)**	**FB&H = 100**
FB&H total	**7,942,660**	**3,425**	**100**
Hadžići	61,947	3,089	90.2
Jablanica	51,690	3,962	115.7
Konjic	93,062	3,112	90.8
Mostar	617,811	5,864	171.2

- Economic sectors in the area of influence

- *Agriculture and Fishery*

Agriculture is one of the key activities in rural areas and the main activity of the rural population. It is a very important factor for the preservation of balance and environmental protection. Agro-environmental conditions in B&H are favourable for agricultural production. However, agriculture also faces the necessity to repair war damages and the transition from a centrally planned to a market economy. With the exception of potatoes, B&H has not achieved self-sufficiency in any of the major agricultural products.

Agricultural production and fishery were rated the second most important activity in the region, although formal employment in this sector did not support this statement. Concentrated in the agricultural complex «Hepok» and Tobacco factory Mostar, the region was an important exporter of specific local products (fruits, grapes, vine, flowers, tobacco and its products).

Hadžići municipality: The municipality of Hadžići is characterised by small agriculture farms with small land peaces of 0.10-4.00 ha and produces a significant quantity of food. Agricultural zones are located around the urbanised area. Agriculture is oriented on vegetable production (potato), crops (rye and oats) and from 2003 started the production of ecologically controlled production of buckwheat on 9,200 ha in the area of Raštelica and around the urban area.

On the territory of Hadžići municipality, fruit growing suffered from heavy devastation. Currently the most numerous are: plum, apple and pear. By the realisation of the Sarajevo canton project, 28 orchards have been planted with around 4,000 seedlings. At the location of Koščan, modern orchard of 1.20 ha was planted. Some companies have been recently established, specialised in buying off and drying medical herbs and wild fruits. Cattle-rising has an important role in this municipality. Meat production already exists, while the facilities for milk processing are in planning phase.

Municipalities of Konjic and Jablanica: The municipalities of Konjic and Jablanica due to their natural-geographic characteristics fall into the category of hilly-mountainous area in which high quality land occupies only one third of total area. Furthermore, the construction of the HEPP water basins reduced the terrain suitable for agriculture due to flooding of terrain.

Due to the territorial characteristics of Konjic municipality, there are no bigger agriculture zones but agricultural production is organised by individual households. Cattle rising zones are located on the mountain slopes of Bjelašnica, Visočica and Prenj.

Jablanica area by its geomorphologic formation belongs to the hilly-mountainous area, including some parts with distinct mountainous character. Forests cover 61.2%, while agriculture land encompasses 32.6% of the municipal area.

According to the applicable classification, Jablanica municipality has small share of land belonging to agriculture land of category I and II and most of the area belongs to categories III and IV (soils with significant defects). Accordingly, agriculture in Jablanica municipality is not well developed, while an intensive cattle rising is possible.

In Jablanica, there are neither agriculture production complexes nor agriculture production on larger areas. Again, agriculture is oriented on individual farms production. However, one of the strategic goals of Jablanica is agriculture development and the Agriculture Institute of Sarajevo has worked out the Strategy of Agriculture Development in Jablanica municipality in 2003.

Small farms, on elevations between 200-700m a.s.l., are favourable for continental fruits growing (apple, pear, cherry, quince, nut, hazelnut etc.), as well as for berry fruit production. Variety and abundance of medical herbs in the area of Jablanica impose the need for defining base strategic goals in the area of exploitation, plantation and processing of medical herbs.

According to the specific conditions of Jablanica municipality (relief, inclination, land etc.), in large areas a cattle rising is practically the only way of using the land as agricultural resource.

Northern Part of Mostar City (Mostar North): Agriculture is an important economic activity for this area and important opportunities for agriculture production are present in the private sector in Salakovac, Jasenjani, and Donja Drežnica. It is possible to plan production of vegetables in Gornja Drežnica, as well as the production of vegetable seeds. Area available for plantations are limited and planned in the area of Željuša, Salakovac and south, on Gubavica and Hodbina. Cattle rising zones are located in Ravni and Gornji Jasenjani.

Up to now, valuable agricultural areas have been protected from intensive urbanisation; however, it is necessary to implement planned measures for agricultural land protection and improvement.

Agricultural production and fishery were rated the second most important activity in the area and the region was an important exporter of specific local products (fruits, grapes, vine, flowers, tobacco and its products).

- *Industry*

There are smaller industrial zones located in the vicinity of Konjic, Jablanica and Mostar. A number of pre-war built premises and industrial zones with the necessary infrastructure lie unused after the war. These old industrial sites are in proportionally high-value locations and still have the infrastructure and plants. There are also new locations with invested resources, production and employment. There is a lack of significant post-war investment and growing concern related to the development of new economic premises caused by a vacuum in the new economic system.

Abandoned locations could be analysed and the remaining capital could be evaluated. This would support the urbanization of towns and the organisation of land use, which would prove to be a convenience for investors.

The Herzegovina economy has been developing since World War II with systematic neglect of the economic potential in the agrarian sector of private property in the rural areas and strong development of the processing industry in public property in towns. With such development new sectors (aluminium industry, metal-processing, textile and military industry) have been built in the traditional activities (agriculture, handicraft, trade). They were gathered in industrial conglomerates and clusters. The structure of the market sector before the war was as follows: The mining and processing industry made up 57.8% of the domestic product of the region and had 47% of the total number of formally employed persons. Production of bauxite, coal, stone for concrete and asphalt, decorative stone as well as clay and tuff exploitation that was later abandoned, dominated the mining industry. The processing sector produced aluminium, metal constructions, and products of different scope in the metal-processing industry, tool industry, textile, furniture, aircrafts and the electronic industry. In addition to agricultural production, these activities were the main pillar of development and foreign trade in which there was a positive trade balance. Leading economic entities were: Aluminium plant, Aircraft and Metal-processing industry «Soko» (all situated in Mostar), Igman Konjic, UNIS Mostar, Tool industry Trebinje, Textile industry «Djuro Salaj» Mostar, Furniture industries in Mostar and Konjic, Granite industry Jablanica, etc.

- *Energy Sector*

Bosnia and Herzegovina's total hydropower potential is estimated at 6,100 MW, mostly located within the Drina, Neretva and Trebišnjica river basins. Less than 40% of this potential is so far used, so about 40% of the country's energy production today comes from hydropower.

Analyses show that increased use of hydropower would not only be justified from an economic point of view, but would also have positive environmental repercussions compared to increasing the use of thermal (coal) energy. Building artificial reservoirs for hydropower could also be advantageous with regard to flood protection, and could make new irrigation systems possible.

The electric energy generation system in power plants built on Neretva, Trebišnjica and Cetina is built up on 8 hydro power plants and one coal mine, meaning that 9 power plants were built on three water streams, using approximately 60% of the region's water potential.

The hydro-geological characteristics of the Neretva river basin and hydropower generation facilities in the project area are shown in the tables below:

Table 22 Hydrological characteristics of Neretva River basin

RIVER BASINS	AREA (km^2)	RIVER LENGTH	AVERAGE FLOW (m^3 /s)
Neretva rivermouth	8.20	230	250
Neretva (the end of the Lot 3)	4.20	130	180

Table 23 Power production facilities in the project area

HYDROELECTRIC PLANTS					
PLANT	LOCATION	RIVER	PLANT TYPE	USABLE STORAGE HM3	INSTALLED CAPACITY MW
Total B&H				2,043	2,064
Jablanica	FB&H Herzegovina-Neretva Canton	Neretva	DA	288	3 X 25 + 3 X 30
Grabovica		Neretva	PA	5	2 X 58.5
Salakovac		Neretva	PA	16	3 X 70
Mostar		Neretva	PA	6	3 X 25
Note : P = run-of-river; DA = derivation storage; DP = derivation run-of-river; RHE = reversible; PA = storage.					
SOURCE: Elektroprivreda B&H. THE PUBLIC ELECTRIC POWER COMPANY OF BOSNIA AND HERZEGOVINA 2003.					

Hadžići municipality has a power station and is supplied by HE Jablanica.
HE Jablanica and HE Grabovica supply Jablanica municipality and additional potential for the construction of mini-hydroelectric power station is explored and confirmed. The power network at present is in good condition.

Mostar-North is served by the following transmission lines: 2 x 110 KV HE Jablanica – Mostar I (Raštani I and II); 220 KV Mostar III (Jasenica) – HE Salakovac; 220 KV Mostar III (Jasenica) - RP Jablanica (Bokulja); 35 KV HE Grabovica – HE Salakovac; 10 KV HE Grabovica – Drežnica – Jasenjani; Donji Jasenjani –Gomila (Repetitor)-Gornji- Jasenjani.

The whole *Konjic* municipality has electricity. The Hydro-energetic potentials of Konjic municipality comes from a part of Neretva HE Power Plant (382 MW installed power and 1072 GWh average year production)

It is necessary to point out that there is potential for building another hydroelectric power station in the project area that would increase hydro potential from 25% to 38%.

There are no other kinds of energy production in this area- solar energy is not being used and there are no gas systems.

- *Construction Industry*

Due to high investment, the construction industry was the activity with an approximate 10-12% share in the economic activity of the region. In the first decades of its development it relied on investments in the region whilst in the last two decades it employed about 1/3 of its capacities outside the region, B&H and former Yugoslavia.

- *Transport Industry*

According to the Federal Office of Statistics the number of registered private and public vehicles in the project area is as follows:

Table 24 Registered private and public vehicles in the project area

	PRIVATE CARS		BUSSES		TRUCKS		MOTORCYCLES		OTHER		TOTAL	
	2002	***2003***	***2002***	***2003***	***2002***	***2003***	***2002***	***2003***	***2002***	***2003***	***2002***	***2003***
Hadžići	3,285	3,341	2	5	381	513	13	11	136	21	3,817	3,891
Konjic	3,602	3,837	51	58	393	383	4	6	134	295	4,184	4,579
Jablanica	1,477	1,461	17	19	128	114	16	6	28	22	1,666	1,622
Mostar (total)	23,786	21,905	97	97	2,568	2,162	210	140	91	534	26,752	24,838

In the municipalities in 2005 has been registered the following number of transport operators:

In Hadžići there are no registered freight or passenger transport operators.

Main destinations for freight transport operators depend in occupation of the company and the location of clients. Main destinations are Mostar and Sarajevo, other towns in Federation and nearest countries. Regarding passenger transport, main destinations are Mostar and Sarajevo, serving the municipalities of Konjic, Jablanica and Hadžići.

Konjic: 5 private freight transport operators ("Transportation of goods in road traffic") and 3 private passenger transport operators ("urban and suburban transportation of passengers").

Jablanica: 6 private freight transport operators ("Transportation of goods in road traffic") having between 1 and 4 employees and 3 passenger transport operators ("urban and suburban transportation of passengers") of which 2 small private operator and 1 public with 20 employees.

Mostar North: In Salakovac were registered one private freight transport company and no passenger transport company. However, for the total municipality of Mostar, there are registered 2 freight transport operators with 92 and 127 employees respectively.

- *Tourism*

Tourists' capacities in the project are still undeveloped but the area has numerous potentials. The present diversity of cultures, tradition and available resources make the comparative advantages of the region and support the idea that this region has many realistic development opportunities if properly and economically used.

Ecological tourism for example becomes more and more important putting importance on experiencing and understanding of nature, which has not been disturbed by human activities. Obviously this kind of tourism is sensible to changes in natural surroundings and environmental status.

The tourist demand is present in the authentic surroundings with permanent raising tendencies. Regarding the project area the approach to introduction of ecological tourism, village tourism, sport and recreational tourism, religious tourism etc. is of increasing importance.

Tourism in this area should become an important element of cultural connection and approach, both at the local, regional and international level. A concept to be realised in such mode should become the inevitable part of acknowledging and safeguarding the natural and the historical heritage.

Hadžići Municipality: As per the geographic position, natural and potential areas of the Hadžići Municipality areas, there are pre-conditions that they become attractive tourist destination connected to the development of winter tourism, ecological tourism and village tourism. The advantages of the tourist oriented developing concept are:

- good infrastructure link with Sarajevo, remaining national area of B&H and wider international surrounding (airport vicinity, highway road M 17 and railway line Sarajevo-Ploče),
- various natural beauties,
- abundance of cultural-historical heritage
- possibility of development of various types of tourism at small and geographic area.

The natural characteristics of the Hadžići municipality give the possibility of development of the following types of tourism: winter tourism (Igman, Bjelašnica, Šavnici), village tourism (Mrtvanje, Ljubovčići, Korča), mountain tourism (Šavnici-Podgradina, Šavnici- Stanari, Šavnici-Opservatorij, Šavnici – Hranislava, Šavnici-Mehina Luka), speleological tourism (Megara cave and Kuhija) and sport and recreational tourism (areas of Igman and Bjelašnica).

The current state of tourist capacities and tourism in the municipality area is not satisfactory. The war made its impacts, thus until now, on the Igman territory there are abandoned sky jumps with infrastructure out of operation (except the traffic routes).

One development concept is incorporating the global projects of Bjelašnica I and Bjelašnica II, which are already realised. These projects would enable the return of tourists and the revitalisation of accommodation and other capacities.

Municipalities of Konjic and Jablanica: Present destinations as Međugorje and Neum are recognised and affirmed on the tourist markets. Tourists are organizing to come back in the pre-war tourist centres Mostar, Blagaj with Vrelo Bune, Počitelj and Jablanica and the area of natural resources such as Boračko and Blidinje lakes.

The Neretva River with the most beautiful effluents (Rama, Rakitnica, Konjička Ljuta, Šištica, Neretvica, Drežanka, lakes Boračko, Bldinje and Jablaničko, as well as numerous Medieval tombstones necropolis (Konjic and others) are monuments of natural, cultural and historical heritage of “0” category.

The important traffic position of the wider analysed area within the Corridor Vc for the Tarčin-Mostar part, enables this region to establish the recognisable tourist offer.

The main capital of the region is represented by its natural and cultural heritage. Therefore the long-term development of tourism may not even be conceived without the safeguarding of natural resources and creation of possibilities for the quality improvement of these resources. The basic tourist resources are functionally related to: geological importance of the area, water river courses, flora and fauna and natural heritage sites.

The basic resources for the development of tourism are the following:
- Tourist potential related to water resources,
- Tourist potential in mountainous areas,
- Tourist potential of cultural and historical heritage.

Tourist facilities and attractions in the wider area are the following:

- *Lake Jablaničko* (with the coastal strip and places Čelebići, Butorović Polje, Lisičići): water sports, sport fishing, rural tourism; hunting areas; Ribići (cave with lake); motels, apartments, pensions, rooms in the home hand craft, auto-camps, tourist and sport and entertainments on water; gastronomic offer,
- *Rakitnica*: The most attractive canyon of the South Europe, morphological phenomenon, natural rarities of flora and fauna, endemic types and relicts, wealth of non-discovered caves, sport fishing; touristic adventurism, mounting, water sports,
- *Bokševica – Buturović Polje*, Neretva estuary into Jablančko lake, sport fishing, sport and sport recreation, Sport and touristic entertainments, medical herbs, mushrooms, hunting; Association of hunters "Neretvica" (hunting house),
- *Bitovnja*: Forest complex: attractive plateau, mountain roads, hunting, touristic connection with the area of Pogorelica (Fojnica),
- *Prenj, the future National Park* (Igman, Bjelašnica-Prenj) or Prenj-Čvrsnica (Čabulja); mountain-climbing, mounting houses, mountain bike roads, photo hunting, photo safari; Tisovica-Jezerce-Ruište, (winter tourism) sources of potable water, vertical connections over Idbar,
- *Šunje-Podorašac*: Trešanica River (bifurcation); richness with fruit (cherries and Cherries week); cave, honey, brandy etc.,
- *Bradina-Repovci*: Spring and river Kraljuščica; river crab; eco-tourism; Gradina "Lis". Silver memory plate-spruce (Tito-Nehru),
- *Idbar – valley of Idbarčica*: The river and village of Idbar; fishpond; vertical climbing to Tisovac (Prenj); sport fishing; adventure tourism, mounting.
- *Konjic City, Neretva and Jablaničko lake*; Old bridge and old city; relief plate and temple of God Mitras; tombstones; memory house-museum of Zuko Džumhur; important touristic, cultural and sport manifestations; multiethnic objects of sacral architecture; cultural, sport, artistic and other associations; museum of the wood-curving; gastronomic offer.

Northern Part of Mostar City (Mostar North): A very rich vegetation and fauna, variety of geomorphologic shapes of the mountains Čvrsnica and Čabulja, existence of important surfaces under forest as well as other conditions will guide this area in the future, as National Park with particular conditions of protection where we would like to particularly stress the area of Diva Grabovica.

Natural conditions of the area (slopes of Čabulja and Čvrsnica) are indicating the possibility of the touristic development in connection with the recreation, hunting and fishing. In the water reservoirs Salakovac and Grabovica there are 8 fishponds and wide opportunities of improvement of the fish tourism. The City Administration will develop:

- mountain tourism (Rujište, Diva Grabovica, Prenj, Čvrsnica),
- village tourism-agro-tourism,
- sport tourism,
- water tourism,
- economic days and events,
- hunting and fishing .

The mentioned areas have no pre-war accommodation; therefore we have the offer of smaller mountain homes that may not accommodate a bigger group of tourists.

4.1.6 The affected population

The affected population corresponds to the population in the direct and indirect area of influence. While effects on the population living in the vicinity of the motorway to be constructed are mostly negative (impacts due to noise and air pollution), effects on the population in the indirect area of influence are anticipated to be positive due to better transport services and cost and timesaving.

The population in the area of indirect influence has been determined to be the population in the municipalities crossed and the affected population according to this has been defined as follows:

Table 25 Population in the indirect area of influence

MUNICIPALITY	TOTAL
Hadžići	20,169
Konjic	30,040
Jablanica	13,065
Mostar-total	105,454
Total - Indirect Area of Influence	**168,728**

According to the corridor defined as the area of direct influence (2 km wide stretch), the proposed alignment affects directly the population of the settlements, villages and towns. The villages and settlements directly passed are presented in the table below and accordingly the total number of people living in the direct area of influence is about 22,000.

Table 26 Population in the area of direct influence

FROM KM	TO KM	LENGTH (KM)	NAME OF SETTLEMENT / VILLAGE PASSED	POPULATION
0+000	1+825	1.83	**Tarčin**	2,245
			- Do	
			- Smunica	
			- Vrbanja	
2+750	6+000	3.25	**Raštelica**	811

FROM KM	TO KM	LENGTH (KM)	NAME OF SETTLEMENT / VILLAGE PASSED	POPULATION
			Vukovići	2,649
			- Džanići	
7+250	9+325	2.08	**Ivan Sedlo Area**	639
			Bradina	1,448
			- Gornji Bradina	
			- Polje	
			- Gradac	
12+375	23+825	11.45	**Podorašac (km 12.3-15,…)**	1,487
			- Ribići (km 13.5)	
			- Vrbljani (km 14.5)	
			- Podkanjina (km 15.5)	
			- Kanjina (km 16)	
			- Borovac (km 16.5)	
			- Živašnica	
			- Ovčari (km 17.5-18.5)	
			Donje Selo Area (up to bridge over Lake Jablanica)	1,288
			- Repovica (km 19)	
			- Galjevo (km 18)	
			- Čovici (km 18.5)	
			- Jurići (km 20)	
			- Gredina (km 19.3)	
			- Cerići	
			Pokojište	285
24+075	31+250	7.18	**Čelebići (km 24.07)**	1,416
			- Matići	
			- Ušanovići	
			- Seljani (km 26.75)	
			Ostrožac (km 31)	1,525
			- Zakaljača (km 28)	
			- Vode (km 28.5)	
			- Ribići (km 28.75	
			- Ćosići (km 29)	
			- Osište (km 30)	
			- Jasike (km 29.8)	
32+175	34+500	2.33	**Jablanica**	5,954
			- Dobrigošće	
			- Donje Paprasko	
			- Gornji Paprasko	
			- Donje Jablanica	
39+000	42+625	3.63	**Djevor**	1,282
			- Glogošnica	
			- Šanica	
50+375	52+750	2.38	**Bijela**	400 *
53+125	53+750	0.63	**Grabovica**	200 *
54+500	60+000	5.50	**Mostar North Area**	500 *
			- Lajpur	
			- Zeleni Dol	
			- Bresnica	
			- Vala	

FROM KM	TO KM	LENGTH (KM)	NAME OF SETTLEMENT / VILLAGE PASSED	POPULATION
			- Lijeska	
			- Makanovina	
TOTAL				**22,129**
** = estimated population*				

4.2 Climate and Meteorological Characteristics

Basic climate parameters, such as precipitation quantity and distribution and air temperature, have been processed for the 5 meteorological stations (Sarajevo, Ivan Sedlo, Konjic, Jablanica and Mostar).

Air temperature

In the project area, the yearly average temperature ranges from 7.2 °C (Ivan Sedlo) to 14.6 °C (Mostar) with absolute maximum of 33.6 °C (Ivan Sedlo) to 40.8 °C (Mostar) and absolute minimum of –26.2 °C (Ivan Sedlo) to –10.9 °C (Mostar).

Total yearly number of days with frost is ranging from 117 (Ivan Sedlo) to 22 (Mostar). In average, the first day with frost is October 16 on Ivan Sedlo and December 2 for Mostar. In average, the last frosty day is April 27 for Ivan Sedlo and February 28 in Mostar.

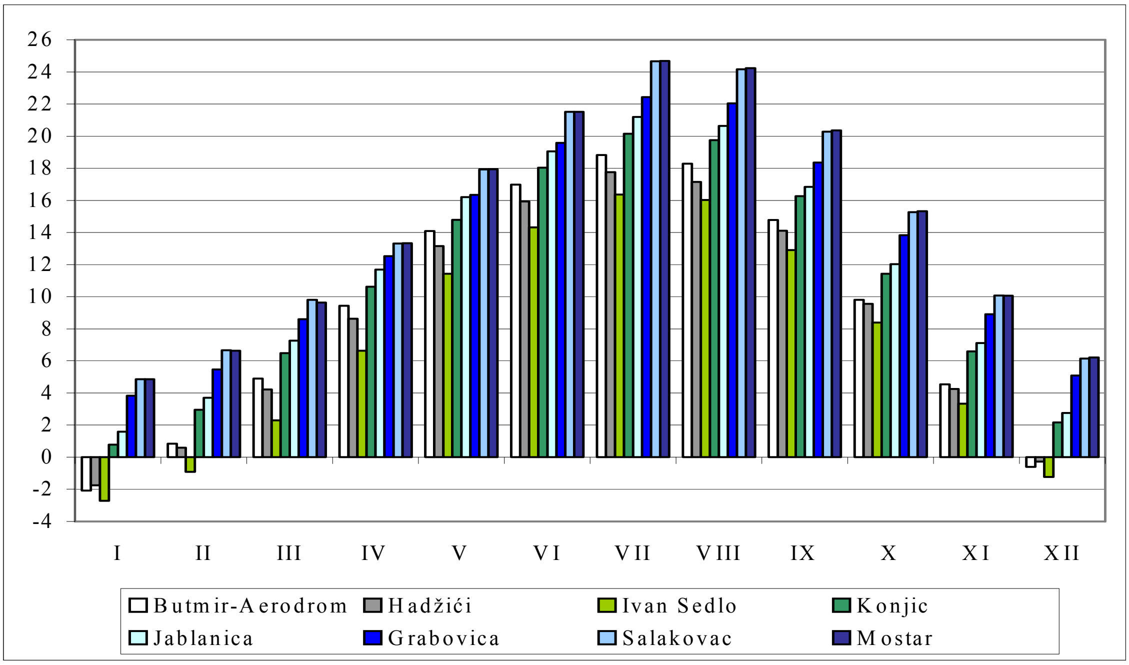
One of the main parameters for the climate characterization in this area is the air temperature, like presented in the next table.

Table 27 Mean air temperature (°C)

Station	*Minimum (January)*	*Maximum (August)*	*Mean Annual*
SARAJEVO	-5.7	21.3	9.5
IVAN SEDLO	-7.7	18.7	7.2
KONJIC	-3.5	22.9	10.8
JABLANICA	-2.7	24.2	11.7
MOSTAR	1.4	28.2	14.6

In the next figure, the distribution of main monthly air temperatures in the wider area of the Sarajevo-Mostar area, within the year, is given.

Main monthly air temperature distribution within the year



Precipitations

Average annual precipitations at the considered section have been elaborated based on the data obtained from the Hydro Meteorological Institute of the B&H Federation, Sarajevo from the meteorological stations indicated in Table 28 and for the considered time period from 1961 to 1990.

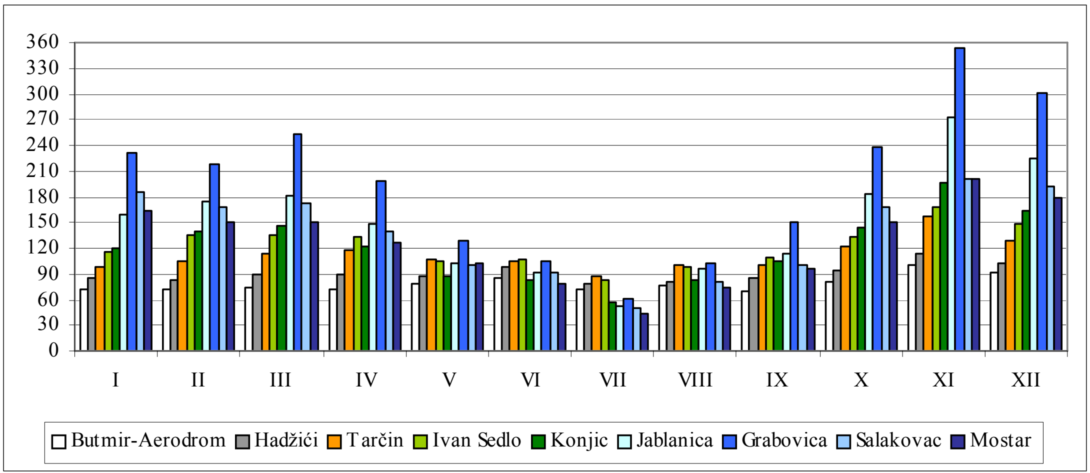
It is noticeable that average annual precipitations in Sarajevo amount to 932 mm, increasing gradually towards Jablanica, so that in Konjic they are 1,449 mm, in Jablanica 1,799 mm and in Mostar 1,515 mm.

Table 28 Average monthl and annual precipitations (mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Climatologic													
SARAJEVO	71	67	70	74	82	91	80	71	70	77	94	85	932
IVAN SEDLO	115	135	135	132	104	107	82	99	110	134	169	149	1469
KONJIC	121	140	145	123	87	83	57	83	105	144	196	164	1449
JABLANICA	158	173	182	148	104	92	51	98	113	182	272	225	1799
MOSTAR	165	151	150	127	102	78	43	74	96	151	200	179	1515
Rainfall													
Tarčin	98	105	113	117	107	104	88	100	101	121	156	128	1338

Gornja Bijela	179	189	199	166	114	101	63	97	134	206	281	254	1983
Boračko lake	170	169	176	153	101	100	56	85	112	173	242	209	1746
Ostrožac	126	137	158	141	96	95	58	92	105	159	230	172	1568
Grabovica	230	223	255	193	130	107	61	114	147	231	349	295	2335
Salakovac	167	157	164	137	103	76	50	76	89	153	247	193	1612

Distribution of mean monthly precipitations within the year (mm)



Maritime pluviometer regime with dominant autumn and winter precipitation predominates on the south and middle part of the observed stretch (Mostar-Konjic). In the north part of the section (Tarčin-Ivan Sedlo), pluviometer regime is modified by influence of continental pluviometer regime.That is expressed by increased precipitation in warmer seasons of a year.

Maximum daily precipitations

Occurrence probability of maximum daily precipitations for the different return periods is indicated in the Table 29.

Table 29 Daily maximum by time of return at Rainfall Stations (mm)

Return period (years)	Sarajevo	Ivan Sedlo	Konjic	Jablanica	Mostar
2	45.6	65.9	72.9	100.9	74.2
10	68.5	105.0	100.6	174.0	96.5
50	91.8	151.0	130.4	263.1	116.1
100	102.8	174.5	144.7	309.5	124.4

Short-duration rainfalls

In order to evaluate the daily variations of the precipitations the Intensity-Duration-Frequency curves have been estimated based on values recorded at 4 meteorological stations in the project area.

The evaluations have been performed for short-duration rainfalls: 10, 20, 30, 60 and 300 minutes and the results of calculations, carried out the by the Hydro Meteorological Institute of B&H Federation, Sarajevo (METEOB&H), as the only authorised body, are given in the following Table 30.

Table 30 Precipitation Intensity (mm)

Duration (minutes)	Sarajevo				Ivan Sedlo				Konjic				Mostar			
	2 yrs	10 yrs	50 yrs	100 yrs	2 yrs	10 yrs	50 yrs	100 yrs	2 yrs	10 yrs	50 yrs	100 yrs	2 yrs	10 yrs	50 yrs	100 yrs
10	0,88	1,43	2,30	2,95	1,46	2,44	4,05	5,16	1,32	2,08	3,16	3,94	1,48	2,75	4,79	5,89
20	0,62	1,05	1,74	2,23	1,00	1,64	2,73	3,50	0,93	1,45	2,19	2,73	1,08	1,90	3,19	4,05
30	0,50	0,86	1,48	1,87	0,81	1,34	2,22	2,75	0,71	1,12	1,79	2,18	0,84	1,43	2,42	3,03
60	0,33	0,57	0,98	1,24	0,53	0,87	1,45	1,80	0,45	0,71	1,13	1,38	0,52	0,89	1,50	1,88
300	0,11	0,16	0,24	0,28	0,16	0,24	0,36	0,43	0,12	0,20	0,28	0,33	0,14	0,22	0,33	0,40

Snow

Snow is the heaviest during the winter time, and there is not snow at all from June to September. Snowing regime varies by the different areas. Average yearly number of days with snow cover ≥10cm is increasing with elevation above sea level and it is, therefore, smallest in Mostar (1.6 days) and highest on Ivan Sedlo (76 days).

In the area of Hadžići, this number amounts to 50 days and than, through the river Zujevina river, over Tarčin and further to Ivan Sedlo, the number of days with snow cover ≥10cm is gradually increasing, 8 days more on every 100m.

Number of days with snow cover ≥30cm is ranging from 0 in Mostar, over 2.9 in Jablanica, up to 39 on Ivan Sedlo, while, going from Ivan Sedlo to Hadžići, it is decreasing to 10 days.

Number of days with snow cover ≥50cm is ranging from 0 in Mostar, over 1.9 in Konjic, up to 19 on Ivan Sedlo, while, going from Ivan Sedlo to Hadžići, it is decreasing to 5 days.

Relative humidity

Relative air humidity is a climate element that is directly related to air temperature and cloudiness and it is in an inverse proportion with air temperature during a year.

In the analyzed area the relative humidity is:

- Average annual value of relative humidity in region of Mostar is 62%. Minimum mean monthly value of 52% is in July, and maximum mean monthly value of 70% is in November.
- Average annual value of relative humidity in region of Salakovac is 66%.
- Average annual value of relative humidity for Jablanica is 76%. Minimum mean monthly value of 69% is in August, and maximum mean monthly value of 84% is in December.
- Average annual relative humidity is 79% in region of Konjic. Minimum mean monthly value of 71% is in July and maximum mean monthly value of 89% is in December.
- Average annual value on Ivan Sedlo is 81%. Minimum mean monthly value of 74% is in April and August , and maximum mean monthly value of 91% is in the month of December.
- Average annual value on the peak of the Bjelašnica is 83%. Minimum mean monthly value of 74% is in August, and maximum mean monthly value is 87% in January, March, November and December.

As elevation above sea level is getting higher the relative humidity increases. It should be noticed that processed data of relative humidity, on stretch downstream of Jablanica, are taken from period when following structures were not yet constructed: HPP Grabovica, HPP Salakovac and HPP Mostar, so it is very much possible that present values of relative humidity are bigger because of existing accumulations.

Cloudiness

The importance of this climatologic element is that it directly influences the sun radiation (reducing it), and thus influences the air temperature. This parameter is in alteration with potential insolation.

For the considered section, the annual cloudiness trend shows minimum value in July and maximum in February (for Konjic in January). Winter months are the cloudiest, summers are the clearest, and spring months are cloudier than the autumns. Variation of number of clear and cloudy days is very high from year to a year.

For the region of Mostar, within average year, there are 91 clear days and 105 cloudy days. Annual cloudiness is 52% (cloudiness in February is 64%, and in July 33%).

A cloudy weather is predominant, in the region of Salakovac because annual cloudiness is 55%. The clearest month is August with cloudiness 35%, and the cloudiest is December with cloudiness 70%.

There are 147 cloudy and 67 clear days within average year, in the region of Konjic, which means that in Konjic predominates cloudy weather. Concerning months of July and August it could be said that they are clear.

Insolation

The data on this parameter are observed at MS Bjelašnica, MS Sarajevo, MS Mostar and MS Ivan Sedlo. It can be considered generally, that sunshine duration is the greatest in summer months (July and August), and the least in winter months (December, January, and February).

For the region of Mostar, daily sunshine duration in an average year is 6 hours, in January 3 hours, and in July 10 hours.

For the region of Konjic, the longest relative sunshine duration is in summer months with a maximum in August 60-65%, and a minimum in December, when it is only 25-30% of possible sunshine duration.

For the region of Ivan Sedlo, daily sunshine duration in 1978 was 3.14 hours, in February 0.81 hour, and in July 5.83 hours.

For the region of Bjelašnica, average daily sunshine duration in 1977 was 4.99 hours, in January 1.54 hours, and in July 8.3 hours.

For the region of Sarajevo, average daily sunshine duration in 1977 was 5.04 hours, in January 1.75 hours, and in July 8.67 hours.

Wind

For wind analysis at the observed section Tarčin-Mostar, the data from four Climatologic Stations (MS Mostar, MS Jablanica, MS Konjic, MS Sarajevo) have been used.

Because of developed relief, wind is very changeable, by direction and speed.

The Mostar city area is extremely windy. Calm weather lasts over only 20% of the year, while windy weather lasts over 80% of the year. Average annual strength of wind is force 3, e.g. approximately 4m/s. Extremely predominant wind is the wind of the north quadrant known as "bura". Within the year, during 170 days there is presence of a strong wind and during more than 50 days there is a storm wind.

In the wider region of Salakovac 50% of the year is windy. There are mostly winds of the north quadrant; the second by appearance frequency is south wind. The average speed of wind is 4m/s.

North wind predominates in the larger region of Grabovica, and secondly, a wind from the south quadrant. Wind blows during more than 60% of the year and the strength of wind is 3 degrees by Beaufort scale or 4-5m/s. There is a strong wind over 100 days per year. In this number of wind appearance the storm wind lasts over 30% of the year.

Winds from direction of the southeast and the northwest predominate in the region of Konjic, while other directions are less present and they are only a result of a daily wind alternation. Wind takes less than 30% of an average year, and calm weather takes more than 70%. Average strength of wind is a force 3.

During 95% of a year there is a wind on the top of Bjelašnica, and calm weather is during only 5% of the year. Winds from the north and the south quadrant are predominant. The north wind is a force 6 in average and south wind is a force 7.

Eastern as well as west winds predominate in the region of Sarajevo, while other directions are less present and they are only a result of a daily wind alternation. Within average year, calm weather takes less than 30%, and a wind more than 70%. Average wind force is approximately 3.

The wind values are available at the climatologic stations along the alignment as show in the following tables.

Table 31 Annual frequency of wind by direction (in %)

Station	***Calm***	***N***	***NE***	***E***	***SE***	***S***	***SW***	***W***	***NW***
SARAJEVO	23.9	3.0	3.0	17.8	13.1	7.0	7.4	14.6	10.2
		2.2	3.0	2.9	2.8	4.3	2.5	2.4	2.3
IVAN SEDLO	8.3	17.4	2.2	17.1	11.9	14.8	5.7	15.0	7.6

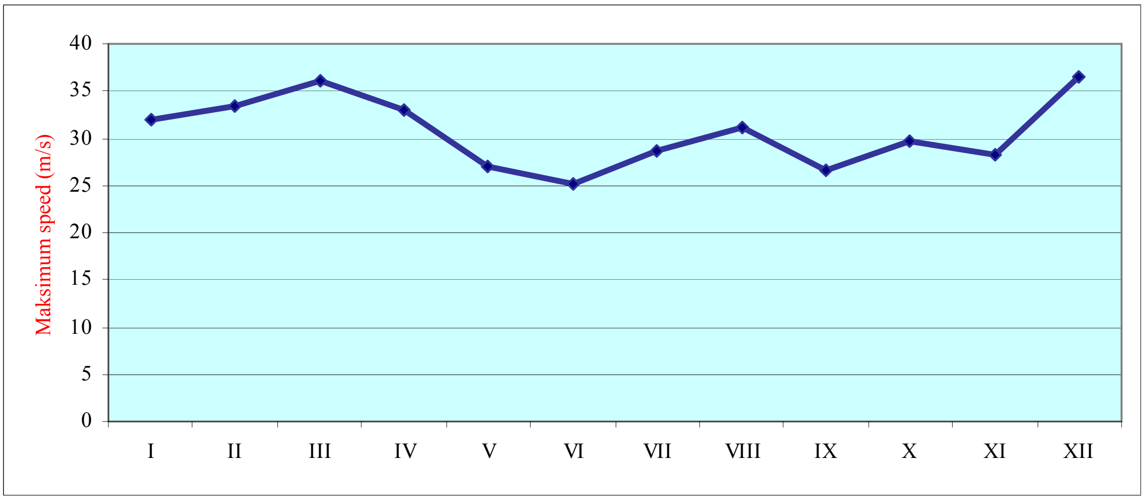
		6.4	1.8	1.7	1.7	3.9	2.4	2.4	2.7
KONJIC	68.5	6.8	3.5	3.7	6.6	1.5	2.2	2.2	5.0
		2.2	2.5	2.6	2.9	2.5	2.3	2.1	2.4
JABLANICA	73.9	3.7	3.6	3.8	1.6	2.9	5.2	2.3	3.1
		1.1	1.1	1.4	1.3	1.5	1.6	1.4	1.2
MOSTAR	10.2	24.2	18.8	6.2	4.3	9.6	11.3	6.4	9.0
		4.6	4.7	4.0	2.0	2.6	2.5	2.4	3.1

Table 32 Average monthly wind speed (m/s)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
SARAJEVO	2.1	2.3	2.5	2.5	2.2	2.0	1.9	1.9	1.9	2.1	2.3	2.2	2.2
IVAN SEDLO	3.2	3.4	3.5	3.4	2.9	2.4	2.2	2.1	2.4	2.6	3.3	3.1	2.9
KONJIC	2.2	2.3	2.3	2.3	2.3	2.2	2.3	2.2	2.3	2.4	2.2	2.2	2.3
JABLANICA	2.2	2.4	2.2	2.4	2.2	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2
MOSTAR	3.7	3.7	3.4	3.0	2.7	2.7	3.0	2.9	2.9	3.1	3.3	3.6	3.2

Wind speed values are particularly critical at the exit for the Neretva river canyon, from Grabovica towards Mostar, where there are frequent stormy winds. These speed values range from 30 to 45m/s in the colder part of the year, with frequency of 4 to 5 occurrences during one month.

Meteorological station Mostar, Annual distribution of maximum speeds



4.3 Geomorphologic characteristics

The geomorphological composition of the ground along the terrain under consideration is very much diverse and morphometrically uneven due to great variations in the lithofacial composition of geological formations, complex tectonic relations, neotectonic activity and different behaviour of rock masses in the surface weathering zone under the action of exogenous agents. Based on this, it can be established that the geomorphological composition along the corridor under consideration varies in terms of time of origin, composition, strike direction, spread, form and height, which is from the engineering-geological perspective, extremely important for the accurate categorization of the investigated area according to the degree of complexity of the engineering-geological conditions.

Based on the aerial photographs and from the perspective of geochronology, it may be stated that the basic morphotectonic forms (units) emerged during the tertiary folding phase, the macro and micro morphological units emerged during the neotectonic activity in the course of Pleistocene and Quaternary, while the present forms of relief emerged through a very complex intensive action of exogenous forces, the activity of fluvial and lacustrine water, abrasion, erosion, chemical corrosion, glacier activity, wind activity, temperature changes, etc.

Generally, about 90% of the investigated area accounts for the highland-relief, with altitudes of up to 500m and over 500m, while only about 10% of it accounts for the lowland-relief, with altitudes of up to 500m.

According to the genetic types, two relief categories were generally identified, depending on the nature of tectonic activity: geomorphological units in the neotectonic subsidence phase and geomorphological units in the neotectonic elevation phase. Fluvial-accumulation relief and denundation-accumulation relief belong to the neotectonic subsidence phase, while gravity-deluvial relief, erosion-denundation relief, karst-erosion relief and glacial relief belong to the neotectonic elevation phase.

4.4 Geological, engineering-geological and geo-technical characteristics

The studied terain from Tarčin to Mostar generaly belongs in the two geotectonic units: Middle and Exterior Dinarides. The boundary between these units is generally located in the zone of Jablanica, and its extension course is of the Dinarides direction.

Starting from Tarčin up to Jablanica, the terrain is composed from paleosoic rocks with penetrations of magmatic rocks, than from Mesosoic clastites and carbonates, Miocene sediments, as well as from shallow Quaternary detritus.

South from Jablanica, carbonate rocks of Triassic, Jurassic and Cretaceous age are dominating, as well as Quaternary fluvio-glacial sediments and talus.

In the studied area all rocks can be divided in two main groups: hard and soft rocks and cohesion-less soils.

Hard rocks make large area at the studied zone, occupying north and south parts. They form stabile parts of the terrain and work conditions in them are generally favorable. The following units have represented lithologic types:

- Limestone rocks cryptocristalline, bedded, seldom thick-bedded to massive with subordinated dolomite rock interbeds of Upper Triassic, Jurassic and Cretaceous age,

- Cryptocristalline dolomite rocks, bedded, seldom massive and thick-bedded, that are weathered in surface zones, of the middle to Upper Triassic age,
- Schistose marl limestone rocks, bedded and partly metamorphosed, of Perm-Triassic age.

Lithologic complex form mostly stabile and subordinated conditionally stabile terrain parts, while detritus over the complexes forms stabile parts of the terrain. Building conditions are relatively less favorable comparing to the mentioned rock masses. This conclusion results from the lithologic composition, tectonic disturbance and impact of the exogenic agents during the time.

The following units are representing in the complex:

- Limestone rocks and more subordinated by dolomite rocks, thin-bedded to thick-bedded, of Middle Triassic, Jurassic and Cretaceous age,
- Palaeozoic complex - chlorite-muscovite and sericite-schist rocks, argilloschist, siltstone rocks, lydite rocks, phylite and porphyrite brake outs. This complex is secondary folded and schistose.
- Volcanogenic-sedimentary formation - cherts, claystone rocks, sandstone rocks, tuffs and limestone rocks of Middle Triassic age,
- Jablanica complex-represented by schistose marly limestone rocks- calchists of Lower Triassic age. Seldom, schist, marlstone and claystone rocks of laminated to sheet texture occur. Characteristic is divisibility and decomposition to small plates.

Soft rocks occupy the central area. Soft rocks and soils form stabile-conditionally stabile and unstable parts of the terrain. Solis-detritus are generally shallow, small thickness. Due to linear character of the structure; the majority of the alignment will be placed in it. The following lithologic units represent soft rocks:

- Large grain conglomerates, sandstone rocks, claystone rocks and tufaceous limestone rocks of Perm age,
- Substratum breccias and conglomerate cemented with clayey and ferruginous material, sandstone rocks, marlstone rocks and clays of Miocene and Neogene age,
- Sandstone rocks, marlstone rocks, claystone rocks and sandy limestone rocks of Lower Triassic age. They are of laminated and sheet structure and subject to surface weathering.

Soils have a little spread and occur around Tarčin and Pazarić, Konjička Bijela, the valley of the Idbar, around Konjic (alluvions of the Neretva river) and Jablanica (fluvioglacial terrace), from Gornja Grabovica to Drežnica and south from Salakovac as bigger isolated parties.

These are large size grain cohesionless rocks, represented by the following lithologic complexes:

- Gravels, sands, tufaceous limestone rocks of small thickness - covers, alluvial and lacustrian formations.
- Poorly rounded and non-rounded boulders from limestone material, containing also remaining of eruptive rocks - glacial and fluvial-glacial sediments - around Jablanica are very massive.
- Limestone and dolomite sandstone debris, locally cohesive to slope breccia-diluvium and talus.

Regarding the engineering-geology phenomena along the alignment under consideration, remote sensing, engineering-geological mapping and field investigation work have identified the following: weathered rock, erosion processes, landslides, and small areas of ground instability. With respect to the landslides, the scars of active and dormant landslides have mostly been identified in geologically more recent formations, primarily in Neogene sediments and surface covers of various genetic origins.

The **rock weathering** processes are particularly pronounced in dolomites, where grusification process causes the transformation of the hard rock mass into a sandy fraction, a grus. The grossed fields are more frequent near fault structures, where more intense ruptures caused by mechanical movements sooner bring about the physical degradation of the rock mass under the influence of exogenous agents, as well as faster weathering into a grus. In addition to the dolomites, the weathering processes have been identified in the Verfenian polyfacial complex of Jablanica and in Neogene conglomerates with clayey bonding.

The **erosion processes** have been registered within the Neogene and Verfenian polyfacial complex and in Triassic dolomites. They are the areas in which planar scouring occurs in combination with gorging. These are mainly steep denuded parts of the terrain, without or with scarce vegetation, where a number of linear flows can be observed, as well as smaller «fluting for drift material» whereby the eroded detritus is transported. The gorging is present as an individual phenomenon especially in fronts of local streams with the occurrence of land sliding in surface covers.

The landslides are represented at relatively small area along the motorway alignment with respect to the total length. They are mainly associated with the positions of specific geological areas with complex polyfacial composition, susceptible to weathering processes resulting in covers having unfavourable geomechanical properties. Most of these phenomena have been identified within the Medium and Upper Miocene ($^{1}M_{2,3}$) Jablanica Neogene basin, while less frequently within the Verfenian complex and the Perm-Triassic. In the Neogene sediments most of the identified phenomena have been taken as dormant landslides and this creates an active and potential risk for the road construction phase, although when building linear structures, the dormant landslides, depending on the alignment position, should be treated as unstable areas. The landslides occur in eluvial-deluvial covers and in the geological substratum weathering crust. They occur in the phase of the morphogenetic shaping of the relief upon the completion of the Neogene phase of sedimentation, when in diagenetically insufficiently consolidated formations there occur gravity processes during neotectonic movements.

Based on the analysis of the ground composition along the corridor under consideration, its morphological and morpho-metric characteristics, the following ground categories can be identified from the stability perspective: stable ground, conditionally stable ground and unstable ground.

The **stable ground** has been identified in the major part of the motorway alignment, in low-land parts of the terrain, on flat saddles, on hilly-mountainous terrains composed of hard carbonate rocks of Mesozoic period and in other lithofacial areas with substratum on the ground surface or the surface cover less than 2m-thick. It is estimated that about 50% of the road alignment accounts for this category.

The **conditionally stable ground** is present in sloping areas where on the surface there are Quaternary covers of eluvial-deluvial and deluvial origin, composed of sandy clay, mixed with the underlying substratum debris and thick deposits of debris in the foots of steep slopes.

The **unstable ground** is found in the zones of identified dormant and active landslides, where morphological setup of the sliding process is less expressed. Such phenomena are easy to identify on the aerial photographs by their characteristic geometry and undulating ground. These are the areas where the sliding process could be re-actuated during the execution of earth works.

In respect of the seismicity and the choice of the seismicity base level, it has been agreed that, in reference to the character of the object, its duration and adopted risk of 10%, the seismic map for return period of 500 years is adopted. For the studied area and mentioned return period of 500 years, the areas with maximum intensity of the expected earthquakes, with the occurrence probability of 63% have been determined; those are in range of 7-9º MCS of the seismic scale. In the north part of the considered area, from Tarčin to Jablanica, it is 7 degrees MCS.

As previously indicated, in terms of the lithostratigraphic characteristics, in the area along the alignment and corridor under consideration, the following have been identified: Paleozoic schist and clastites of Silurian-Devonian, Permian and Permo-Triassic periods, as well as magmatites, Mesozoic complex composed of Lower Triassic clastites, Medium and Upper Triassic, Jurassic and Cretaceous limestones and dolomites, then a heterogeneous complex of Neogenic sediments and Quaternary deposits. Engineer-geological conditions along approved alternative 3 with categorization of excavation are given further in text.

At the station from 0,00 km to close to Bradina until 7,25 km, in the soil composition the lacustrian, Perm, Perm-Triassic and Werfenian sediments are participating. Beginning of the alignment is lying in lacustrine sediments in a base of which there are Perm sediments represented with large-grained conglomerates with gaskets of sandstone rocks and claystone rocks. Few meters thick gravel and sands represent shallow alluviums. Rock bed above the tunnel is thinner, composed from the Perm-triassic sediments represented with grey and green marly schist limestone rocks and Werfenian white and red quartz-mica sandstone rocks are occurring. Werfenian sediments are overthrusted above the Palaeozoic complex- quartz sericite schists. The old tunnel on Ivan Mountain had problems of instability due to gypsum occurrences. The same can be expected also in the designed tunnel-occurrence of gypsum and anhydrite-rock weathering. In addition to a standard measures it is necessary to predict appropriate measures during the tunnel drilling. Due to the reverse fault around 7th km, the rock mass has been strongly damaged. The beds are dipping towards the entrance portal and are tectonically heavily damaged.

Scarps and notches will be done in covers of the significantly damaged base rock mass (soft and hard) that are at the Engineering-geological map distinguished as lithologic types. On this section any significant water penetration is not expected. In Werfenian, due to the thick loose cover the occurrence of local instability can be expected.

Tunnel excavation in Perm-Triassic sediments-by the Construction standards-No. 206 it is estimated that the 3rd category makes 70% and 4th category makes 30%. In the tunnel at the overthrust-reverse fault it is estimated that the 3rd category makes 60% and 4th category makes 40%.

From Bradina (7,25 km) to app. 12,35 km, up to Perm sediments; the Palaeozoic complex exists, represented by chlorite-muscovite and sericite schist rocks, argilloschist and alevrollite rocks, lydite rocks, phyllite rocks with porphyrite brake outs (9,5 km – 10,1 km). Along the contact, there are significant damages. They are extremely secondary folded with a dominant schistosity that will be relevant for determination of slopes as well as of damage on the rock mass, considering folding and possible breakouts along the alignment. By the Construction standards-No. 206, the excavation will be done in the rocks of the following categories: 2nd category-20%, 3rd category-60% and 4th category-20%. Scarps and notches can be generally constructed with slopes from 1:1,5-2 (clay-cover) up to 1:1 and 2:1 (soft rocks), and very seldom 3:1 or more, depending from the excavation depth. Along the tunnel excavation, the change of lithologic units is expected. Water penetrations are not expected, apart the usual occurrences-humidity, pouring and dripping in the tunnels.

At the station from 8,05 to 8,45 km we enter into the shorter zone of Perm schistose limestone rocks. According to the Construction standards-No. 206 it is estimated that the 2nd category makes 30% and 3rd category makes 70%.

From 12,7 to 18,0 km, the alignment is located in Campil sand-marl limestone rocks-with smaller part in Middle Triassic massive dolomite rocks. In sub-surface part, the dolomite rocks are affected by weathering from 1,0 to 10,0 m, so they can be excavated manually and with machinery without an explosive. In the deeper massive parts, dolomite rocks are fresher and harder.

Significant water appearance is not expected, but to the certain measure they are surely higher, comparing with the previous sections, depending of the oscillation during the seasons (min. and max.). According to the Construction standards-No. 206 it is estimated that the 2nd category makes 50% and 3rd category makes 50%. Grus and dolomite debris will be used for embankments.

From 18,0 km to app. 24,00 km, the alignment is lying in polifacial sediment complex of Middle to Upper Miocene age, represented by substrate breccia and conglomerate, cemented with clayey, ferruginous and rarely carbonate mass, as well as sandstones. The mentioned sediments are alternating each other, as discovered by boreholes. Beside that, there is an occurrence of clay interlayer. Covers are very thick and the soil is wet. Slopes are conditionally stable to unstable (small local landslides) and there is one bigger landslide (Landslide "Jezerine"-north from the road alignment).

There is a frequent alternation of different members that are degraded in the sub-surface part. Dipping is relatively favorable in respect of making scarps and notches-the angle of layer dip is 8-20° (one side is favorable, while the other is not -moderate slopes). According to the Construction standards No. 206, it is estimated that the 3rd category makes 70% and 4th category makes 30%. No significant water quantities are expected during the excavation.

Bridge foundation in Čelebići has to be executed in bedrock with satisfying bearing, and not in surface covers. Geo-mechanical borehole S-23 that is drilled in Jablanica lake basin at 5,8 m depth found gravel, and at 9,7 m bedrock – polifacial complex.

From 24,0 km - near Čelebići to 25,3 km, there is alternation of Campil sandy-marl limestones and Middle Triassic limestones and dolomits with thinner covers.

From 25,3 km to 29,9 km approved road variant is laid in Ladinian volcanogenic sedimentary rock formations, and it is represented by layered calcarenites, red weathered hornstone, spilites, tuffs, alevrolites and claystones are subordinated. Just in one small section from 28,2 to 28,5 m it is entered in above explained polifacial sediment complex of Middle to Upper Miocene age that are thinning out here.

Next section from 29,9 km to 32,7 km is in Middle Triassic limestones and dolomites with thinner covers. They are compact rocks; according to the Construction standards-No. 206 it is estimated that the 2nd category makes 50% and 3rd category makes 50%.

From 32,7 km to 37,3 km alignment is laid in Campil sediments, so called Jablanica complex, and represented by schistose marly-limestone rocks - calcschist, of light brown to oily color, schistose, plated to laminate structure. More seldom the chlorite-sericite schist, schistose marl rocks and claystone rocks are appearing.

Calcschist rocks prevail, but in places, the rhythmic alternation of the lithologic composition, like in flysh, occurs. Characteristic is rock divisibility to chips and plated under surface conditions, at the sections of foliation and cleavages. Layer dip is relatively favorable. Layer direction is normal to the alignment, but the layers are secondary folded with the angle between 20° and 50°. For the slope formation the most essential are fissuring and cleavage. They will be of smaller inclination slope in Werfenian and of steep slope in Campil stage-that can be noticed along the road in the area of Jablanica. Water penetration in Werfen is expected and also bigger quantities of water in limestone rocks. According to the Construction standards-No. 206 it is estimated that in the Jablanica complex, 60% belongs to 3rd category and 40% belongs in 4th category.

From 37,3 km until the end - 59,7 km road alignment is laid in carbonates, and along the alignment is superpositioned entrance from Middle to Upper Triassic dolomite rocks, towards Jurassic and Cretaceous rocks, that generally dips toward South, Southeast and East, under the angle of 20-40º. Dominant are the local faults and overthrusts that cut the road alignment near Glogošnica, Drežnica and Bijeli Potok. The rock mass is of the relatively most favorable characteristics from the aspect of structure construction.

Only with one small section, on the station 42,2 km to 43,8 km, road alignment is laid in sediments of Ladinian volcanogenic sedimentary formation that is represented by limestones, red weathered hornstone, spilites, tuffs, alevrolites and claystones are subordinated. It is important to mention that at interval from 43,4 - 43,8 km rock is tectonically very degraded and damaged, because it is located in the zone of bigger fault with block movement. Due to thick over-layer (around 850 m) there is specific stress condition, so during execution of underground works, mainly high tectonic, as well as hydrodynamic and lithostatic pressures can be expected, and higher temperatures also.

Besides that it is important to emphasize also fluvioglacial sediments. They are at the station from km 46,3 – 47,5 and they have large distribution, making steep, vertical cliffs 20-30 m in few levels at Bijela riverbed. Above and under these cliffs, riverbed slope is in active talus. There is stratification in higher parts of sediment layer, i.e. breccia conglomerate deposits. Fragments in breccia conglomerates are Jurassic and Cretaceous dolomits and limestones as well as Triassic dolomits (limestones). Binder is clayey-bauxite and limonite. Bond has small strength; fragments are easily dividing from matrix. Layers are 10-20 cm thick and sometimes even 1 m, with irregular alternation and thinning out. Talus is significantly distributed (especially from 59,0 km to the end of the alignment); it is located on steep slopes and can have unfavorable influence on stability during excavation.

According to the Construction standards-No. 206 estimated excavation categories are like follows: 70% belongs to 2nd category, 20% belongs in the 3rd category and 10% belongs in the 4th category. These categories might vary depending on the specific geological conditions. In the tunnels it is necessary to pay attention to the tectonically damaged zones, where the caverns of the larger dimensions, filled up with the clayey material-Terra Rossa are occurring in karst.

Considering the hypsometric layout of the alignment in respect of the Neretva river erosion basis and occurrence of permanent springs along the mentioned, the hydro-geological collectors and reservoirs, and also the underground water levels in carbonate massif are expected far under the alignment level reference line. In tectonically damaged and cavernous zones and fault zones, in the rocks of certain hydro-geological periods, occasional short-lasting penetrations of significant quantities of underground water can occur, estimated to 10-100 l/sec. In respect of their geological composition those tunnels are categorized as easy tunnels.

4.5 Hydrological and hydro-geological characteristics

Hydrological characteristics of the wider considered area are detaily described and elaborated in the separate book “Hydrological and hydraulic report”. The bigest (southern) part of the terrain that the adopted alignment is passing through, belongs to the Neretva river catchment, e.g. to the catchment of Adriatic Sea while the northern and nort-eastern parts of the Lot 3 belong to the Bosnia river catchment (further the Sava river catchment and Black Sea catchment). Watershed between these two regional catchment areas is orographic and it lies in the area of the mountain Ivan.

The river Neretva springs under Gredelj, on the elevation of 1,300m a.s.l., in the northwest side of Čemerno Mountain. Up to the city of Konjic, the catchment area amounts to 1,390km^2; the main flow length is app. 84 km, with an average fall of 12 ‰. Up to the city of Mostar, the catchment surface is 4,331km^2; the main course length is app.150km, with an average fall of 8 ‰. The surface of orographic basin is 2,494km^2 and of the hydrographical basin is 1,837km^2.

The highest basin elevation is 2,228m a.s.l., and the lowest is at 57m a.s.l.

The drainage density, given as length of streams divided by drainage area, for the catchment up to HEPP Mostar equals 0.12 km/km^2.

Among the natural lakes within the catchment, Blidnje Lake and Boračko lake are characteristic by their volumes. As for the artificial lakes, the most important are the ones next to the HEPP on the Neretva river: Jablanica, Rama (on the tributary), Salakovac, Grabovica and Mostar.

The Neretva river catchment relief is consistent, thus the orography and the geomorphology are extremely emphasised.

The Upper Neretva is flowing through a narrow canyon with steep, 600m-high rocks. The Middle Neretva, from Donja Jablanica to Salakovac, crosses a magnificent canyon, up to 1000m deep, and, at some locations, not wider than 10m.

The Neretva river can be considered a karst river, aldought its origins are not located in the karst. Around 80% of the catchment area, in respect of hydrogeology, has typical karst relations.

The Neretva river canyon, as the deepest erosion basin in the considered area accepts all underground waters and surface water courses. The left affluent rivers of the Neretva river are: the river Trešanica near Konjic, Doljanka near Jablanica and more downstream the Diva Grabovica river and the Drežanka river. The right tribotories are the following rivers: Bijela (Konjička), Idbar, Glogošnica and Mostarska Bijela.

The karst sources are mostly distributed along the middle canyon areas and around the Nertva riverbed.

Due to significantly barren area, limestone composition of the ground and human activities, there are various phenomena of surface and ground hydrography created in the area. There are many influent streams, karst springs, estavels and other hydrographic phenomena of a barren karst.

It is important to underline that the Corridor construction does not have direct impacts on hydrological conditions in bigger open watercourses, since they are passing over high bridges, while drainage of smaller brooks cut and gullies will be solved by adequate culverts in the motorway embankments.

Rock masses composing the studied terrain are very heterogeneous and complex, in respect of lithologic composition, structural-tectonic characteristics, structure and porosity, water-permeability and by other characteristics relevant for definition of hydrogeological characteristics. Considering hydrogeological function of the rock masses, generally, water-permeable and water-impermeable rock masses can be distinguished.

In the north part of the considered area, close to Jablanica, there are permeable, impermeable and more subordinated water permeable rock masses, while in the south area, from Jablanica and further, extremely water-permeable, karstified rock masses dominate. In the frame of the south carbonate part of the ground, there are underground watersheds, frequently having a zoned character.

All underground waters and surface streams are directed towards the Neretva river canyon, as the deepest erosion basis of the considered zone. From the right side the Neretva river accepts Trešanica near Konjic, Doljanka near Jablanica, and downstream Diva Grabovica and Drežanka. The more important left affluent rivers are: the river Bijela (Konjička), the river Idbar, Glogošnica and Mostarska Bijela. On the Neretva river, three hydroelectric power plants (HPP) have been built: HPP Jablanica, HPP Grabovica and HPP Salakovac.

Underground water exposures temporary and perennial springs in the north part of the studied area are mostly of the less capacity, seldom exceeding 10 l/sec, what indicates that in the considered area there are not significant accumulations of the underground water.

In the south part of the area, there are large temporary karst springs, as well as sinkholes with temporary and permanent inflow water of the Salakovac accumulation.

Circulation is taking place along tectonic and structurally predisposed zones. On some of the more important springs the catchments have been built- Perutac, Vrelo Milješčak has been overflowed by Grabovica accumulation near Aleksin Han. Crno oko has been caught for the needs of HPP Grabovica, while Crno vrelo near Vidikovac has a temporary character. The mentioned springs are not in the zone of the adopted alignment corridor.
Considered wider area is formed out of rock masses that differ from each other by hydrogeological characteristics and functions. Hydrogeological categorisation has been made according to the applicable Instruction, based on the hydrogeological characteristics and functions of the lithostratigraphic units. All rock masses are, according to permeability, divided into two categories: permeable and impermeable rock masses. Within each category, types-groups of the rock masses have been distinguished, and mostly on the bases of the porosity type, like follows:

- The rocks of inter-granular porosity, of the good water permeability, represented by river gravel, slope talus, rocky limestone debris, and moraine and fluvioglacial terrace sediments. These are masses of the good water permeability with the filtration coefficient Kf = 1x10-1 to1x10-2 cm/s. These rock masses quickly conduct all water from precipitation or snow melting, into the rocky environment lying beneath them. Therefore, they are not important from the hydrogeological aspect.
- The rocks of inter-granular porosity and/or fissure porosity, low to middle water impermeable, are categorized as lacustrine and Miocene sediments, represented by conglomerates, clayey gravel, breccia, sandstone rocks with interlayers of clay and marlstone rocks. These sediments are less spread at the studied area.
- The rocks of fissure-cavernous porosity represented by limestone and dolomite rocks of the Devonian, Triassic, Jurassic and Cretaceous age. In the studied area they occupy central and south parts and are the most spread. Generally, thy can be considered as well permeable and karstified, to

the different extents. In them, the underground waters are flowing through concentrated underground channels, and drainage is done through karst springs towards the erosion basis of the Neretva River.

- Perm-Triassic schistose limestone rocks present the rocks of fissure and very subordinated cavernous porosity, Middle-Triassic volcanogenic-sedimentary formation, than flysch sediments of the Cretaceous and Eocene age. Alternately exchange of the rocks with variable hydrogeological functions causes water accumulation in the limestone rocks that, appearing as small capacity spring, flow out at the different hypsometric levels.
- Lower Triassic and Miocene sediments, as well as magmata rocks penetrations represent the rocks of fissure-fracture porosity, mostly impermeable. In the frame of this group, local discontinued water-bearing rocks at the smaller depths.
- Practically water-impermeable rocks are represented by Palaeozoic schist and phyllite rocks, Silurian-Devonian quartz-mica schist rocks, argilloschis, siltstone, sandstone and claystone rocks, as well as by classical sediments of Lower Triassic. They are widely spread and have a big thickness in the North area. They are mostly without Water-bearing rocks, and the spring occurrences are connected mostly to the faulty and surface degraded zones.

Levels of the underground waters, e.g. circulation zones in the south karst part are significantly below the adopted road alignment grade line. In the basis tunnels it is possible, by excavation, to enter the zones of horizontal, even suffosion circulation of underground water.

From the ecological aspect, waters of the upper river courses are clean. Due to dissolved limestone, the waters are hard. Although being abundant with water, this area if known as “dry and thirsty” area. The main reason for this is uneven precipitation distribution, in spite of the fact that they amount to 1,500 mm (almost 50% more than average in B&H).

4.6 Soil and agricultural areas

From the starting point of the Lot 3 motorway section, **0+000.00** (connection point to the neighbouring lot) to the station **1+800.00** located in the plane area of the analysed buffer zone, represented are deep fluvisols with high percentage of colloid mechanical elements. The stated mechanical fraction, being a holder of mineral nutritive component that is necessary for vegetative production, represents a base for agricultural productivity. In this zone, recent fluvisols are prevailingly present on Quaternary gravels and clays. These are high quality soils, with very thick solum, with significant physical depths of more than 1.5m, while physiological depth is significantly over 2.0m.

Along the stated section, along the considered localities within the area of 200m to the both sides of the motorway axis, the soils are flat, representing actually the highest quality agricultural land. The Quaternary recent fluvisols, dominantly represented at this section, are characterised by watercourse that is characteristically meandering, representing the most important factor of the soil water regime. The mentioned watercourse is conditioning presence of underground waters, which during the year, by mean of so-called “supported” categories of capillary waters; supply the soil with necessary water quantities, assuring undisturbed continuity of vegetation physiological processes. It has to be pointed out that, in addition to the explained soil feeding through the ascent capillary water, this watercourse serves for irrigation of agriculture cultivations, what assures the concept of an intensive production with several cycles during one calendar year. Beside this, extremely important agricultural role, this watercourse, due to its characteristic meandering course, represents an important link in a wide diversity of fauna and the surrounding flora.

The above photograph gives a presentation of meandering watercourses in the area of agricultural zone II in the frame of land use category II

In the agricultural context, the zone from **0+000.00** to **1+800.00** represents the most important natural resource and economic potential of the settlements of the close surrounding (Do, Opute, Vrbanja, Smucka).

In addition to the elaborated area belonging to the **agricultural zone II**, (the zone of intensive agricultural production) and in **land use category II and III**, surrounding land, up to the edges of the analysed buffer zone, is encompassed by agricultural zone III, with respective land use categories IVb and V, in which, by inclination of agricultural areas, the land is alternating from artificial meadows to parcels with broad-lined cultivations. Such agriculture land is represented all to the end of the analysed buffer zone (total of 2km to the left and to the right of the alignment axis).

The above photograph shows agricultural land of agricultural zone category II and of land use category II

The above photograph gives a presentation of the most quality land in agricultural zone II of land use category II. The motorway alignment will pass through this zone and Tarčininterchange is planned to be constructed here.

The flat parts of the agricultural area, in **agricultural zone II** (≥200m), are the parts which are directly endangered by the alignment. The alignment will disable simple and customary ways of communications of the owners and the users with their agricultural property. If analysed from the aspect of intensive agriculture production, the land in reach of this section will be directly endangered. The endangerment shall reflect in impossibility of the intensive agriculture production realisation, permanent destruction of major part of the agricultural land and modified approaches to the remaining agricultural land. It is particularly important to point out that the ecological concept of agricultural production (so called "organic food production") will be impossible to achieve since the road is in absolute vicinity of the agriculture areas. It will be impossible to obtain certificates for such kind of agriculture in these areas.

The following important section is encompassed by agricultural land, passed through by the alignment from the station **3+100.00** to the station **4+630.00** that is, in fact, entrance to the tunnel Ivan.

In this part, the buffer zone encompasses the soil series represented by: Eutric cambisols on marls and limestones, Eutric cambisols on claystones and marlstones, Distric cambisols on phyllites, schists and clays and Distric cambisols on claystones.

The entire series of the existing soils represents the area with good potentials for agricultural production. In the land use context, the land with eutric cambisols is the land characterised as a natural resource aimed primarily at a food production.

Each of the existing soil types in the frame of the said section is of good physical characteristics. Positive character of the physical features is increasing with the soil depth. Entire series of the existing soils has deep physical and physiological profile (>1.2m).

In sense of agriculture, around the stations stated, artificial meadows prevail. Mostly on less inclined points, plough fields alternate with artificial meadows.

The previous three photographs show agricultural land of agricultural zone III with land use categories IVb and V

The most quality plough fields are exposed to south and south-west. Part of this agricultural land will be permanently taken away or significantly damaged by construction of cuts (stations **3+100.00** to **3+250.00**; **3+690.00** to **3+790.00**; **4+050.00** to **4+170.00**; **4+440.00** to **4+630.00**).

To our mind, the agricultural land located above the tunnel, from the station **4+620.00** and further up to the mountain saddle Ivan Sedlo will not be exposed to direct impacts of the project.

Agricultural land in the zone of Ivan sedlo mountain saddle comprises agricultural zone III with dominant land use category V

The agricultural area will be temporary damaged and endangered by mechanisation engaged on the tunnel excavation and by the disposal of the excavated geological waste in a wider zone of the tunnel entrance/exit (4+620.00 and 7+660.00).

The next agricultural zone that could be endangered by the Project begins at the station **7+660.00**, correspondent to the exit of the tunnel Ivan, and ends at the entry in the tunnel Bradina, at the station **8+360.00**.

In this area, having the character of agricultural zones, there are agricultural zone III and partially agricultural zone II. In the reach of these agricultural zones, represented are land use categories IVa and IVb.

In the entire area there are anthropogenic colluvial soils. Physical and chemical characteristics of these soils are uneven and rather variable even at small distances. They are mostly skeleton soils of uneven solum thickness, which belong to the category of medium deep and shallow soils. Additional quality these soils get from the watercourse flowing through the part of the area.

The above two photographs represent section of Bradina in the land use zone of category IVa which is exceptionally placed in agricultural zone II.

The previous two photographs represent agricultural zones category II with land use category IVb present at the motorway alignment

The previous two photographs present locations of the tunnel Ivan's entrance/exit with the disposal sites for the excavated material

The previous photograph illustrates location of the viaduct Ivan, from station 8+000.00 to 8+200.00 and tunnel entrance at the station 8+210.00

Land management systems in this are out of date, more than 50 years old. Out of cultivations, present are permanent meadows, used for pasture of sheep and goats.

Direct negative project impacts will take place in the zone of cuts at the station from **7+660.00** to **8+000.00**. Moreover, the negative project impacts will be distinguished on the locations for deployment of the mechanisation to be used for excavation of the geological material from the tunnel. Soil and land on which the excavated material is going to be disposed will remain out of its primary purpose during longer time period.

Within the buffer zone, apart of agricultural land, there is also a forestland area.

Previous photograph illustrates tunnel entrance/exit at the station 9+240.00 and viaduct at the section from 9+300.00 to 9+360.00

The next zone is of characteristic soils and important agriculture land areas, and it starts from the station **10+450.00** and finishes at the station **11+490.00** that represent entrance to the tunnel "Zukići".

The soils existing in a wider zone are very uniform, belonging to amorphous class. By type, they are distric cambisols on phyllites and mica-schists of different sub-type and variety belonging. Due to primary minerals resistance (the group of primary aluminium silicate minerals prevail) existing in these soils, and foliated mineralogical structure the most important physical characteristic is a light mechanical composition. Consequence of such condition is extreme sensibility of these soils to the water-caused erosion. Erosion is particularly distinct on the south and south-west dispositions.

Physical thickness of these soils are small and moderate (mostly not exceeding 80cm), while physiological depths are much bigger in the agricultural zone.

This area belongs to the agricultural zone III and land use category IVb, V and VI. Regardless of low potential land ranking (the most frequent categories are V and VI) very intensive use of these soils is realistic.

Agricultural land directly endangered by the Project, is characterized by alterations of meadows and plough fields. These areas are located in the zones of cuts at the stations from **10+450.00** to **10+750.00** and from **11+050.00** to **11+500.00**.

The above photograph illustrates the cut zone at the stations from 10+450.00 to 10+750.00

The above photograph illustrates location in the zone of embankment in which the agricultural area at the section from 11+050.00 to 11+500.00 will be permanently destroyed

The previous two photographs illustrate the agricultural land that will be damaged or permanently< destroyed due to construction of cuts and beginning of viaduct at the section from 10+550.00 to 10+750.00

The above photograph illustrates the zone under the viaduct at the section from 10+750,00 to 11+050.00 that will be indirectly endangered by the Project

The above photograph illustrates agricultural land above which the viaduct at the section from 10+750.00 to 11+050.00 will be passing

The above photograph illustrates the zone above the tunnel entrance/exit at the station 11+500.00

The previous five photographs show agricultural land above the tunnel at the section from 11+500.00 to 12+600.00. This is the reach of agricultural zone III and land use categories V and VI

The point corresponding to **11+500.00** represents entrance of the «Markovac» tunnel. Agricultural zones above the tunnel will not be directly affected by the Project. In the analysed buffer zone there is more agricultural land to be endangered by the Project in an indirect way. Locations of the two viaducts and the tunnel entrance indicate the possibility of significant damage to the land caused by permanent destruction of production features in the construction period. This damage is going to occur as a consequence of long-lasting temporary damage caused by the Project realization.

Indirect negative impacts in this agricultural zone will be particularly significant to a fruit trees, during both construction and operation period. For this agricultural zone, the fruit species, as well as melliferous species are traditionally of a great importance. It is extremely important to point it out since these areas are subject to influence of Sub-Mediterranean and Mediterranean climate elements.

The panorama photographs below show the areas of the tunnel exit/entrance at the station 10+000.00 with cuts and viaduct at the station from 10+550.00 to 10+750.00 and the tunnel entrance/exit at the station 11+500.00

From the station **11+500.00** the project is developing through a series of longer tunnels, short cuts and notches with the six viaducts. The finishing station of this analysed part is **20+130.00**, representing the tunnel's exit.

In this zone there aren't interesting agricultural areas, primarily because of the present soil types, conditioned by geological substratum. The entire section in the frame of the buffer zone present is Rendzines on dolomites. For the entire analysed section, the main problem and direct negative impact shall cause building camp locations, heavy machinery as well as disposed excavated geological material in the tunnel zones.

The land from the station **20+130.00** to the station **23+150.00** represents the most valuable and the most sensitive agricultural area.

In this part, present is the soil series defined as anthropogenic eutric cambisols on conglomerates and limestones. In places, there are autochthonous and alochtonous Terra Rosa soils with the greatest potential and actual production possibilities. Because of the smaller areas occupied by these soils, they are not distinguished within previous mapping analysis. Due to high productive value, hereinto we conclude Terra Rosa as being actual natural resource.

Alochthonous Terra Rosa on conglomerates as a representative of the most productive soils in this agricultural zone

The above photograph indicates wider area of the section from 20+130.00 to 20+500.00 that will be directly affected by the project

On the above photograph given is a panorama of agricultural land in the agricultural zone II, with land use categories II, III and IVb. This is the zone, in the area of Konjic interchange at the section from 21+550.00 to 22+050.00 in which the agricultural land will be destroyed and permanently damaged

The previous three photographs illustrate agricultural areas in the zone of land use category II, subject of indirect negative impact of the project at the section from 22+050.00 to 22+700.00

Mineralogical and mechanical compositions of these soils result in excellent chemical characteristics. Combination of these characteristics provides permanent high potential and real production capacity. The only limitation factor in respect of productivity can be water shortage during the summer months, what can easily be solved by irrigation system possible to be installed because of Jablanica lake vicinity.

It can be stated that this zone represents a compact land area categorized as agricultural zone II with represented land use categories II, III, IVb and V.

Direct negative impacts of the Project on this agricultural area are reflected in a physical fragmentation of the most quality locations. Interchange of Konjic was planned to be on this location, including the land of a category II corresponding to the section from **21+550.00** to **22+000.00**.

Direct negative impacts on the agricultural area are additionally reflected in construction of cuts, embankments and interchange. Moreover, they will be manifested as interruption of customary communication links to the agriculture land properties. Significant negative impacts reach the strip of 200 m on both sides of the project in this agricultural zone.

Indirect negative impacts will impact the entire analysed buffer zone, only small part of which is represented by a forestland.

Due to favourable geographic locations of this agricultural land, subject to strong influence of Sub-Mediterranean climate, south expositions and production characteristics of the soils, the negative impacts will be expressed through impossibility of classification of this extraordinary agricultural land as a certified, ecologically controlled food production zone.

Potential permanent endangerment is stated as possible soil contamination that, within this buffer zone, represents a habitat for the valuable melliferous plants.

Potentially endangered agricultural land is also on the left side of Jablanica lake, since these areas are exposed to south-east, e.g. to the Project alignment.

The above photograph presents the zone of indirect negative impact by the left side of Jablaničko Lake. The zone at the section from 22+000.00 to 22+700.00 is presented

The above two photographs show the zone of indirect negative impact by the right side of Jablaničko Lake. The zone at the section from 22+000.00 to 23+750.00

The following agricultural zone which doesn't encompass great land surfaces is located in the part corresponding to the stations from **23+400.00** to **25+460.00**.

In this part there are represented the soils typically defined as calc-cambisols, dolomites and limestones. These are moderately deep soils of deeper physiological profile on the saccharoide dolomites. The represented calc-cambisols have an excellent physical and chemical features and good actual and potential production capacity.

Due to characteristic limestone-dolomite orography, these are zones of smaller parcels of extraordinary gardens in vicinity of the settlements.

The above two photographs present small gardens in the village of Hasanovići at the section from 24+600.00 to 25+400.00,that will be directly endangered by pollutants generated by fossil fuel combustion

Shown sequence of panorama photographs presents agricultural area in agricultural zone III, with represented land use categories III, I Vb and V. Immediately above the area the project alignment is going to pass, making indirect negative impact on the entire area.

Previously mentioned gardens in the said zone contain the soils that are completely human-modified and used for food production.

Immediate negative impacts caused by the Project will be, beside destruction of the orographically characteristic space in the surrounding, permanent endangerment by contamination of soil and agricultural products with pollutants resulting from fossil fuel combustion.

The station **25+460.00** represents the position at which the Project is developed through a tunnel to the station 27+550.00. The Project won't have a direct impact on this zone. The smaller enclaves of agricultural land, placed immediately above the tunnel have north and northeast expositions, which are not going to be impacted even indirectly.

The above photograph presents agricultural land in agricultural zone III with represented land use categories V and VI. This is the zone above the tunnel entrance/exit at the station 25+460.00, which shouldn't be subject of negative indirect impacts by the project.

The land passed by the Project from the station **27+550.00** to the station **29+350.00** represent a mixed complexes of agricultural and forestland areas. Due to its characteristic relief, this agricultural land belongs to agricultural zone III with small land area of land use category IVb, and dominantly present land use category VI.

The soils represented in this part of the buffer zone by their type belong to calc-cambisols and colluvial soils on limestones and limestone conglomerates. These are rather skeleton and porous soils. These soils are very shallow on more steep locations, and on moderately and slightly steep parts they are moderately deep. Skeletons presence and high porosity assign the main productivity characteristics to these soils, and thus these zones are classified to the category of xerothermic habitats. In spite of unfavourable physical properties, the series of these soils is characterised by good chemical characteristics that improve their production capacity.

The agricultural land is characteristic by mixed vegetable and orchard cultivations, conditioned by relief characteristics in first place. Production systems are adjusted to a small land peaces and Sub-Mediterranean climate influences. Here, there is also existing tradition of honey production. For this reason, there is a possibility of potential endangerment of melliferous plants by the pollutants generated by combustion of fossil fuels during construction and operation of the Project.

The above photograph shows the tunnel entrance/exit zone at the station 27+550.00 and the tunnel at the section from 27+690.00 to 27+770.00 with cuts at the section from 27+770.00 to 27+850.00 and the zone of viaduct from 27+850.00 to 28+275.00. The zones shown will be partially directly endangered (cuts), and majority of negative impacts will have indirect character.

The above photograph presents agricultural land in the zone under the viaduct, at the station from 27+850.00 to 28+275.00 that will be directly endangered by the project

The previous two photographs illustrate agricultural land with cultivations of mixed orchards and meadows that will be under indirect impact, at the section from 27+800.00 to 29 + 350.00

The above two photographs show localities with beehives. Indirect negative will probably reflect in changed honey production that is tradition in this area.

The above two photographs show the location of tunnel entrance/exit at the station 29+350.00 that will be directly affected by the Project proposed.

No significant and immediate negative effects on the agricultural land are expected at the section from **27+550.00** to **29+350.00.** This statement is supported by the fact that cuts are located in the forestland zones (27+550.00-27+680.00; 27+770.00-27+850.00; 28+275.00-28+350.00; 28+550.00- 28+675.00; 28+720.00-28+790.00), and that the two viaducts (27+850.00-28+275.00; 28+360.00-28+550.00) cross the agricultural land. These agricultural areas can be indirectly impacted during the operation period by the pollutants generated by combustion of fossil fuels.

Direct temporary negative impacts on the land are possible in the Project operation period, when large quantities of the excavated geological material are expected and it's depositing in the wider zones of the stations **27+550.00** and **29+350.00**.

From the station **29+350.00** the Project gets a form of the tunnel that finishes at the station **32+950.00**. The entire said section does not affect whatsoever on the agricultural land and soils present in this area. On this occasion, we bring the statement that in the surface zones, below which the tunnel alignment is passing, there are land composed of mixture of agricultural and forest systems. The agricultural systems are entirely under the cultivations of natural meadows of hilly and mountainous type. The soils represented in the zone of this tunnel are calc-cambisols and colluvial soils on a limestone of different depths and distric cambisols on schists. Soil depths are product of ground characteristics and of geological substratum karstification degree.

The foregoing four photographs illustrate agricultural land in the zone above the tunnel, at the section from 29+350.00 to 32+950.00 on which the Project proposed will not have any indirect or direct effect

Wider zones of the tunnel exits, at the stations as stated earlier, will have a character of directly endangered zones. This statement specifically refers to the area of Dragan Selo that will be surrounded by infrastructure necessary for the Project realisation.

The above photograph presents agricultural land beneath Krstac village, which represents location of tunnel entrance/exit in a wider sense, at the station 32+950.00. Insignificant indirect negative impacts are expected in these parts.

In the zones of Dragan Selo and Ravne there are characteristic narrow strips of agricultural land. These are recent creations formed by sedimentation of the most fine-grained eroded material brought by spring and summer torrent flows. The complete zone of these soils, being the only valuable agricultural land in immediate vicinity of the watercourse and somewhat outside the watercourse zone, is entirely human-modified.

The above photograph shows colluvial and fluvial deposits and agricultural land in the area of Dragan Selo. Here, certain direct and greater indirect negative impacts by the project are expected.

The foregoing three photographs represent narrow zones of fluvisols along the watercourses that are completely anthropogenised and represent the most valuable agricultural land. These are the zones of indirect negative impacts of the project planned.

Directly endangered agricultural land of this area is the one located at the points of tunnel portals and cuts. The first such point is at the station **33+500.00** (end of the tunnel). This is the zone of steep intensive meadows and of characteristic orchards.

The above two photographs present the zones of inclined meadows and tree orchards in agricultural zone III, at the section of cuts, from 33+620.00 to 33+970.00. These are agricultural areas that will be directly endangered by the project planned.

The sequence of cuts alternating with smaller viaducts and tunnels begins from the station **33+500.00** and finishes at the station **35+740.00**. Regardless the fact that the mentioned road section does not physically damage or destroy the agricultural land, we consider the negative impact during construction and operation period to have a negative character. These negative impacts refer to noise and contamination, since here is in question a narrow and much closed valley overtopped by parts of Prenj.

The foregoing five photographs illustrate morphology of narrow valley with agricultural land at the section from 33+500.00 to 35+700.00

The next agricultural area to be directly affected starts at the station **36+050.00** and finishes at the station **37+050.00**.

In this part there are colluvial soils with fluvisol elements on Quaternary gravels. These are shallow soils of distinct skeleton character. There are smaller surfaces that are no much skeleton, and therefore used for agricultural purposes.

The previous two photographs present the zone of planned Jablanica interchange. This is agricultural area directly endangered by the negativeeimpacts due to agricultural land destruction.

Direct negative impacts on the agricultural land in this zone will take place by construction of the "Jablanica" interchange.

Smaller agricultural surfaces, already partially destroyed by torrent flows of the Suhava river but of a great importance for the inhabitants of Glogošnica are the parts subject to direct negative impacts of the Project. These negative impacts encompass parts of agricultural land with small agricultural parcels.

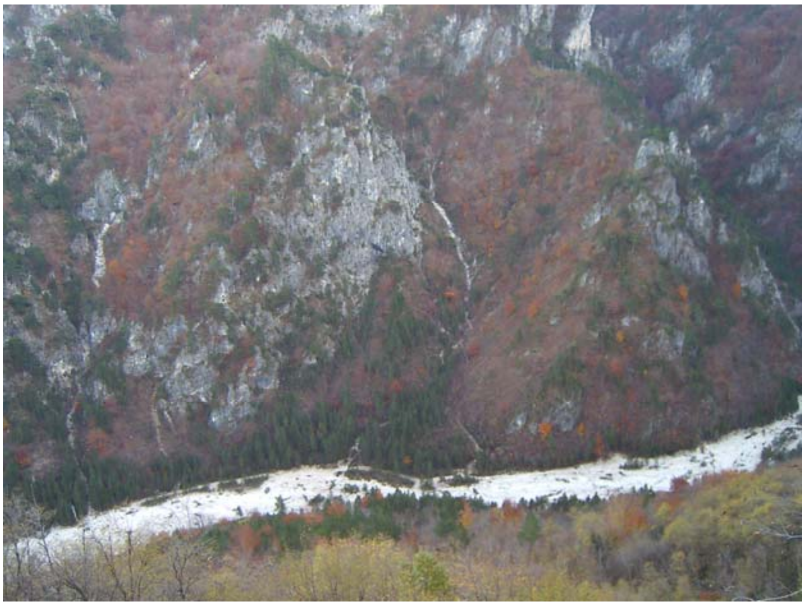
Permanent damage will occur by construction of notches that will have negative impact not just on agricultural land pieces but also on the overall landscape that is impressive in this area. In this area there are cuts on two locations. The first one is placed from the station **37+800.00** to **37+920.00**, and than the next cut is coming in continuity from the station **38+640.00** to **40+030.00**.

The previos photograph shows the tunnel at the station from 37+650.00 to 37+800.00, construction of which will have direct negative cncequences to the surrounding agricultural land

The previous four photographs present the agricultural land damaged by torrent watercourses of the Suhava river

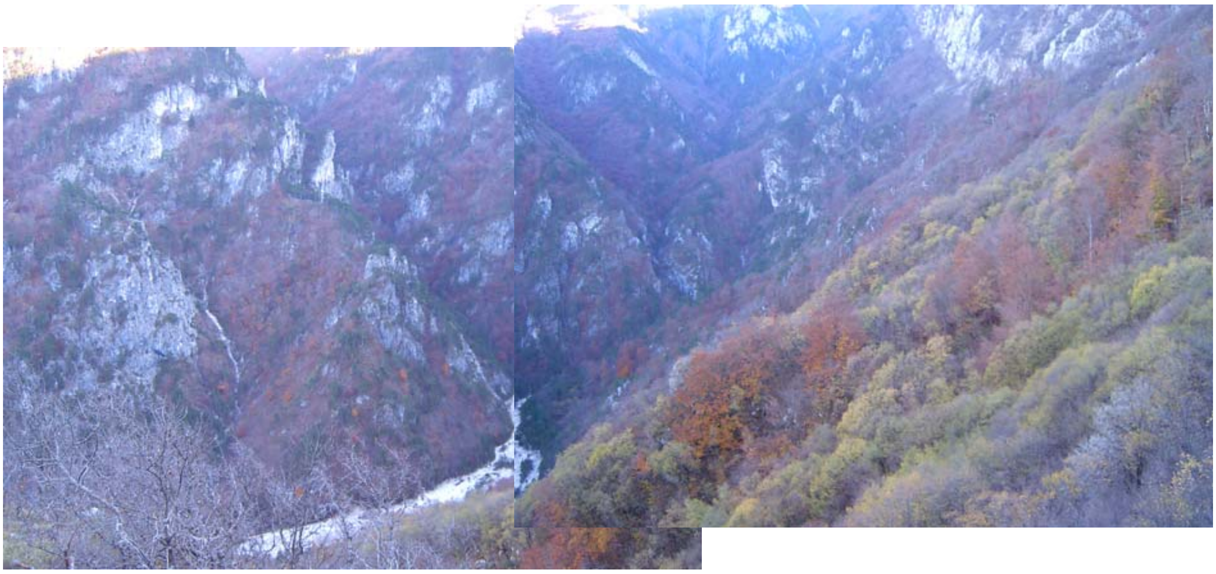
The above two photograph show the agricultural land which will be directly endangered by construction of cut at the section from 38+650.00 to 40+030.00

The station **40+030.00** is corresponding with the end of "Prenj" tunnel. From the said station to the station **57+100.00** the Project is being developed through the series of tunnels, notches and viaducts.



The above photograph shows an entrance/exit of the tunnel Prenj at the station 40+030.00

The previous four photographs represent the element in the surrounding of entrance/exit of the tunnel "Prenj". These elements are expected to be subject of minor indirect negative impacts of the Project



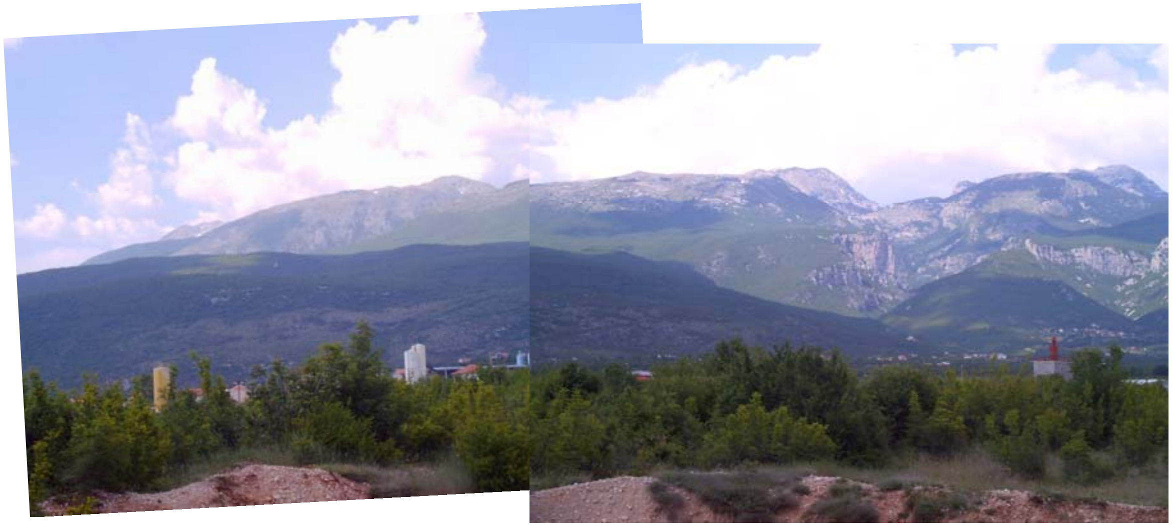
Panorama view on the above photograph represents wider surrounding of the tunnel Prenj entrance/exit

There is not an agricultural land in this area of long tunnels. Consequently, even indirect impacts on the ground surface are minor. At the entire section including the mentioned stations dominant are lithosols, very shallow calc-melanosols and in places colluvial soils of funnel-shaped depression in karst.

From the station **57+100.00** to the station **58+950.00**, present is a conditionaly agricultural area that can be slightly indirectly affected by the Project.

From the station **58+950.00** to the station **59+750.00**, in the zone of Podgorani that corresponds to the end of the Project the alignment is passing through agricultural land in agricultural zone III that is alternating with weaker forest habitats of hop hornbeam and thorn-bush. In the zone of Podgorani represented are colluvial soils and colluvial Terra Rosa on gravels. Direct negative impacts on the agricultural land are expected in this area by forming cuts and embankments. We want to stress that the buffer zone at the finishing alignment sections include high quality agricultural land. South-west exposition and Mediterranean climate influence increase importance of this agricultural land area.

The station **59+750.00**, in the zone of Podgorani that corresponds to the end of the Project the alignment is passing through agricultural land of the agricultural zone III.



Panorama view on the above photographs presents the agricultural zone III, in which there will be some smaller negative impacts due to construction of cuts and embankments. Indirect negative impacts on agricultural land in the area of Dubrave are expected following stronger wind strikes from direction of Porimska draga.

4.7 Flora

Area of interest

The Project alignment is passing through the areas of municipalities of Tarčin, Konjic, Jablanica and Mostar.

The researched area of the future motorway, section from Tarčin to the connection point in the north part of Mostar is passing through more or less populated areas, encompassing different habitats (forest, hilly with pastures) bridging over water reservoirs and pools, following some small rivers and streams and with some alignment parts fragmenting farming land. On few places it is, by system of tunnels. In several places it is entering tunnels, the longest of which is the one in the boundary area of future National park Prenj-Čvrsnica-Čabulja.

This Lot is characteristic by the fact that beginning of the alignment in hydrological sense belongs to Black Sea catchments, while remaining belongs to Adriatic Sea.

Central part is occupied by the river Neretva with its tributaries touching hillsides of massifs of Vranica, Bjelašnica, Prenj, Čvrsnica and Čabulja. Apart the richness in floristic and fauna elements, the river Neretva is offering important potentials in respect of different aspect of ecological tourism (sport fishing, rafting, kayak riding etc.).

Sensitive points in the future motorway alignment in Lot 3:

- The small river Kalašnica with natural breeding area of brown trout which is extremely important for this area of Bosnia and Black Sea catchment, to which this river belongs (together with the rivers Korča, Bijela and Crna rijeka) through the rivers of Fojnica and Bosna;
- Natural passage for game at the section Bjelašnica-Lisin-Vranica;
- Forest complexes on dolomites around Konjic;
- Konjic interchange;
- Artificial water reservoir Jablanica (impact on mixed fish population);
- The small river Baščica (impact on natural breeding areas of endemic and other salmonidae fish);
- The river Baščica canyon (sensitive places in respect of a large game);
- Jablanica interchange –(ichthyologic impact on natural and artificial habitats of a brown trout);
- Grabovica water reservoir (impact on the mixed fish population and cage fish-farms);
- Canyon of the rivers Draganjka, Bijela and Suhava are the places of important impact on a large game (mostly chamois, bear, wolf and roe-deer);
- The system of tunnels and viaducts (entrances and exits), with narrow and wider zones of impact on flora and fauna in the sector of Prenj, e.g. in the area of the future National Park;
- Impact on fish population and widely spread cage fish farming on Salakovac water reservoir;
- Impact on the underground resources of drinking water of Prenj massif.

Future motorway construction in this are must respect all mentioned values, in a way that, in all planned activities, there are planned appropriate and effective protection measures, complementary for all aspects of living and development of this area.

In fact, it is necessary to prepare protection measures for period of project preparation, protection measures during construction period with Program of environment status monitoring.

Flora and vegetation

The alignment itself is passing through continental part of the country, following the vegetation: autochthonous and introduced Black Pine (Pinus nigra), Common Beech (Fagus sylvatica L.) and Hornbeam (Carpinus betulus), dappled with Silver Birch (Betula pendula Roth), Wich Elm (Ulmus glabra huds.), False Aacia (Robinia pseudoacacia-acacia introduced in 19^{th} century), - stations 00 + 000- 1+ 750, 1 + 750 – 3 + 500, 3 + 500 – 6 + 950, 6 + 950 – 10 + 450 and Bitter Oak (Qercus cerris) at the higher elevations. At the lower thermophile deciduous forests, there is Hungarian Oak (Quercus frainetto) and Downy Oak (Quercus pubescens), Horse Chestnut (Aesculus hippocastanum), stands of Hazel Trees (Corylus avelliana.), Walnut Tree (Junglans regia), Lime-tree stands (Tilia cordata), Crab Apple (Malus sylvestris), Mahaleb Cherry (Prunus mahaleb), Sycamore stands (Acer pseudoplatanus), Cornelian Cherry (Corinus mas), Alder stands (Alnus glutinosa Gaertn.)-along the rivers and brooks, together with Poplar (Populus tremula), Black Poplar (Populus nigra), and Willow (Salix alba) having its optimum in thermophyle deciduous and mesophile oak-hornbeam forests near streams and brooks. Stands of juniper tree (Juniperus communis) are characteristic for hilly and mountainous belt.

As a vegetation decoration we can frequently find Mistletoe (Viscum album), in lower strata we can find Raspberry (Rubus ideus), while on the meadows, pastures, along a forest margins and near streams we find various endangered, sensitive and attractive plants as well as the species that did not inhabit these areas before (neophyte), at the stations 10 + 450–12 + 600; 12 + 600 – 17 + 300; 17 + 300 – 20 +150.

At the station 20 + 150 – 23 + 550, near Konjic, e.g. in the parts close to the tunnel through dolomites, characteristic is drastic degradation of thermophile deciduous forests of Bitter Oak with dappled stands of Black Pine.

Going towards Jablanica water reservoir, there are Herzegovina forests of Hungarian Oak and Bitter Oak (*Quercetum confertae-cerris hercegovinicum*), at the stations 23 + 550 – 26 + 650; 26 + 650 – 31 + 000; 31 + 000 – 34 + 500; 34 + 500 – 37 + 950; 37 + 950 – 41 + 400.

In immediate surrounding of future Jablanica interchange, we find the following species:

- Along the river there is a Willow (Salix alba), Purple Willow (Salix purpurea), Marsh Willow (Salix cinerea), Trembling Poplar (Populus tremula),
- Along the riversides and higher, there are the following species: Hazel tree (Corylus avellana), Oriental Hornbeam (Carpinus orientalis), Hornbeam (Caroinus betulus), White Alder (Alnus incana), Hop Hornbeam (Ostrya carpinifolia), individual stands of Bitter Oak (Quercus cerris), Hungarian oak (Quercus frainetto), Common Maple (Acer campestre), Montpelier Maple (Acer monospessulanum), Sycamore (Acer pseudoplatanus), Flowering Ash (Fraxinus exelsior), Common Ash (Fraxinus ornus), Wild Chery (Cerasus avium), Mahaleb Cherry (Cerasus mahaleb), common Pear tree (Pirus burgsd.), stands of introduced Black Pine (Pinus nigra) and some of Aleppo Pine (Pinus halepensis) which was inexpertly afforested on these localities and

vary hardly stands temperature conditions of this area. Also, on this locality, in the lower strata there are an individual stands of Christ's Torn (Palurus Spina Christi Mill.) and samples of Fig-tree (Ficus Carica L.), while Welden's Laburnum (Petteria Ramentacea Presel) can't be found in this area but more south-among the canyon flora of the middle Neretva. Rose (Rosa Spinossima L.), Common spindle (Evonymus Verrucosa Scop.), and on a meadows and sunny places Wild Strawberry, Raspberry bush (Rubus Ideus L.), Daphne Blagyana Freyer.etc**.**

- Further from the future interchange, towards the mountainous area and the Bijela river spring, there is Mugo Pine (Pinus Mugo Turra), more further some of yew (Taxus Bacata), Whitebark Pine stands (Pinus Heldeichii) and Sycomore (1000m a.s.l.).

Wider impact zone (at the sections 37 +950 – 41 + 400; 41 + 400 – 53 + 200 and 53 + 200 – 57 + 600) is closed by mountains of Herzegovina: Prenj, Čvrsnica and Čabulja that belong to the sector of High Prenj. Characteristic vegetation units of this area are:

- Oxytro-pidion prenje
- Carici-Dianthetum freynii
- Gentianetum dinaricae hercegovinicum
- Seslerietum juncifoliae hercegovinicum
- Amphoricarpi-Campanuletum hercegovinae
- Elyno-Edraianthetum serpyllifolii-hercegovinicum
- Festucetum pungentis hercegovinicum
- Saxifragetum prenjae hercegovinicum and others

Endemic vegetation species characteristic for this sector are:

- Dianthus prenjus
- Euphorbia hercegovina
- Dianthus freynii
- Saxifraga prenja
- Amphoricarpus autariatus
- Campanula hercegovina
- Edraianthus hercegovinus
- Gentiana dinarica
- Oxytropis prenja
- Leontodium nivale-hercegovinus and others

These endemics are on the List (Šilić 1996).

Certainly, it is necessary to mention endemic stands of sub-mountainous Whitebark Pine tree occurring on the mountains close to the Neretva river (*Pinus heldreichii Christ*.). It also appears in different ecosystems of distinguished phytocenosis of white-bark pine (Pinetum heldreichii hercegovinicum) on the mountains of Prenj area, forming separate ecotype P. heldreichii var. Leucodermis (Ant.) Markg.

In a wider area around the ending stations of Lot 3 there is also a group of Herzegovina phytocenosis (Pinetum heldrechii hercegovinicum Horv. 1963) present on Prenj, Čvrsnica and Čabulja, where White-bark Pine is present individually or in groups, within several phytocenosis of high-mountain meadows or in associations with sub-alpine Beech and Mugo Pine forests.

In this range, according to Fukarek (1966), White-bark Pine forms the following phytocenosis:

- Amphoricarpo-Pinetum leucodermis Fuk. 1966 inhabits exposed and very narrow dolomite crests of steep slopes, on the elevation of 1300 to 1800m a. s. l. They are characterised by numerous endemic species, among which there are characteristic Amphoricarpus neumaeurei, Dianthus prenjus, Thesium auricilatum, Hieracium villosum.
- Apart the xerophytes of rocky area's phytocenosis, greater part are formed also by kinds from Orno-Ericion Horv connection. In some stands, there is also black pine (Prenj-Ruište).
- Associations Senetio-Pinetum leucodermis Fuk. 1966. occupies relatively more favourable habitats on Prenj and is characterised by number of endemic species of Senetio vissianianus i Sesleria coerulans associations. Out of black pine forests from the connection Orno-Ericion, frequent are: Calamagrotis varia, Scabiosa leucophylla, Erica carnea, Brachypodium pinnatum etc.

Somewhat lower, up to 700m a.s.l., on the slopes of these mountains, there can be found Carpinetum Orientalis petterietosum Bleč. association, on southern and warmer expositions. At the very end of the Lot one can find association Carpinetum Orijentalis paliuretosum Fuk. In the literature, association Paliuretum adriaticum H-ić, 1963 is mentioned as a separate association, always present at the lower area, frequently close to human settlements, on strongly eroded ground with limestone blocks on the surface. In our case, at the end of the section, it occupies area of Terra Rosa and brownish Terra Rosa, around Bijelo Polje, where there are xerophyte's species such as Feather-grass (Stipa bromoides) and Sage (Salvia officinalis), forming famous and widely spread association Stipo-Salvietum Horvatić, continuing to the Lot 4 section with other characteristic associations along future motorway.

With its ending part (connection point to Lot 4) it is entering to sub-Mediterranean part, leaning on Ostryo-Carpinion connection, characterised by association of Downy Oak and White Hornbeam (*Querco-Carpinetum orientalis*).

Associations of Viper Grass and Gold-beard Grass (order Scorzonero-Chrysopogonetali) connected to the Sub-Mediterranean and Mediterranean strip, e.g. to the range of Downy Oak.

Also, in this area important is Seslerio-Ostryetum Carpinifoliae association; while in the canyon of the Neretva River there is the association of Maple and Lime-tree (Aceri-Tilietum mixtum).

In the wider surrounding of middle and upper Neretva canyon, according to recent authors (Lovric et al., 2002) mentioned are more important thermophile plant species (Anthericum liliago subsp.balcanicum) – a on rocky and talus ground of the middle Neretva canyon, as well as Aristolochia lutea and Asplenium csikii in the Drežnica river canyon. There are following species on the respective habitats: Ceterach javorkeanum on the sunny canyon parts of north Herzegovina, Cymbalaria pallida on the canyon rocks of Middle Neretva, Sedum orientale- Balkan sub-endemic species on sub-Mediterranean rocks and flutings for drift material, characteristic for Middle Neretva and Drežnica.

On the karst limestone rocky areas in sub-Mediterranean zone there are stands of Welden's Laburnum (Petteria ramentacea), forming the association Petterietum ramentaceae, protected by the Law on forests F B&H 02.

In the Querco-Carpinetom association there is Jjuniper (Juniperus oxycedrus), while in northern parts there are different Juniperus communis-juniper with Hazel tree and some other associations, on some higher a.s.l. elevation.

Available bibliography related to the Neretva river canyon dates from Beck et al. 1903-1983 and Lakušić et al. 1987, Stefanović 1987, Redžić et al. 1992.

More important indicators of the ground strata forest phytocenosis with breakdown of more important associations in a wider impact zone at the Lot 3 section:

Black pine forests, Ericio-pinetalia order

- Erica carnea
- Sedum album
- Melitis melissophylum
- Campanula rotundifolia
- Carex digtata etc.

Forest of Hornbeam, Beech and M;aple (Fagetalia order)

- Geum urbanum
- Anemone nemorosa
- Veronica chamaedrys
- Lllium ursinum
- Euphorbia amygdaloides
- Carex silvatica
- Anemona hepatica
- Asarum europaeum
- Polypodium vulgare
- Poa bulbosa
- Valeriana montana
- Saxifraga rotundifolia
- Rosa pendulina
- Valeriana officinalis etc.

Thermophile deciduous forests of sub-Mediteranian and continental area- order Quercetalia pubescentis

- Teucrium chamaedrys.
- Geranium sanguluneum
- Pallurus spina christi
- Viola canina
- Thymus serpyllum
- Colutea arborescens
- Gallium purpureum
- Clinopodium vulgare
- Petetia ramentacea
- Juniperus oxycedrus

Bosnia and Herzegovina has not yet prepared a Red Book of Flora, but only the List of rear, endangered and endemic vegetation species (Šilić1996), according to / IUCN 1983,1994 /.

Table 33 Some meadow species which are on the list for the Red Book of Bosnia and Herzegovina in the wider impact zone at the upper stations

Domestic Name	Latin Name	English Name	Status
Ljupka Ljubica	Viola elegantula Schott	Elegant Violet	Endangered species on the list for the Red Book
Bosanski ljiljan	Lilium bosniacum G.Beck	Bosnian Lily	Endemic species of Dinerides on the list for the Red Book
Brđanka,Moravka	Arnica montana L.	Montain Tabaco	Endangered species on the list for the Red Book
Zlatan	Lilium martagon L.	Purple Martagon Lily	Endangered species on the list for the Red Book
Udovčica	Scabiosa leucophylla Borb.	Mourning-bride	Endemic species of Dinerides on the list for the Red Book
Visibaba	Galanthus nivalis L.	Snowdrop	Endangered species on the list for the Red Book

Table 34 Some meadow species, characterising their habitats with is colour, shape and other specificities, exclusively connected to the starting stations

Domestic Name	Latin Name	English name
Šafran,Kaćun	Crocus vernus (L.) Hill.)	Spring Crocus
Kohov Encijan	Gentiana acaulis L.	Koch's Gentain
Proljetni Encijan	Gentiana verna L.	Spring Gentian
Livadni Zvončić	Campanula glomerata L.	Clustered Bellflower
Ptičija Grahovica	Vicia cracca L.	Tufted Vetch
Šumska Svjećica	Gentiana asclepiadea L.	Willow Gentian
Proljetna Jagorčevina	Primula veris L.subsp. columnae(Ten) Luudi)	Cowslip, Paigle
Obična Borovica, Kleka	Juniperus communis L.)	Common Juniper
Kaljužnica, Žutenica	Caltha palustris	Marsh Marigold
Žuti Zvjezdan,Svinjđuša	Lotus corniculatus L.	Common Bird's Foot
Ivanjsko,Cvijeće	Galium verum L.	Yellow Galium
Kaćunak Medeni	Orchis ustulata L.	Dark-Winged Orchis
Mošusni Sljez	Malva moschata L.	Musk Mallow
Dubačac	Teucrium chamaedrys	Common Germander
Divlja Grašica	Coronilla varia L.	Crown Vetch

LJepica	Lychnis viscaria L.	Clammy lychinis
Livadska Udovica	Knautia arvensis (L.) Coult.)	Field-Scabies
Ranilist,Ranjenik	Stachys officinalis (L.) Trev.)	Betony
Crvena Lazarkinja	Asperula cynanchica L.	Squinancy-wort
Šareni Karanfil	Dianthus deltoides L.	Maiden Pink
Kiprovina, Vrbica	Epilobium angustifolium L.	Willow-Herb
Zečiji Trn	Ononis spinosa L.	Bocks-hauhechel
Konjski Trn	Cirsium eriophorum L. Scop.	Spear-thistle
Bodilica	Cirsium acaule L.	Dwarf –Charlene -thistle
Vrijesak	Calluna vulgaris(L.) Hull)	Common heather
Mrazovac	Colchicum autumnale L.	Meadow Saffron
Šumarica,Obična Berberina	Anemone nemero**sa** L.	Wood Anemone
Šumska Jagoda	Fragaria vesca L.	Wild Strawberry
Zečije Šapice	Antennaria dioica L.(Gearten	Cat's-foot
Panonska Djetelina	Trifolium pannonicum Jacq.)	Hungarian Clover
Sunčica	Filipendula vulgaris Moench)	Dropwort
Ivančica	Leucanthemum vulgare Lam.	Oxeye daisy
Kunica	Achillea millefolium L.	Common Yarrow
Kravljak	Carlina acanthifolia All	-
Kopitnjak	Asarum europaeum L.	Asarabacca
Obična Borovnica	Vaccinium myrtillus L.	Blue-berry
Vranilova Trava	Origanum vulgare L.	Wild-marjoram
Širokolisni Grahor	Lathyrus latifolius L.	Everlasting Pea
Repuh	Patasites hybridus L.	Umbrella Leaves
Žućkasta Celinščica	Prunella laciniata L.	Cut-leaved self-heal
Obična Runjika	Hieracium pilosella L.	Mouse-ear
Ranjenica	Anthyllis vulneraria L.	Lady̓s Fingers
Uskolisna Mlječika	Euphorbia cyparissias L.	Cyprus Spurge
Modri Kotrljan	Eryngium amethystinum L.	-
Piskavac	Succisa pratensis Moench	Devil̓s Clover
Veliki Zvončić	Campanula rapunculoides L.	Creeping Bellflower

Major part of the section is passing through the strip of climatogenous forests /Querco-Carpinetum/ with edificatory species:

1. Quercus cerris / Bitter Oak
2. Quercus frainetto/ Hungarian Oak

3. Quercus pupescens/ Downy oak
4. Acer obtusatum/ Maple
5. Ostria carpinifolia/ Hop Hornbeam
6. Fraxinus ornus/ Flowering Ash
7. Pinus nigra/ Black Pine
8. Evonymus/ Common Spindle

Since the future motorway is partly encompassing the river canyons of Herzegovina. It is important to mention typical associations in different ocosystems and on different elevations.

At the elevations up to 800m, there are:

- Ostryo-Quercetum cerris
- Castaneo-Quercetum confer.
- Seslerio-Ostryetum/ steep slopes
- Saturejo-Andropogonetum / meadows
- Drypterido-Seselietum/gully
- Teucrio-Campanuletum/ clifs

Bottom of the canyon, up to 500 m:

- Querco-Carpinetum orientalis
- Orno-Quercetum cerris
- Phyllyreo-Carpinetum orien./ steep slopes
- Festuco-Poetum bulbose/ meadows
- Moltkio-Inuletum candidae/clifs

Endems of the Herzegovina endemic centre on the mountain Prenj can be found in the narrow strip around the future motorway:

- Euphorbiaceae / Euphorbia hercegovina (300- 740m a.s.l., dolomites on Prenj and arround Konjic)
- Caryophyllaceae/ Silene rezdorffiana (200-900m a.s.l., canyons of the Neretva river)
- Brassicaceae/ Alyssum moellendorfianum (270-800m a.s.l., dolomite slopes of Prenj and around Konjic)
- Apiaceae/ Seseli hercegovinum (140-300m a.s.l., distribution is limited to a part of the Neretva river course, from Prislap in the valley of Neretvica river in the north, to the Drežnica river mouth in the south. It is a distinguiished endem of Prenj and Čvrsnica, inhabiting rock fissures and rocky ground.
- Lamiaceae / Thymus richardii subsp. Richardi (=T. Aeropuntactus) (280-1,200m a.s.l., dolomites of close and far surrounding of Konjic and Acionis orontia (dolomites around Konjic).

4.8 Fauna

Different habitat types are present in the area of future motorway section: groves, meadows, rocky grounds as well as several types of aquatic habitats

In respect of habitat variety, there is a large number of different animal species what makes the area extremely rich in sense of biological variety and very vulnerable and sensitive to any future fragmentation of the area.

Table 35

Family	***Species***	***Strictly protected/Bern Convention***	***Protected/ Bern Convention***
Shrews /Scoricide	Big bark beetle - Rinolopus ferum-equ.	+	
	Small bark beetle Rhinolopus hipposideros	+	
Rodents /Rodentia	Common rabbit Lepus europaeus		
	Squirrel -Sciurus vulgaris L.		+
	Common mouse Apodemus sylvaticum L.		
	Rat -Rattus r. frugivorus L.		
	Dormouse -Glis glis		
Canine /Canidae	Grey wolf -canis lupus L.	+	
	Fox -Vulpes vulpes L.		
Martens Mustelidae	Badger -Meles meles L.		+
	Weasel -Mustela nivalis L.		+
	Pine marten -Martes martes L.		+
Bears Ursidae	Brown bear.-Ursus arctos L.	+	
Cats /Felidae	Wild cat -Felis silvestris Schreber	+	
	Lynx -Lynx linx L.		+
Boars /Suidae	Wild boar -Sus scrofa L.		
Empty-horned Bovidae	Chamois –Rupicarpa rupicarpa balcanica		+
Deers/Cervidae	Roe deer -Capreolus		+

	capreolus L.		
Avian fauna /Aves/			
Hawks /Accipitridae	Montagu's Harrier - Circus pygargus L.	+	
	Sparrow-hawk - Accipiter nisus L.	+	
	Goshawk -Accipiter gentils L.	+	
	Buzzard -Buteo buteo L.	+	
	Golden eagle -Aquila chrysaetos L.	+	
Falcons /Falconidae	Kestrel -Falco tinnunculus L.	+	
Pheasants /Phasianidae	Quail -Coturnix coturnix L.		+
Fowls /Rallidae	Rock Partridge - Alectoris graeca Meisner		+
Snipes Scolopacidae	Woodcock -Scolopax rusticola L.		+
Pigeons /Columbidae	Rock dove -Columba livia Gmelin		+
	Woodpigeon - Columba palumbus L.		
Cuckoos /Cuculidae	Cuckoo -Cuculus canorus L.		+
Owls /Strigidae	Scops owl -Otus scops L.	+	
	Eagle owl -Bubo bubo L.	+	
	Tawny owl -Strix aluco L.	+	
Kingfishers /Alcedinidae	Kingfisher -Alcedo althis L.	+	
/Picidae	Green woodpecker - Picus viridis L.	+	
/Alaudidae	Skylark -Alauda arvensis L.		+
Swallows /Hirundinidae	Swallow -Hirundo rustica L.	+	
	Sand-martin -Riparia riparia L.	+	

/Motacillidae	Water Pipit -Anthus spinololetta L.		
	Grey Wagtail - Matacilla cinerea Tunstall.		
Wrens/Troglodytidae	Wren -Troglodytes troglodytes L.	+	
/Prunellidae	Alpine Accentor - Prunella collaris Scopoli.	+	
Thrust /Turididae	Robin -Erithacus rubecula L.	+	
	Nightingale -Luscinia megarhynchos Brehem.	+	
	Blackbird -Turdus merula L.		+
	Mistle Trush -Turdus viscivorus L.		+
	Fieldfare -Turdus pilaris L.		+
Titmouse/Paridae	Great tit -Parus major L.	+	
	Sombre tit -Parus lugubris Temminock	+	
Golden oriole /Oriolidae	Golden oriole Oriolus oriolus L.	+	
Shrikes /Laniidae	Lesser Grey shrike - Lanius minor Gmelin	+	
	Great grey shrike - Lanius exubitor L.	+	
Crow//Corvidae	Jay -Garrulus glandarius L.		+
	Magpie -Pica pica L.		+
	Hooded crow - Corvus corone cornix L.		+
	Raven -Corvus corax L.		+
Starling /Sturnidae	Starling -Sturnus vulgaris L.		+
Sparrows /Passeridae	House Sparrow - Passer domesticus l.		
	Tree sparrow -passer		

	montanus L.		
Finch//Fringillidae	Chaffinch -Fringlla coelebs L.		
	Goldfinch -Carduelis carduelis L.		+
Buntings /Emberizidae	Yellow Hammer- Emberizia citrinella L.		+
	Ortolan bunting - Emberiza hortulana L.		+

Given tables indicate protection level for the species listed, in accordance with the Bern Convention which, along with the other CBD (Conventions on Biological Diversity) that is to be ratified by Bosnia and Herzegovina in the forthcoming period.

Fauna of Reptiles /Reptilia/

In a wider area of the future motorway fauna of reptiles is relatively abundantly represented. Thus, in this document only the most typical representatives are presented.

At the beginning of starting stations, characteristic is common European adder, while in middle and ending part there is Horned viper (*Vipera ammodytes ammodytes* L.). In the underbrush we frequently find European legless lizard (Ophisaurus apodus). The following reptile species we usually find near the river ecosystems: King fisher (*Natrix tessellata* Laurenti), Grass snake (*Natrix natrix* Pallas), Aesculapian snake (*Elaphe longissima* Laurenti), and Smooth snake (*Coluber austriaca* Laurenti). Horned viper and Common adder are among the most dangerous on entire Dinarides while the other snakes are not dangerous for human beings. Along the motorway we find some species of lizard *Algyroides nigropunctatus* Dumeril and Bibron and Green lizard (*Lacerta viridis* Laurenti).

Out of turtles (Testudines) we can find Hermann's tortoise (*Testudo hermanni* Gmelin).
Out of amphibian (Amphibia), there is a Lake frog *Rana ridibunda* Pallas from the family of Ranidae, Green toad (*Bufo viridis*) from the family of Bufonidae, Black salamander (Salamandra atra) from the family of Salamandridae as a remaining of ancient glacial fauna.

Fish fauna /PISCES/

Starting stations are following catchment area of the Korča river which, through the rivers Lepenica and Fojnica, belongs to the river Bosna catchment, e.g. Black Sea basin. Watershed of the two main catchments is at Ivan Mountain. At the southern slopes of Ivan mountain, the alignment is crossing over the river Trešanica, stretching along its right side to Konjic in order to cross over artificial water reservoir of Jablanica. In this part, the future alignment is touching the most upstream parts of bigger left tributaries of the Neretva river (Idbar, Glogošnica and Bijela).

In a wider surrounding of the researched area of the future alignment, especially on the foothill of Prenj massif, the Neretva river, as a main receptor of all surrounding waters and its artificial water reservoirs (Jablaničko lake, Grabovica lake and Salakovac) is characterised by specific piscine fauna with few endemic species characteristic only for Adriatic Sea catchment.

The most important small rivers and streams are:

In a wider surrounding of future motorway there is the river Bukovica, springing under Čičava and Kula. Also, there is the river Bijela, flowing through the valley of the same name, springing in Rakov Laz and the river Doljanka with spring under Risovac.

The river Diva Grabovica has got a spring on the eastern part of Čvrsnica, at the foothill of Vilinac. The river Drežanka is the longest and the biggest watercourse of the river Neretva catchment, accepting waters from Čvrsnica, Vran and Čabulja.

Future motorway is following watercourse of the river Korča with the small river Kalašnica, than the river Idbarčica/Baščica in the Idbar valley, springing under Rakov Laz. After that, it is following the rivers Draganjka and Bijela in the cut of Bijela, on the exit from the Bijela canyon and Glogošnica on the west side of Prenj, having the spring beneath Glogova and the river Bijela in the canyon of the same name in the north part of Mostar.

In wider and narrow reach of the future motorway, from ichtiological point of view, important are the following species:

Family of Salmons /Salmonidae/

Out of Salmonidae, there is *Salmothymus obtusirostris oxyrhynchus*, endemic Marble trout (*Salmo marmoratus*) and Brown trout (*Salmo trutta* m. *fario*), as well as introduced Grayling and Bull-head.

Family /Cyprinidae/

Out of Cyprinidae present are Chub (Leuciscus cephalus albus), Leuciscus svallize, Carp (Cyprinus carpio), and some species inserted during inadequate stocking with fish (Chiton and Pike-perch).

It must be mentioned that some of the Upper Neretva tributaries (Rakitnica, Ljuta, Neretvica, Bijela and Idbar) are distinctly stocked with trout species, many of which are endemic. These are typical hatching localities and localities for recruitment of endemic and other fry for all other waters. Special attention must be paid during earthworks and other works, especially during spawn and fry feeding.

Due to the construction of the dams on the Middle Neretva without fish paths obtained, a natural gene flow was blocked for the mentioned endemic species. Therefore, any new infrastructure intervention without an adequate protection measures can additionally disturb ecological balance of the only remaining natural breed locations for these species, extremely important and unique in Europe and wider.

In this document the fauna of insects' /INSECTA/ is not separately considered. It is only indicated the presence of some families: Dipterous insects' /Diptera/, Mosquitos' /Culicidae/, Horseflies' /Tabanidae/, Butterflies /Lepidoptera/, /Noctuidae/, Coleopters /Coleoptera/, Hymenopterans /Hymenoptera/, Heteropterans /Heteropotera/ etc.

On a base of research undertaken up to date, the following animal communities with typical representatives from the different families inhabit wider area of the future motorway:

Mammals (Mammalia)

Particular importance among the mammals is given to big carnivores, such as Wolf (Canis lupus) and Brown bear (Ursus arctos L.). It is also important to mention Chamois from the family of Bovidae (Rupicarpa rupicarpa X R. R. Balcanica).

4.9 Landscape

Introduction

The main landscape elements of the analyzed area are:

- Natural system (Forest);
- Human-created system (Agriculture land, settlements and infrastructures)

The settlement system is deeply connected to the transportation system and, trough this, to the natural morphology.

In general, the landscape of the interested area looks like being in continuity and unified with the present natural environmental characteristics. Then this landscape is in very a sensitive balance with characteristic values (natural and human-created).

Natural system

In the analysed area, natural conditions represent one of the most important characteristics. The forest environmental systems, analysed in the area of interest, include different types and stages of forest vegetation showing distinctive characteristic. The forest environmental systems contain natural systems that went through significant changes under human influence in form of transformation into systems for food production. On strongly degraded locations important parts of these forest systems adapted for food production have been transferred from plowfield cultivation into perennial meadows or pastures because of the high degradation level achieved even before the war.

The morphology found in the wider area is typical for mountainous areas (river valleys, mountain heights and hills). The top of the mountain chain is a typical example of unpopulated alpine area. Regardless the dominant presence of mountainous geomorphologic formations, the entire space is characterised also by hilly zones, hilly-mountainous zones and narrow zones of river valleys, which have special ecological value.

One important ecological system for the area of interest is the Neretva River river system originating in the Dynaric Alps and belonging to the Adriatic Sea System. The Neretva River Valley, together with oases of the karsts fields, funnel-shaped forms, depressions, hills and hillocks with numerous forms of bleak karsts, is present in the relief of low Herzegovina.

Forest, meadow and pasture systems are the existing vegetation resources. Land adjusted for food production is used in the frame of husbandry production systems, which are of rather uneven character and alternating with natural, meadow and pasture systems. Due to significant geomorphologic, geological, pedological, and hydrological and climate characteristic, forest systems on relatively small areas have wide diversity range: from high deciduous, conifer or mixed forest to extremely degraded forests and underbrush.

The area of Hadžići municipality is formed by great number of ecosystems within the narrow system. Primary ecosystem of this area is forest, which, depending on the conditions and climate or elevation above the sea level, appears on the respective elevation belts / climate-depending belts of the ecosystem. Forest stands with black alder; oak and hornbeam are present in the lowest parts. Above the lowest oak-hornbeam belt there are distinct areas of beech, divided in tree parts on Bjelašnica: belt of hilly beech forest, belt of beech and fir and the belt of sub-mountainous beech forest.

In the section from Tarčin to Bradina there are areas of highly valued land, but with dominating slope areas, which are maintained in good condition by management systems. South from Bradina, there is land of high value representing especially valuable locations near Jablanica accumulation and along the river courses on the parts of alluvial terraces. Very important are also the smaller mountainous plateau areas with land that was not cultivated so far. In the whole area is the non-advanced management system applicable, due to the character of the land, the inconvenient site of properties and due to very small pieces of land spread on different locations.

The area between Konjic and the end of the section, especially in canyons and steep cliffs zones, is characterised by talus. The characteristic forms of forests vegetation are frequently degraded or of protective character. In the after war period until now, biological aspects of these zones are improving. Due to the absence of intensive cattle grazing, these zones are already becoming ecologically important zones. But the land under forests and other natural vegetation (i.e., wild blueberries, wild red berries, wild strawberries, mushrooms, herbs, flowers etc.) are rather insufficiently regulated, under-managed, and definitely under-exploited. The wood products are being destroyed due to non-viable State control and delayed forestation plan undertaken by any of the concessionaires. There are ongoing illegal activities related to timber cutting and taking away, without any legal enforcement in place or any consequences such as remedies. The catchment's area of Neretva River, in the Municipalities of Konjic and Jablanica, can be divided into four main ecosystems: **"**Mugho Pine Tree" (*pinion mughi*) ecosystem; Sub-Alpine Forests; High Mixed Forests, and Hilly zones (between 280 m and 700 m).

In fact, as shown in the previous paragraphs, the natural values of the area are many and should be protected in different ways.

The Spatial plan of the Republic, adopted in 1982, establishes that:

- The regions of Igman and Bjelasnica should be proclaimed as National Parks, as Prenj Mountain, Čvrsrnica and Čabulja and Vran (part of Jablanica, Konjic and Prozor Municipality);
- The area of "Glavatičevo": (Konjic); "Jablaničko lake": (all three municipalities Konjic, Jablanica and Prozor); "Grabovičko lake": (Jablanica part), should be proclaimed as Areas of natural beauties / recreational territories;
- The area of Jablanica (Jablanica municipality) should be proclaimed as Memorial territories (natural historical territories);
- The Prenj sheer rock in the Neretva valley should be protected as Geomorphologic natural reserve;
- The Canyon of Diva Grabovica, known for extraordinary beauty and rare flora and fauna, should be protected as geomorphologic natural reserve;
- The Neretva River stream should be protected as nature reserve of natural areas;

- The Hajdučka door (Passage of Mijat) at the Čvrsnica Mountain should be protected as Monument of nature.

Human-created system (agriculture and settlement system)

The analysed area could be divided in 3 main types of human-created systems:

The first part of the alignment is characterised by Tarčin Valley, which is slowly elevating into hilly forms up to the mountain saddle Ivan Sedlo located in the mountainous zone. Between Tmor and Sevid, the Bijela River has cut a deep canyon named Tuhelj running in northern direction. There, it is joining the Crna River, forming in the following Lepenica River.

Hadžići municipality has a relatively small surface in the area of the alignment, but this area is suitable for the development of agriculture and cattle rising.

Settlements from the prehistory (hill-forts) on the territory of the present Hadžići Municipality area where located at the hillsides of Ormanja, Bjelašnica and Igman and along Zujevina River. Among the archaeological locations are the chronologically not defined in Tinovo brdo, Gradelj and Gradina (Gradac). Archaeological data on the middle Ages are indicating two medieval cities such as: Hadžići and Tuhelj near Tarčin as centres of smaller administrative units.

In correspondence of Konjic municipality the resources are characterised by agriculture land and forestland. Processes of industrialisation, disagregation and urbanisation have deeply influenced significantly the transformation of purpose and use of space in general of Konjic and Jablanica. The most radical spatial repercussions, in sense of transformation of landscape, are consequences of construction of three hydroelectric power plants with their reservoirs. Due to the fact that the municipalities of Konjic, Jablanica and Prozor with their natural-geographic characteristics fall into hilly-mountainous area in which good quality land makes only one third of total area, the impact of HEPP water basins on the natural relations after the over flood is even more complex, influencing formation and settlement system development.

The agriculture land encompasses smaller part of the Konjic and Jablanica municipality areas. According to the classification established, Jablanica municipality has insignificant area belonging to agriculture land of category I and II (the soil suitable for cultivation of all kinds of crops; very low erosion or no erosion at all, favourable for intensive husbandry, fruit growing, gardening etc.). The remaining area belongs to categories III and IV (soils with significant defects).

Due to its natural location, Jablanica was, even from the ancient time, interesting for housing and population settlement. The oldest archaeological sites show that this area had been populated even in the Iron Age, although the real boom happened during Romanian period and Middle Ages, evidenced by locations with necropolis with bogomil thumb stones and rock piles. The only caravans had been travelling through this area from Dubrovnik to central Bosnia, and on the roads leading towards Vrbas valley. Also in Konjic Municipality, many locations from the prehistory period, from the antique, late antique period and from Middle Ages were discovered. In this area medieval tombstones and standing tombstones at 149 necropolises were found.

Existing settlement system of Jablanica municipality is developing in conditions of relatively small number of total population and rather significant concentration in the municipality centre. In that respect, functional development of the other settlements within the municipality is more conditioned by their urban equipment than by number of inhabitants. Five local communities in Jablanica Municipality can be considered as part of municipality centre or linear agglomeration formed around it. These are: Donja Jablanica, Gornja kolonija, Jablanica, Lug and Mirci. Among the existing settlements-local community centres, Ostrozac already has the role of secondary municipal centre. Although not distinguished by high population, Ostrozac has relatively good urban equipment. It is favourably located on the main road Sarajevo-Mostar. Some more important settlements have function of village community centre, such as: Doljani, Glogošnoca and Slatina, and should be treated as such.

With total number of 149 settlements, Konjic is characterised by an extremely disseminated settlement network. Beside five city local communities, there are 23 more village local communities. Even 20 of them have less than 2,000 inhabitants. It is very difficult to provide social infrastructure for satisfactory life for such small number of inhabitants in that big number of local communities.

In the last part of the alignment, economy forest has been dropped from the protection regime category II and I, but has been accepted into category of production-protective forests. The other valuable forest areas are set under the third protection regime that allows organised planned activities. The listed forest areas include the northwest massif (the massif of Čvrsnica and Cabulja) and the northeastern part (Prenj-Velež massif) of Mostar municipality.

In this part Turheljkina rock in Drežnice (Middle Age inscription) Mastana Bubanjića protected areas, the settlement of Diva Grabovica (which has not been more completely examined), the rural-village entity with important ethnic contents have been identified.

In the Northern part of the Mostar- Bjelopoljska valley, the population is mostly living in individual housing objects and settlements, located in the valley and in suburbs of Vrapčići, Potoci, Vojno, Željuša, Prigrađani, Podgorani, Kuti-Livač and Humi-Lišani. The existing construction characteristics are small densities of settlements, insufficient equipment in traffic, cultural and social infrastructure and illegal construction. The prior mode of the spontaneous construction caused and imposed the necessity for the majority of settlements to be rehabilitated through the further reconstruction, additional construction, interpolation of objects, as well as construction of the traffic, communal and social infrastructure. The most extensive construction is ongoing at the location of Potoci and part of Vrapčići. At these territories all types of constructions are planned, from the collective construction, through double or houses in lines, up to the individual objects or weekend cottages or houses for temporary usage. The presumed type of the construction is the agricultural inhabitation for which partial communal network is planned.

The analyzed landscape shows two different situation of sensitive value.

The first one is linked to the present agriculture system and to the connected facilities. This landscape is result of rapidly increased industrialisation process that has caused an intensive disagregation of the original agriculture system. This disagrarisation was not followed by appropriate urbanisation; in fact migration of disagrarised population happens also towards suburbs of the existing settlements, especially along the new-built or modernised roads. This phenomenon causes huge problems in rational organisation of settlement system, and also in overall landscape arrangement.

In the majority of the studied area, use of agriculture land in sense of cultivation, is localised in the flat area of the main and secondary valleys. Privately owned land, along the motorway alignment is of small surface what disables economically sustainable agriculture production. Uncultivated land is enlarging, being overgrown by grass or transferred in permanent culture of natural meadows At the same time, permanently lost agricultural land is, also, that one renounced to the other users, for building of settlements, roads, factories ect.

The main agriculture sensitive areas are the valley on the south part of Tarčin (km 0+000 - km 3+250), around the Rosulje settlement (km 7+700 – km 8+350), the north bank of Jablanica Lake (km 20+150 – km 22+300), in the Draganka valley (km 36+050 - km 37+650) and in Potok valley (km 38+650 – km 40+000).

The other landscape system is the one linked to a natural forest system that covers the main part of the interested area. Those areas represent an important natural and ecological resource that has to be protected and preserved. Along the proposed alignment the sections that show this kind of sensitivity are near the Čelebići settlement (km 24+600 – km 25+450), above Ćosići settlement (km 27+550 – km 29+350), near Dragan Selo settlement (km 33+500 – 34+550) and in correspondence of Bijela valley (km 46+600 – km 48+700).

4.10 Protected parts of nature

According to the Law on nature protection (Official Journal FB&H, 33/03, Article 27 and Article 30) the motorway's 2km-wide corridor (analysed corridor) encompasses the area protected by the mentioned law.

Mountainous area of Prenj, Čvrsnica and Čabulja, with the river Neretva, by the strictest scientific criteria, represents an extraordinary natural value. Geomorphologic characteristics, hydrological specificity, glacial phenomenon, flora and fauna with great number of endemic species are just a part of values, ranking this area high at the scale of strict criteria for proclamation of this area to be the National Park.

Presently, this area has a status of important space of natural heritage (parks of nature Prenj, Čvrsnica, Čabulja). According to the Article 30 of the Law on protection and use of cultural-historical and natural heritage (Official Gazette SR B&H, 20/85) each asset recorded as a natural heritage has got a treatment of protected asset.

By the Law on physical arrangement (Official Journal FB&H, 52/02, Article 16 and Article 80) and the Law on nature protection (Official Journal FB&H, 33/03, Article 27 and Article 30) the proposal was given for establishment of the area ″Prenj-Čvrsnica-Čabulja″ as an Area of importance for Federation of Bosnia and Herzegovina, as well as declaration of the area to be protected area, e.g. National Park.

By the Draft of the Spatial plan of Bosnia and Herzegovina for the period 1981-2000, cave Kuhija received the status of natural heritage.

4.11 *Cultural-historical heritage*

4.11.1 Introduction

Each structure built either as a building or as a structure, always impacts surrounding area in a certain way. Mechanisms, manifestations and effects of that impact can be different and are registered in the process of structure construction and (or) during the period of its operation.

If we observe an impact in the opposite direction, we can figure out that exactly a location features condition a great number of technical system characteristics in the field of construction. Thus, the relationship **a built structure – an environment** has an interactive character. Positive feed-backs, e.g. positive effects of this interaction mean: constructed object becomes an "organic" part of the environment and lives its life in harmony with the environment. If it's not a case and if interaction causes object or environment devastation, than the project doesn't meet one of the elementary imperatives and goals.

In the case of motorway construction-a new element in the existing natural and architectural context, cultural-historical heritage was treated as one of a "risky groups"- a group exposed to **potentially negative impacts**. In the process of evaluation of different alignment variants, and finally during designing itself, the cultural-historical heritage was considered as one of **limitation factors**.

Starting from such problem statement, the following basic **research goals** are defined:

- **Conflict points identification** in the relations: motorway alignment → specific heritage object; natural-architectural, urban, rural, cemetery entireties, sepulchral entity; archaeological locality; memorial or memorial designation. Conflict points were considered to be a locations where environmental impacts by the motorway construction and operation can be negative, e.g. potentially damaging for any aspect of determined cultural property (physical or non-material)

  Impacts which, by their character, are not negative, what means positive impacts were elaborated separately since they don't require implementation of particular protection measures and represent specific base for presentation and popularization of heritage, as well as integrated protection and tourism development.

- **Finding technical solutions and offering recommendations aiming at neutralisation (elimination) of adverse impacts**, e.g. their potentially negative consequences (technical solutions and recommendations can vary from recommendation for the alignment dislocation at the certain sections to the most different mitigation measures).

From the goals established, resultant are the **research tasks**, formulated as follows:

1. *Determination of existence – identification of recorded cultural properties in the contact zone*[1], that can be endangered by the motorway construction,
2. *Determination of existence – identification of cultural properties in the contact zone* that can be endangered by the motorway construction but were *not recorded* – processed in literature,
3. *Identification* and classification of possible *impact mechanisms* and *determination of possible negative impacts* (potential causes of cultural heritage devastation),

[1] Contact zone – strip of 1 km on both sides of the alignment that was the area of consideration

4. *Zoning*-determination of *spatial range for different negative impacts* during the motorway operation and construction period,
5. *Determination of specific conflict points* and analysis of each specific case,
6. *Definition of protection measures* and recommendations for each specific case.

In this chapter, processed are the tasks described under the items 1 and 2; in the Chapter 5.12-"Description of potential impacts...», the tasks described in the items 3 and 4, and in the Chapter »6.2.10. Mitigation measures...», the tasks described under the items 5 and 6.

4.11.2 Identification of cultural assets in the contact zone

Favourable natural and geographical conditions in the wider area of the Neretva River are, positively, the main reason why, in that area, we can follow continuity of people settlements from ancient times until today. Numerous material remainings witness, about that - both so far discovered movable findings and small archaeological material and existing 'in situ', remaining of architecture heritage, cult or tombstones.

As an illustrative example we can state that bigger number of archaeological localities processed in this Study represent **multilayered** sites, on which it is sometimes possible to find above-ground structures – more or less preserved assets of **architectural heritage** or **tombstones**. After ubicating of certain elements into the maps, it is possible to outline specific areas of spatial continuity, with noticeable extremely high concentration of individual, dot-distributed sites, remaining of architectural heritage and cemeteries from the different periods. It clearly proofs that these zones, during the different periods, were continuously being a places where people were living, building, respecting their cults and dying.

Having that in mind, it is logical that, apart diversity in **chronological categorisation** of material remaining, in the considered zone we can register also the most different **kinds of cultural heritage** – from archaeological localities, over cemeteries and necropolis to individual objects of architectural heritage.

Concentration of material remaining is also not even in different areas[2] - it significantly varies by zones. Thus, for example, in the Neretva river valley, within the alignment section passing through Donje Selo, Breber, Pokojište, Čelebiće, and close to Orahovica, Ribići, Radešina, Ostrožac, we found significant spatial presence of heritage property. However, in the zone of Mostar North, encompassing the Suhava river valley, southwest slopes of Prenj and the Bijela river valley, the motorway is mostly avoiding settlements. Therefore, it is logical that no architectural monuments or other historical structures exist in the area of consideration. In the tables hereinafter, one can easily follow very uneven spatial distribution of heritage property along the alignment sections, as a result of geographical heterogeneousness and natural specificities of micro regions that consequently condition different genesis of human settlements from prehistory until today.

All these material remaining certainly represent testimonies of specific periods of anthropological history and have certain value. However, it is also certain that mentioned value is not either qualitatively or quantitatively equal for all numerous assets present in the researched area of interest.

[2] Applied on the area of consideration-approximately, strip of 1 km on each side of the alignment

In reference to that, it was necessary to define criteria for categorisation and processing specific, individual asset in the Study.

Starting from its **purpose and goals**, unified criteria were the **existing protection status** and **existence of a certain value**. According to this, conditions for certain object, entity or locality to be treated were:

- Proper **legal protection** (registered as **national monument**) or the property recorded (through literature, lists etc.)
- Proper **identification during field research** conducted along the different sections of the alignment, along with determination of a certain **value** – (potential property of heritage)- historical, documentary, typological, cultural, architectural, ambient, originality or other value.

Explanation of the **national monument** notion; In accordance with the *Law on modification and supplementation of the Law on protection of the assets which are pronounced as national monuments of Bosnia and Herzegovina by the Commission for national monuments protection (Year IX-Number 27, July 2002)*, based on insight to the List of assets pronounced as national monuments by the Commission in accordance to the Article V and VI of the Annex 8 of the General Peace Accord of Bosnia and Herzegovina and the List of assets recorded in the Temporary list of national monuments, (data updated on November 27, 2005) in the considered 2km-wide strip along the motorway Alignment there are not any cultural assets that **are pronounced** as cultural monuments or recorded in the **Temporary list**. All assets processed in this Study have a status of **3rd category property** and **legally protected property** - recorded assets – registered in the literature, research studies, catalogues or files, e.g. assets of certain **value potential** and consequently there is a possibility of getting status of a higher protection status, through appropriate scientific valorisation in future.

Following research of available documentary basis, existence of large number of assets of different kinds and chronological classification was identified using a “rapid survey” field reconnaissance method. Depending on the specificity of the particular area, in accordance with a need for obtaining **relevant information,** there was made an asset classification, based on generally accepted nomenclature (basic division on archaeological localities, cores/entities and individual objects) and further developed with slight modifications, from the reasons mentioned.

Procedure of preparation of cultural-historical heritage record, in the considered area for the purpose of the Corridor Vc motorway Environmental Impact Study, at the section Tarčin - Mostar North, from expert, scientific, legal and administrative aspect, was determined by the above elements. However, methodologically, it was conditioned by additional criteria - criteria of **relevant information**.

While establishing methodological research and data presentation model, one of the basic criteria for information gathering and selection was a **criterion of data required in a context of potential impact of the motorway operation.** In that sense, selection of information given in the “data core” (Data Core Sheet) is not accidental. The Data Core Sheet is rather common methodological structure - standardised form enabling connection and exchange even on the international level and selection of information has its clear goal in the Study context. For example, property kind data have its function while considering possible negative effects, since aboveground and substructures / covered up structures are endangered in completely different ways, by different kind of works and in the different construction and operation phases. Information on property age is closely connected to this; chronological categorisation of data gives an elementary “inputs” information about preservation level of the matter itself –physical composition of the monument. Finally, in the cell "Notes on field observations" given are the remarks that can be particularly important from the aspect of potential conflict; if let's say, it has been found that some object of ambient value was in structurally bad condition, one should anticipate increased vulnerability level during both construction and operation phase.

In the further text, there are tables and Data Core Sheets example presenting research results, while the following photographs with short descriptions represent an illustrative review of different property categories existing in the studied zone, according to the categorisation established. All Data Core Sheets, containing detailed data, given are in the Attachment 13.2.

In the wider area (1 km left and right of the alignment) documentation and field research have been done and the data collected have been processed in the Data Core Sheets. For the First zone of impact separate analysis has been done for each conflict point and the results are indicated in the chapter 6.2.10.

4.11.3 Archaeological Localities

(Remaining of architecture or sepulchral monuments in situ, determined existence of cultural layer, surface finding, movable property etc.)

The considered zone is abundant with localities that can be dated in different prehistory periods, Romanian Period or Middle Ages. Konjic municipality area is particularly rich with these sites. In the wider area of Donje Selo, there is a multilayered archaeological locality named Breber. According to reconnaissance done until now and literature assertions, it dates back to classical period and Middle Ages. P. Anđelić writes- *"One broken stele without inscription was used for the second time as a tombstone on the medieval necropolis in Donje Selo, at the locality of Breber. In vicinity, there are medieval church ruins, where at the time, there were, as spoils, found steles with and without inscriptions. (...) Through repeated verifications, I have determined that the wider locality is named Breber, while the locality of church ruins is named Crkvina and that all together belongs to Donje Selo and not to Homolje ...*", (Breber (Crkvina), P. Anđelić, 1961, 334-335)

Breber, not far from the medieval necropolis on Šćepan Ledina

Within a wider area of Homolje village, located on the right riverside of the Neretva river, there is Gradina locality, according to the sources dated back to bronze or iron period. Also by toponym, it can be concluded that it is some kind of fortification structure – on the western slope of Koznik, there was located a prehistory hill-fort. *"Numerous ceramic fragments can be found on the plateau and in the foothill. By site and natural position, this locality belongs among the biggest and best fortified prehistory hill-forts in this area ..."* P. Anđelić, 1975. 26; Architecture Lexicon, Book II

View towards Homolje hill-fort from the road Homolje-Breber

4.11.4 Cemeteries, necropolis, individual preserved tumbstones, sepulchral monuments

Beside a great number of medieval necropolises, in the examined area there are rather big numbers of Moslem cemeteries of different age, and in places, isolated Moslem tombstones or pairs of them. Some of them are valuable as representatives of the older phases, characterised by symbolic motifs, dimensions and forms.

Lonely old Moslem tombstones on the road from Galjevo to Konjic, close to the road. Judging from carved in symbolic motifs and shaping, they belong to an older tombstones, i.e. in the group of traditional šehid tombstone

4.11.5 Architectural entities – complexes and assembles

Forts and fortified cities

Medieval city of Tuhelj near Tarčin, was built up in late Middle ages, on distinguished hill above the right side of the river Bijela. By the sources, fortress's outlines are 50x20m. Within the fortress it is possible to recognise contours of few smaller objects and protection cut, while on the left side of the river Bijela, there are visible foundations of the smaller fortress. P. Anđelić, 1963, 175-176, 189-191, Architecture Lexicon, Book II.

4.11.6 Urban cores, rural entities, agglomerations

Rural entities

One of the characteristics of the researched area is significant number of structures built in a typical rural manner of the narrow region, frequently placed in picturesque natural environment.

Ćosići, rural entity

Natural-architectural entities and vernacular

Very recognisable autochthonous "popular architecture", frequently fully incorporated into natural surrounding, almost grown together with it, is characteristic for a great number of areas around Konjic and Jablanica.

Dragan Selo, smaller residential and supporting facilities

Individual objects

Residential buildings

In the analysed area there are not construction heritage objects of high architecture value and representative residential and public structures are bypassed by the motorway alignment. However, in the examined area, one can register objects of ambient value or moderate ambient value.

Ravna village, residential objects of ambient value

Vrbljani village, residential objects of ambient value

Table 36 Review of the objects, localities and entities of cultural-historical heritage located in wider contact zone (1 km right and left of the motorway alignment)

SECTION 1

NAME / Location	CODE	DESCRIPTION
TARČIN		
Borak	2/13	Necropolis with 5 tombstones (2 plates, 2 cases and 1 ridge element).
Borak	1/19	1. Prehistory fortress from Bronze and Iron Ages. 2. Medieval necropolis with eight tombstones – at the fortress.
Tarčin I	1/377	Prehistory storage. Early Iron Age (around 500 B.C) It contains 8 iron spears of different dimensions
Tarčin II	1/378	Medieval necropolis. Late Middle Ages. (Preserved standing case-shaped tombstone, oriented in direction N-S)
Tuhelj	1/389	Medieval city. Late Middle Ages.
RAŠTELICA		
Gromiljače	1/166	Remaining of Roman facility. Roman Period, I-III century
Carina	S/1	Traditional shahid tombstone
Carina	S/2	Traditional shahid tombstone

SECTION 3

NAME / Location	CODE	DESCRIPTION
BRADINA		
Bradina	6/11 1/25	Above the settlement Gornja Bradina, close to the orthodox cemetery, necropolis with 57 medieval tombstones. In the south part of the necropolis, there is a remaining of an old Moslem cemetery.

Ivan-sedlo	5/15	Memorial to the victims of fascism

SECTION 4

NAME / Location	CODE	DESCRIPTION
ZUKIĆI		
Zukići	6/12 1/367	Group of 51 tombstone (45 case-shaped and 6 ridge-shaped)
Giaour's Cemetery (Crkvina)	6/15 1/188	1. Medieval necropolis, 2. Remaining of Roman architecture 3. Milestone
Vrbljani	6/16 1/354	Group of 3 medieval tombstones

SECTION 5

NAME / Location	CODE	DESCRIPTION
VRBLJANI		
Vrbljani	S/5	1. Rural entity 2. Individual residential buildings of ambient value
PODORAŠAC		
Kraljica	6/14 1/204	Small necropolis with three tombstones
Podorašac	1/275	Fragments of Roman Stella (upper part of the Stella with half-lying lions and Athis in the middle)
KANJINA		
Kanjina	6/32 1/185	Group of tombstones

SECTION 6

NAME / Location	CODE	DESCRIPTION
DONJE SELO		
Breber (Crkvina)	1/30	1. Traces of Roman mausoleum and necropolis 2. Fragments of medieval church
Breber -Šćepanova ledina	1/ 30a	Medieval necropolis
Gradac	6/28 1/101	1. Medieval necropolis 2. Neolith settlement 3. Roman settlement
GALJEVO		
Gradina	1/113	Prehistory fortress
Galjevo	S/16	Traditional shahid tombstone
HOMOLJE		
Gradina	1/118	Prehistory fortress
	S/17	1. Autochthonous rural agglomerations 2. Individual residential structures of ambient value

SECTION 7

NAME / Location	CODE	DESCRIPTION

CERIĆI		
Cerići , Munara, Trebeda	1/35	1. Remaining of Roman settlement. 2. Roman monument 3. Byzantium coins.
Razice - Stećak	S/ 18	1. Medieval monument 2. Old Moslem standing tombstones
Razice - Stećak	S/ 19	Building of modest ambient value
ORAHOVICA		
Mouth of the Orahovica river	1/336	1. Prehistory settlement 2. Roman settlement
Šušnjata Glavica (Orahovica– Lončari)	1/325	1. Prehistorically fortress
Orahovica 1	6/29 1/257	Group of medieval tombstones, partially over flood by Jabničko lake.
Orahovica 2	6/31 1/258	Group of 6 tombstones, necropolis over flood by the Jablaničko Lake.
Slana voda	1/307	1. Prehistorically settlement 2. Roman building
Paradžici	6/30	Necropolis with 15 medieval tombstones, flooded by Jablaničko Lake
GORNJA ORAHOVICA		
Gornja Orahovica	6/105 1/259	Necropolis with 5 medieval tombstones Autochthonous rural agglomerations
POKOJIŠTE		
Grebine	6/124 1/148	Necropolis with 9 medieval tombstones
Pokojište	S/3	Smaller group of residential-agricultural buildings
Krvavo Polje- Terzića Luka	1/327 (6/98)	1. Prehistorically tumulus 2. Medieval monument
ČELEBIĆI		
Zelovo polje	1/366	1. Prehistorically necropolis with tumulus 2. Roman necropolis
Čelebići, location of over flooded original Orthodox church under Jablaničko lake	5/16_OR	Over flooded remaining of the building

SECTION 8

NAME / Location	CODE	DESCRIPTION
ČELEBIĆI		
Čelebići, location of Orthodox church built instead of the	5/16_SAD	Church with fragments of over flooded structures

one over flooded		
Mravinjac	6/21 1/248	Necropolis with 7 medieval tombstones, over flooded or dislocated
Čelebići 1	1/46	1. Illyrian-Greek coins and Roman Republican coins
Čelebići 2	6/20 1/47	Necropolis of 109 medieval tombstones, over flooded by Jablaničko lake.
Ćupine (Mravinjac)	1/53	1. Prehistorically cult place
SELJANI		
Seljani	5/1	Old Moslem cemetery
Pliješ	5/2	Old Moslem cemetery (separated groups of old tombstones)
RADEŠINE		
Kiseljača	1/189	Roman building , Roman Stella with inscription
Radešine 1 (Radeško polje)	6/18 1/288	Necropolis with 78 medieval tombstones, flooded by Jablaničko lake.
Gradina	1/128	1. Prehistorically fortress 2. Roman fort
Radešine 2	6/19	Group of 6 tombstones, over flood by Jablanica Lake

SECTION 9

NAME / Location	CODE	DESCRIPTION
RIBIĆI		
Grad	1/96	1. Roman fort. 2. Medieval city
Gromile-Široka	1/156	1. Traces of Roman settlement
Ribići 2 (Gaj)	1/297	1. Storage of medieval coins

SECTION 10

NAME / Location	CODE	DESCRIPTION
DRAGAN SELO		
Dragan - Selo	S/7	1. Water mills 2. Autochthones rural agglomerations

SECTION 11

NAME / Location	CODE	DESCRIPTION
RAVNA		
Ravna	S/8	1. Autochthonous rural agglomerations 2. Individual residential buildings of ambient value
Podkula	4/10 1/273	Group of 7 medieval tombstones
Ravna	4/11 1/293	Group of 4 medieval tombstones
Biešćak	4/12 1/10	Group of 20 medieval tombstones
DJEVOR		
Tulac	4/13 1/332	Necropolis with 20 medieval tombstones
DONJA JABLANICA		

Lokve, Donja Jablanica	4/14 1/225	2 Medieval tombstones
GLOGOŠNICA		
Glogošnica	S/9	1. Old Moslem cemetery 2. Old Moslem cemetery 3. Remaining of autochthonous old cobble pavement, dry stone masonry
Glogošnica	4/15	Individual tombstone (locality)
Donja Jablanica - Glogošnica	S/20	The Old Bridge

SECTION 12

NAME / Location	CODE	DESCRIPTION
RAVNA		
Šanica, Klanac	4/16	3 medieval tombstones

Data Core Sheet sample (All sheets are attached in the Annex 13.2)

Environmental Impact Study - CULTURAL HERITAGE	KORIDOR Vc 

Data Core Sheet

Itinerary No.	Municipality	Location	Kind of property
3	**Konjic**	**Vrbljani**	Cemeteries, necropolis, individual preserved tombstones, sepulchral monuments

Name of the Property (name, toponym, locality)	Code	Chronological affiliation
Vrbljani	**1/354** (6/16)	Late Middle Ages

Description	Notes of field observations
Medieval necropolis Group of 3 medieval tombstones, ridge-shaped with a base. Two tombstones are decorated.	By field reconnaissance the tombstones have been determined "in situ". They are not in critical condition, apart the plastic which is jeopardised, losing its form due to the surface weathering. Also, the tombstones are in places pulled of and separated from the stand. It is the entity of extraordinary cultural-historical and natural value: medieval tombstones in relatively good condition, attractive geological-morphological picture, and preserved natural ambient.

Spatial relation alignment - cultural heritage asset

Location in relation to the alignment and zone of impact

The first impact zone

Identification photo

Core Sheet preparation/Terrain Reconnaissance

M.S. Nermina Mujezinovic, B.S. In Architecture
Field reconnaissance date:
October 15, 2005

4.12 Hunting

The alignment of the TEM-Corridor Vc in the area of Bosnia and Herzegovina is passing over the areas different to each other by natural characteristics. The hunting areas formed there are occupying different biotopes inhabited by a stable wolf and bear populations on the top of the food pyramid, as well as of Balkans chamois sub-species.

By the Law on hunting that is based on the ownership principles, hunting economy is defined as one of the land use categories, complementary to agriculture and forest management. This is particularly important in the wider area of the motorway where all the three activities are in a very important interactive relationship.

The wider area, cut by numerous natural watercourses and other water elements, with abundance of forestland and other natural features is very quality for hunting and hunting economy.

Considering the facts mentioned, it is estimated that some hunting areas in the wider zone of the motorway are above average in the frame of Bosnia and Herzegovina, belonging to the classes of high value in respect of a game (rich with water, dense vegetation and sufficient quantity of other important elements such as food and peace).

The adopted alignment of the future motorway is lying in the two cantons (Sarajevo canton and Herzegovina-Neretva canton), three municipalities (Hadžići, Jablanica, Konjic) and north part of the City of Mostar (Mostar-North), with the hunting areas formed in them.

Legally, hunting is regulated by the Law on hunting (Official Gazette SR B&H, 7/77) and by the Law on modifications and amendments to the Law on hunting (Official Journal 30/90) and the Law on hunting (Official Journal FB&H, 04/06).

In the area the Project impact, the hunting areas have been established on the territorial principle within the municipal boundaries, as formed after the Dayton Peace Accord, as follows:

- In the area of Hadžići municipality:
  Hunting area ″Ormanj″ (11,388 ha)
- In the area of the municipalities of Konjic and Jablanica:
  Hunting area ″Tetrijeb″ (27,600 ha)
- In the are of Mostar north:
  Hunting area ″Divojarac″ (50,000 ha)

The stated data are indicated in the following tables containing the hunting area positions. Detailed description of each hunting area is given after the tables.

Table 37 Relationship among the hunting areas

Canton/ Municipality or City	Hunting Area	The LOT 3 Motorway Section in the Hunting Aarea				Hunting Area Surface	Hunting area reduction (300m-zone)	Reduction share (degree 8 / (degree 7)
		From the station	To the station	Section Length	Length in the hunt. area			
		m	m	m	m	ha	ha	ha
1	2	3	4	5	6	7	8	9
Sarajevo canton / Hadžići municipality	Ormanj	0+000	7+000	29,830	7,000	11,388	**420**	**3.7%**
Herzegovina-Neretva canton / Jablanica municipality	Tetrijeb	29+830	42+950	13,120	13,120	27,600	**787**	**2.9%**
Herzegovina-Neretva canton / North part of Mostar	Divojarac	42+950	59+700	16,750	16,750	50,000	**1,005**	**2.00%**

Description of the relation hunting areas-alignment

The hunting area ″Ormanj″ managed by citizens association Hunting club ″Bjelašnica″, based in Hadžići, is located within Hadžići municipality area, encompassing connected forests and forestland north of the main road Sarajevo-Mostar and the valley of Tarčin. Hunting area boundary in the north corresponds to Hadžići municipality boundary, while in the south, the hunting area is bordering on the hunting area ″Bjelašnica″. The hunting area is located in south part of Sarajevo canton and northwest part of Hadžići municipality. It is also placed north of the mountain Bjelašnica massif and east of mountain saddle Ivan Sedlo in direction of Sarajevo valley.

Since the main road M17 and a dense local road network pass over this hunting area, it has a very favourable geographical and transportation position.

Starting from its far west part, the hunting area has been divided to a numerous mountain ranges and valleys with brooks that the river Kalašnica is taking into the river Bijeli potok. Mountain crest Šljemena, with its peaks Tmor and Vis, dominate upon the relief. Middle part of this hunting area is hilly, with moderately high peaks and with several bigger brooks oriented towards the north, inflowing into the Bijeli potok in Tarčin. Moderately steep slopes exposed to south and southeast form majority of this area (70%).

Going further towards the centre of this hunting area, e.g. towards the east, there is the orographically distinguished dolomite limestone massif Doljanske stijene (cliffs) with it speaks whose moderately slope hillsides are lowering to the river Zujevina. In this area, there are numerous brooks and springs. North of Hadžići the hilly terrains are starting, cut by smaller watercourses and springs collected by the watercourse of the Drozgometva that flows into the river Zujevina in Hadžići. In this part of the hunting area, there is a big number of *pištalina* and smaller springs, which dry up only during extremely dry seasons.

Surface of the hunting area is 11,388ha, out of which a hunting-productive surface amounts to 10,828ha, and non-productive amounts to 560ha. This is a hilly-mountainous type of hunting area. Forests and underbrush covers 6,820ha, while the remaining area is covered with plough fields (1,839ha), meadows and pastures (1,887ha), orchards and gardens (15ha). Barren land, karst and water surface take 267ha. This surface structure is exactly what makes a source of food abundance for all kind of game.

Status and number of game in the hunting area in spring is given in the Tables 36 and 37.

The hunting area ″Tetrijeb″ managed by citizens association Hunting club ″Tetrijeb″, based in Jablanica, in Herzegovina-Neretva canton. Jablanica municipality boundary is at the same time a boundary of the hunting area, which is bordering on the hunting areas of Konjic, Prozor-Rama, Posušje and Mostar.

The hunting area covers the surface of 27,600ha. This is a hilly-mountainous type of hunting area. Surface structure is exactly what makes a source of food abundance for all kind of game.

Status and number of game in the hunting area in spring is given in the Tables 36 and 37.

The hunting area ″Divojarac″ managed by citizen's association Hunting club ″Divojarac″ based in Mostar has boundaries identical to the ones of ex municipality of Mostar North (presently the area of the City of Mostar – north area).

The hunting area is bordering on the following hunting areas: ″Tetrijeb″ Jablanica, ″Jarebica kamenjarka″ Mostar, ″Jarebica″ Mostar, ″Golub″ Blagaj and ″Srndać″ Nevesinje.

The hunting area covers the surface of 50,000 ha.

Status and number of game in the hunting area in spring is given in the Tables 36 and 37.

The mentioned statements are indicated also in the following tables, containing review of the game, which inhabits the hunting areas in the Lot 3 area, including number of game in specific hunting area.

Table 38 The game inhabiting the hunting areas of Lot 3

Local name	***Latin name***	***English name***
Protected game		
Mrki medvjed	*Ursus arctos* L.	Brown bear
Medvjed		Bear
Divokoza	*Rupicapra rupicapra balcanica* L.	Chamois
Srna	*Capreolus capreolus* L.	Roe deer
Divlja svinja	*Sus scrofa* L.	Wild boar
Zec	*Lepus europaeus* L.	Hare
Koka lještarka	*Tetrastes bonasia* L.	Hazel hen
Poljska jarebica	*Perdix perdix* L.	Grey partridge
Jarebica kamenjarka	*Alectoris graeca* Meissner.	Greek partridge
Šumska šljuka	*Scolopax rusticola* L.	Woodcock
Šljuka		Snipe
Bjeloglavi sup		Griffon vulture
Golub grivnjaš	*Columba polumbus* L.	Wood pigeon
Golub		Pigeon
Patka gluhara	*Anas platyrhyncos* L.	Mallard Duck

Divlja guska		Wild goose
Permanently protected species		
Orao (suri)	*Aquila chrysaetus* L.	Golden eagle
Jastreb kokošar	*Accipter gentilis* L.	Goshawk
Jastreb		Hawk
Soko sivi	*Falco peregrinus* L.	Peregrine falcon
Vjetruša	*Falco tinnuculus* L.	Windhover
Škanjac (kobac)mišar	*Buteo buteo* L.	Sparrow-hawk
Šumska sova	*Strix aluco* L.	Owl
Sova		Owl
Gavran	*Corvus corax* L.	Raven
Vjeverica	*Sciurus vulgaris* L.	Squirrel
Koka lještarka	*Tetrastes bonasia* L.	Hazel hen
Non-protected species		
Vuk	*Canis lupus* L.	Wolf
Lisica	*Vulpes vulpes* L.	Fox
Kuna zlatica	*Martes martes* L.	Pine marten
Kuna bjelica	*Martes foina* E.	Stone marten
Tvor	*Mustela putorius* L.	Polecat
Jazavac	*Meles meles* L.	Badger
Lasica	*Mustela erminea* L.	Weasel
Velika lasica		Ermine weasel
Mala lasica	*Mustela nivalis* L.	Least Weasel
Veliki puh		Fat dormouse
Obični puh	*Glis glis* L.	Dormouse
Divlja mačka	*Felis silvestris* Sch.	Wildcat
Siva vrana	*Corvus cornix* L.	Hooded crow
Vrana		Crow
Svraka	*Pica pica* L.	Magpie
Čavka	*Corvus monedula* L.	Jackdaw
Kreja	*Garrulus glandarius* L.	Jay
Divlja patka		Mallard
Guska		Goose
Divlja guska		Wild goose
Liska		Moorhen
Čaplja		Heron
Ronac		Pochard
Lunja		Kite
Kobac		Sparrow hawk
Galeb		Sea gull
Rovac		Mole cricket
Gnjurac		Grebe
Sojka		Jay
Ptice pjevice		Songbirds

Table 39 Number of the game in the specific hunting area

Kind of Game	***Hunting Area***			***TOTAL***
	Ormanj	**Tetrijeb**	**Divojarac**	
Brown bear	4	20	The game is not present	24

Bear	The game is not present	The game is not present	20	20
Chamois	The game is not present	1,000	300	1,300
Roe deer	40	350	470	860
Wild boar	52	200	500	752
Hare	294	The game is present but no data on its number	3,000	3,294
Hazel hen	62	The game is not present	The game is not present	62
Grey partridge	The game is present but no data on its number	The game is not present	1,700	1,700
Greek partridge	The game is not present	The game is present but no data on its number	4,500	4,500
Woodcock	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Snipe	The game is not present	The game is present but no data on its number	1,000	1,000
Griffon vulture	The game is not present	The game is not present	25	25
Wood pigeon	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Pigeon	The game is not present	The game is not present	1,500	1,500
Mallard Duck	11	The game is present but no data on its number	The game is not present	11
Wild goose	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Golden eagle	The game is not present	The game is not present	70	70
Goshawk	6	The game is not present	The game is not present	6
Hawk	The game is not present	The game is not present	180	180
Peregrine falcon	The game is present but no data on its number	The game is not present	3,400	3,400
Windhover	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Buzzard	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Tawny Owl	2	The game is not present	The game is not present	2

Owl	The game is not present	The game is not present	150	150
Raven	10	The game is not present	750	760
Squirrel	The game is present but no data on its number	The game is not present	380	380
Hazel hen	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Wolf	The game is present but no data on its number	The game is not present	20	20
Fox	The game is present but no data on its number	The game is present but no data on its number	350	350
Pine marten	The game is present but no data on its number	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Stone marten	The game is present but no data on its number	The game is not present	250	250
Polecat	The game is present but no data on its number	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Badger	The game is present but no data on its number	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Weasel	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Ermine Weasel	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Least Weasel	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Fat Dormouse	The game is not present	The game is not present	500	500
Dormouse	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Wildcat	The game is present but no data on its number	The game is not present	350	350
Hooded crow	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Crow	The game is present but no data on its number	The game is not present	1,000	1,000

Magpie	The game is present but no data on its number	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Jackdaw	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Jay	The game is present but no data on its number	The game is not present	The game is not present	The game is present but no data on its number
Mallard	The game is not present	The game is present but no data on its number	The game is present but no data on its number	The game is present but no data on its number
Goose	The game is not present	The game is present but no data on its number	The game is not present	The game is present but no data on its number
Wild goose	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Moorhen	The game is not present	The game is present but no data on its number	The game is not present	The game is present but no data on its number
Heron	The game is not present	The game is present but no data on its number	The game is not present	The game is present but no data on its number
Pochard	The game is not present	The game is present but no data on its number	The game is not present	The game is present but no data on its number
Kite	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Sparrow hawk	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Sea gull	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Mole cricket	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Grebe	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Jay	The game is not present	The game is not present	The game is present but no data on its number	The game is present but no data on its number
Songbirds				

Rough number of the game was received from the hunter's clubs managing specific hunting areas in the area of the Project impact (the data are not extracted from the management plans and thus should be accepted with reserve of 10 – 15% in respect of deviation from the real number on the field).

4.13 Noise environment

Unit of measure for noise level is decibel (dB) based at the logarithm scale. In acoustics, decibel is the most frequently used for comparison of sound pressure in the air to a referent value. The referent value is $20x10^{-6}$ Pa, which represents hearing sense of a young healthy person and corresponds to the clock tick-tacking sound at the distance of 7m. Acoustics experts use dB scales because of a wide range of considered values. The logarithm scale compressed that range. Other reason is that human hearing interprets loudness in logarithm and not in linear proportions. That, practically, means that the intensity of the doubled intensity source (for example double traffic capacity) will demonstrate as increase of +3dB. From the receptor side, human subjective impression of doubled noise requires noise increase of +10dB. Generally, changes of less than 1 dB are not considered to be significant. In majority of European Countries ISO R 1999 criteria is accepted, by which the acceptable noise level that doesn't cause hearing damage is 90 dB (A) for the time of 8 hours. In case of exposure to 93dB(A) noise level, maximum time that will not cause hearing damage is 4 hours.

Since human beings are sensitive to sounds, what depends of their frequency, there is a convention on the use of frequency adjustment curve in order to obtain noise level measure independent of frequency, marked as dB (A).

One of the most important traffic impacts is noise, affecting people living in settlements along the road alignment. By definition, noise is unwanted sound, since it damages hearing, makes oral communication impossible, and disturbs concentration, causing decreased working efficiency and damaging human health. Researches conducted within European Community discover that the great part of population feel uneasiness caused by noise from road traffic. It is known that too big noise has a negative impact on health, concentration and mood. Different people sense traffic noise and industrial noise differently. Therefore, it is extremely difficult to determine the way and extent to which noise damages human health. Exposure to noise and noise-caused stress can cause different diseases like blood circulation problems, deafness or nerve diseases. Recent medical researches even showed correlation between negative noise impacts and hart attacks.

Examples of noise levels for customary sounds in the environment are:

- Ambulance car siren 140 dB(A)
- Aeroplane taking off at 100 m 110 – 120 dB(A)
- Pneumatic hammer 90 – 110 dB(A)
- Restaurant full of gests (inside) 65 – 75 dB(A)
- Office with lot of staff (inside) 60 – 65 dB(A)
- Normal conversation 40 – 60 dB(A)
- Quiet living room 30 – 40 dB(A)
- Quiet bedroom by night 20 – 30 dB(A)
- Quiet garden 30 dB(A)

At that moment, in the interested area, the main noise pollution source is the traffic on main national road M17 from Sarajevo to Mostar. As say before (chapter 8) there aren't data about the noise level in the area, interested by both the M17 and the new alignment.

Otherwise, the affected residential houses line up along the M17 for a 50% of the road section's length. The construction of the new alignment will therefore allow a shift of parts of the traffic from the residential zones to less sensitive areas along the alignment.

The Government of FB&H to date does not specify noise level standards. Therefore, the standards to be applied for the new motorway are those set forth by the Canton of Sarajevo (see chapter 2.2.4).
On base of those standards, given the character of mixed function areas (area with market, business, residential buildings near communication corridors, warehouses without a heavy transportation), along the M17, a zone IV classification will be used in order to assess the present noise level. For this zone, the highest allowed noise levels are 60 dB(A) at daytime and 50 dB(A) at night time.

On base of the traffic data[3] along the present M17, the calculated theoretical noise level[4] for the different road sections are:

Table 40

Section		**Average traffic (veh/h)**	**Average speed (km/h)**	**Leq dB(A)**			**> 50 dB(A)**
				25 m	**50 m**	**100 m**	**m**
Tarčin	Konjic	297	45	60.95	56.09	51.23	115
Konjic	Ostrožac	264	45	60.49	55.63	50.77	110
Ostrožac	Jablanica	290	45	60.85	55.99	51.13	115
Jablanica	P. Jablanica	250	45	60.27	55.41	50.55	105
P. Jablanica	Potoci	250	45	60.27	55.41	50.55	105

On base of those data the present main noise critical areas, in the sense of areas with human sensitive receptors (as residential buildings, schools, hospitals) far less of 50 m from the present M17 alignment, are:

- Isolated buildings along the road near: Smucka and Prosnica; Donja Raštelica; Rosulje; Lijeha; Jabuke; Šiljovine; Okruglovača; Podorašac; Živašnica; Lokve; Ostrožac; Donje Seline;
- Settlement areas in correspondence of Vukovići; Barakuša/Njiva; Bradina; Kartinac; Česme/Kruševica; Radešine; Prisoje/Bašča;
- Urban system areas of Konjic; Čelebići/ Vrtla; Jablanica.

[3] The data comes from the *Traffic Study of the Lot 6 Sarajevo south (Tarčin) - Granica south - Corridor V*, done by the Civil Engineering Institut of Zagreb in September 2005. Those informations are about the Avarage Daily Traffic ADT along the present M17 alignement (2004) and along the future M17 alignement (20013) in case of no intervention and along the proposal alternative alignement (2013).
[4] The analysis is elaborated on base of the next medium daily traffic and calculated with the follow adopted formula (source ENEA)
Leq (dB(A)) = leq (Q,V,d) – A(divergence) – A (earth) where
Leq (dB(A)) = 9,1 log (Q eq) – 6,5 log (d) + 51,2
Qe =α(V) Ql + β(V) Qp+ γ (V) Qc
Qp light vehicles flow
Ql heavy vehicles flow
Qc motocycles flow
α β γ factor of proportionality in function of speed flow
d reference distance
A(divergence) noise level decrease d(B) in function of divergence
A (earth) noise level decrease d(B) in function of earth

4.14 *Situation of air quality*

Combustion processes from industry, traffic, and heating of buildings mostly generate emissions of air pollutants. In the past years the most significant contributor to air pollution was the industrial sector. Due to demolition during the war and pending or unwanted restoration, contribution of such emission sources is significantly reduced at present compared to the time prior to the war.

Concerning the air pollution, i.e. air quality in the area of Corridor Vc motorway (section Sarajevo South (Tarčin) – Mostar North) there are no indicators for determination of the present status, as said in 8.0 chapter.

The main air pollution is actually derived from the existing road due mainly to the high intensity traffic flows. On base of the present traffic flows (average daily traffic ADT) from the *Traffic Study of the Lot 6 south Sarajevo (Tarčin) - south Granica - Corridor V*[5], it has been possible to define the theoretical data about the PM10 and other pollutants (CO, NO_x, CO_2, COV)[6].

Table 41 Number of vehicles expressed in Average Daily Traffic (from the Traffic Study of the Lot 6 Sarajevo south (Tarčin) – South Border - Corridor V).

From	To	ADT	Length (km)
Tarčin	Konjic	7,122	20.0
Konjic	Ostrožac	6,343	13.0
Ostrožac	Jablanica	6,953	8.0
Jablanica	P. Jablanica	6,003	3.5
P. Jablanica	Potoci	6,003	24.0

Table 42 Present air emissions along the M17 (2004)(g/km/h) and (g/h)

Scenario	Flow A>B vehicle/h	Flow B>A (vehic/h)	Emissions (g/km/h)				
			CO	COV	PM10	CO2	NOx
M 17 in 2004	136	136	1,615	257	7	43,102	435

Scenario	Flow A>B (vehic/h)	Flow B>A (vehic/h)	Emissions (g/h)				
			CO	COV	PM10	CO2	NOx
M 17 in 2004	136	136	110,604	17,596	449	2,952,493	29,765

The new alignment will reduce the air pollutant around the urban settlements and the villages actually affected (due the strong reduction of the long distance traffics flows and vehicles especially freight traffic), while an increasing can be expected in air pollution along the countryside.

5 Done by the Civil Engineering Institut of Zagreb in September 2005.
6 Done by a specific SPT s.r.l. Software elaboration

4.15 Infrastructure

- *Electrical network*

The network of power lines and transformer stations for distribution of electric energy was repaired partially with support of international community. It is now functional and meets needs, but not in the pre-war capacity. Low-voltage network of the region is satisfactory and there are not non-electrified settlements. Public companies (Elektrodistribucija BiH and Elektroprivreda HZHB) are currently responsible for production and distribution of electrical energy in the region.

In the area of Hadžići municipality there are not any primary or secondary energy sources, but the energy supply is provided through the system for continuous supply and distribution (electricity and gas system), as well as through the terminals for storage and selling of liquid and solid fuels.

The status of the electrical network in the area of Hadžići municipality is relatively satisfactory. However, it is important to mention that the urban areas and the areas reconstructed after the war have a stabile electricity supply, while the villages frequently have the problem with electrical power supply when the weather is bad.

The areas of Konjic and Jablanica are supplied by electrical power through the primary 110 kV and 35 kV high voltage power lines, the primary supply knots (110/x, 35/x kV) and electricity distribution network. HPP Jablanica is located in this area and its plant is situated at the north entrance of the city.

Adopted solution of the energy utilisation of the Upper Neretva predicts a new concept that realistically respects spatial problems of Konjic municipality. Adopted solution predicts construction of four HPP in a chain: HPP Ulog, HPP Ljubuča, HPP Glavatičevo and HPP Konjic. Realisation of this hydro-energy project was designed to be implemented in two phases. Up to date, the design documentation has been completed, without indications if the project will be implemented and when.

Energy resources used in Mostar municipality are hydro energy and coal thermal energy. In the area of North Mostar valley there are two hydroelectric power plants, Salakovac and Mostar. In the area, there are the power lines of the following voltage levels: 400kV, 220 kV, 110 kV and distribution one of 35 kV. Middle voltage network of the North Valley is supplied by the TS 35/10 kV "Bijelo Polje" and partially from the TS 35/10 kV "Vrapčići".

The planned motorway alignment is intersecting the existing long-distance electrical power lines. Impact of the motorway on the existing distribution network is mostly of a technical nature. In the case of non-compliance with prescribed construction and layout requirements, the underground and overhead HV power lines must be reconstructed in order to meet the conditions required. Those conditions are: prescribed distance between the poles, prescribed height of cables above the motorway pavement surface, mechanical protection of underground electrical cables against mechanical load of variable intensity. Extremely rear, but theoretically possible are the situations of cables falling down on the road lines due to collapse of the poles under conditions of natural disasters. In that context, indicated are the conflict points, e.g. places where the overhead power lines of transmission and distribution voltage levels get in contact with the planned motorway, either leading in parallel or crossing it.

The existing overhead transmission and distribution lines are crossing, approaching or passing in parallel to the planned motorway alignment in the zones of the following stations:

Table 43

Corridor	Conflict points related to the electrical network:	
Alignment	**Electrical line is crossing the motorway alignment – stations**	**Electrical line is coming close to the motorway alignment – stations**
	km 3+650; 6+400-6+600 (tunnel); 7+550-7+700 (tunnel); 9+050-9+150 (tunnel); 9+550-9+800 (tunnel); **10+100-10+200*;** **10+800-11+000*;** **12+800-13+000*;** 14+150-14+250 (tunnel); 18+100-18+150 (tunnel); 18+800-18+850 (tunnel); **21+350-21+500*;** 22+900-23+000; **23+350-23+550*;** 23+750-23+900**;** 24+200-24+300 (tunnel); 24+950 (tunnel); 25+300; **36+600*;** ***Design of shifting the power lines is prepared**	km 2+150; 4+950 (tunnel); 9+200-9+300 (tunnel); 10+200-10+450; 10+300-10+800; 12+700-12+800; 36+400-36+500; 36+700-36+800;

Going further south, towards the alignment end (connection point to Lot 4) there are not contact points of the motorway and the power lines.

- *Water supply system and sewerage system*

There are many issues related to the water supplies and its distribution. Generally speaking, quantities of the resources are far beyond the actual needs and requirement, but the existing infrastructure does not adequately or sufficiently channel the water to the end user.

An organised water supply covers, by water supply network, the consumers from narrow municipality centres and bigger settlement of the area. Periphery parts are using alternative supplies: local, capillary springs, wells and water tanks.

Water supply in the area of Hadžići municipality is performed by water supply system managed by Public Utility Company «Komunalac» but only in the urban and some village areas. Population of the other settlements is supplied from village water supply systems, and their supply is not satisfactory, since there is not a regular maintenance, water control and chlorification.

Municipalities of Jablanica and Konjic have good capacities for covering their needs for good quality water, both planned and currently used.

Beside the main karst springs, which supply the city centres: Ljuta, Crno vrelo and Vrtla for Konjic and Komadinovo vrelo for Jablanica, it should be counted on the local springs of village water supply. The mentioned springs will cover the most part of the total needs but for the majority of the rural area of the Municipality, numerous small local springs remain the source of water supply.

The water system development of the North-East part of Mostar valley, is planned within the unified water system of the Mostar valley, conceived and based on the water resources of the high quality waters of the area, based on the springs: Salakovačka vrela, Potoci and Studenac. The water of the Potoci source is flowing into the water system by gravitation and the Salakovići springs and Studenac by pumping.

Generally, it can be concluded that the motorway alignment is not going to endanger the water supply systems of the area and the possible conflict points will be resolved in the next designing phases.

Table 44

Corridor	**Conflict points related to the water supply network:**	
Alignment	**Water supply pipeline is crossing the motorway alignment – stations**:	**Water supply pipeline is coming close to the motorway alignment – stations**
	km 0+850-0+950; 1+000-1+050;	km 0+000-0+250;

Sewerage system in the area of Hadžići municipality is not at satisfactory level. It is characterised by the two catchments, so that waste water drainage can't be solved with one sewerage collector. In the area of Tarčin there is a separate sewerage system, built only for the city core. Wastewaters from the system are discharged into the Bijela river. Construction of filtering plant is necessary. Generally, the village areas do not have sewerage systems, but waste waters are disposed in septic tanks.

Sewerage systems are already constructed: mixed type for Jablanica and separation type for Konjic , with necessary prior treatment of industrial waste waters.

Sewerage system of Jablanica and part of its suburbs was constructed as a mixed system for joint conduct of wastewaters and rainwater. Although, there is a sewerage system provided for majority of Jablanica population, the sewerage system is insufficient, lacking suitable filtering facility.

Wastewaters and faecal waters disposal is still being done in a toilet and septic tanks or is being conducted by uncontrolled discharge to the water streams.

Sewerage systems are now also accepting waste waters of suburbs and such tendency is expected to be continued in further system development.

In the rest of the area, it can be expected that, after an extensive construction of village water supply systems, the action for solving waste water disposal will have to follow.

Settlements in the north-east part of Mostar valley, as well as part of Mostar city do not have public sewerage system. Therefore, the problem of waste water disposal is solved by its disposal in ground or water streams, effluents of the Neretva River.

It can be stated that the planned motorway will not endanger the existing and planned smaller village sewerage systems, since it is mainly avoiding populated areas or passes above them.

- *Telecommunications*

The area of interest is divided in two systems - wire and mobile telephone system, HT Mostar and BH Telecom. Significant part of the regional territory is also covered by the ERONET (operator of Croats in B&H).

According to the General Plan of Telephone Network of Former Yugoslavia, a telephone node area corresponds to each municipal area. In a town-municipal centre, there is a node telephone exchange, while ending telephone exchanges are located in secondary municipal centres

Hadžići municipality belongs to the network group Sarajevo, while municipalities of Konjic and Jablanica belong to the telephone network group Mostar. Mostar is a base of a transit telephone exchange.

Planned motorway alignment is crossing the existing telecommunication cables and main optical cable. Impact of the planned motorway on underground telecommunication cables is mainly of technical nature since all cables have to be reconstructed and placed into protective hoses for protection against mechanical damage due to the motorway impact. In that context, listed are the conflict points, places where telecommunication cables get in contact with the planned motorway, either coming close to it or crossing over it.

Table 45

Corridor	**Conflict points related to the telecommunication network:**	
Alignment	**Telecommunication line is crossing the motorway alignment – stations:**	**Telecommunication line is coming close to the motorway alignment – stations:**
	km 2+750+3+050; 3+700-3+750; 4+700-4+900; 7+400; 8+750; 23+050-23+100;	km. 4+450-4+650;

Motorway alignment, towards connection point with Lot 4, does not get in conflict with telecommunication cables.

- *Transport infrastructures*

Road network

The Study area is crossed, along the north – south direction, by the main road M17. The M17 is presently the main road link inside Bosnia and Herzegovina, and it is part of the road/rail axis E-73 (Budapest) Mohacs - Beli Manastir – Osijek - Djakovo- Doboj - Zenica –Sarajevo – Opuzen (Ploče) that is the Pan-European Corridor V, branch C. This corridor plays an important economic role since the seaport of Ploče is the main maritime gate for export-import commodities for Bosnia and Herzegovina.

The area of interest for our project is between Tarčin and Mostar North. M17 is passing through Konjic and Jablanica and practically it is following the river Neretva.

Another important link in the Study area is the main road M16-2 that comes from the M17 at Jablanica, going towards the North – West direction and in the direction of Bugojno.

The remaining part of the network is composed by regional and local roads that have the role of traffic distribution at a local and semi-local level.

Generally, the roads are far away from the European standards. The extremely bad technical characteristics of roads cause high costs of transportation. This data is implying the necessity of improvement of the road network with the construction of new roads and modernisation of the existing roads.

The most important road direction-highway, which passes through the Valley of Neretva River from the junction with the Mediterranean main road in Opuzen (Republic Croatia) through Mostar, Sarajevo and through the valley of river Bosnia until the state border at Sava River, is carrying the sign M-17. It is designed through the route of the old “Austrian” road during the 50-s of the 20th century, constructed during the 60-s and has been modernised several times in accordance with the possibilities. Regularly maintained, with adequate horizontal and vertical signalisation, there is no adequate for frequency of traffic and transportation characteristics of modern vehicles; therefore it is “slow”. For example for the distance of 130 km (Mostar-Sarajevo) there is need for app. 2.5 hours of travel, because the road is for the most part passing through the more extensive part of the settlement (only one line highway is built around Mostar), therefore the medium speed is not possible (around 50 km/h)

The second main-road direction-the Mediterranean main road, with the length of only app. 20 km is passing through the region in the only B&H marine municipality Neum. The third is directing towards the north-south direction of the Drina river valley.

If we consider the above mentioned, the construction of the corridor of the highway Vc would be more than convenient for the solution of interior communications and the connection with Europe.

Hadžići – road network
Base road network consists of main, regional and local roads, which are interconnected in the unified system. Corridor of the main road M-17, Sarajevo- Mostar is following the Zujevina River valley, leading further to Tarčin and Raštelica and tunnel Ivan, at the canton boundary. Critical points on this road are: Mostar crossroad, Zovik, passing through Pazarić with the part of the road leading to Tarčin. Regional roads are: Mostar crossroad -Kiseljak, road Hadžići-Igman, Bjelašnica and further and Tarčin- Sastavci-Kreševo.

Konjic – road network
Municipality of Konjic is connected to the road network through the main road Sarajevo- Ploče (M17). The municipality is connected to the other municipalities by regional roads that are not modernised.

Network of categorized roads is undeveloped. Road network density is 26.5 km/ 100km^2 and it is far less density than B&H one, which was 40.8 km/100 km^2 in 1991.

Local roads are bad and risky for passenger cars.

Jablanica- road network
Jablanica municipality is well connected through the main roads towards Ploče (south) and toward Banja Luka (north-west). Network of regional roads should be developed, for both traffic infrastructure and general development of the area.

Mostar North- road network

Traffic connection of this part with Mostar and with the rest of the country is through the main road Sarajevo-Adriatic Sea, as well as through the road Potoci-Humi-Lišani-Podgorani-Prigrađani-Salakovac that are at the same time corridors of public city traffic.

The existing road network is crossing, approaching or passing parallel to the planned motorway alignment in the zones of the following stations:

Table 46

Corridor	Conflict points related to the road network:	
Alignment	**Road network is crossing the motorway alignment – stations**:	**Roads are coming close to the motorway alignment – stations:**
	km 1+100-1+150; **1+700-1+800;** **2+250;** **2+850-3+100;** **3+950-4+050;** 6+250-6+350 (tunnel); 6+450-6+600 (tunnel); **6+900-6+950;** 7+350-7+400 (tunnel); **7+900-7+950;** **8+100-8+150;** **9+350;** **10+750-10+800;** **13+100-13+150;** 13+800-13+900 (tunnel); 14+200-14+300 (tunnel); 18+000-18+050 (tunnel); 18+200 (tunnel); 19+050-19+100 (tunnel); 20+850-20+950 (tunnel); **21+750;** **22+000;** **22+450;** **22+600;** **23+350;** 23+550-23+650 (tunnel); **23+800;** 23+900-24+050 (tunnel); **25+350;** 27+500-27+550 (tunnel); **36+400-36+800 (interchange);** **36+900-37+000;**	km 1+850-2+150; 2+250-2+500; 2+650-2+850; 3+100-3+200; 6+350-6+600 (tunnel); 24+400-24+600; 37+000-37+200;

Going further south towards the connection point to Lot 4, the motorway alignment does not get in conflict with the existing road network.

Railway network

The railway link between Konjic and Mostar is a section of the Sarajevo – Čapljina railway line, which is a part of the Pan-European Corridor V, branch C, i.e. the line (Ploče) Mostar, Sarajevo, Doboj – Bosanski Šamac (Budapest). The line is single-track and electrified and the section length between Konjic and Mostar is about 62 km.

The line was put into operation in 1966. It serves for the operation of trains to and from Ploče Seaport in Croatia on the Adriatic Sea and it used to be a very busy line - in 1990; it counted 41 trains a day.

The authority responsible for this railway sector, in respect to both infrastructure and operation, is the Railways of the Federation of Bosnia and Herzegovina (ŽFBiH).

The section passes through terrain which is very unfavourable for train operation. It passes through a mountainous area with limited technical possibilities for alignment lying. The maximum gradient is 14% and the minimum curve radius is 300m along the section. This imposed a speed restriction below 80 km/h for regular train operations. The section Bradina – Konjic was built under extremely difficult terrain conditions, with a great number of structures and tunnels, deep cuts and high embankments.

During the period 1966-1991, the infrastructure components of the railway track alignment were maintained in accordance to the regular maintenance procedures. However, no comprehensive activity, like complete replacement of the infrastructure components, was carried out during the period 1966-1991, apart from the above-mentioned regular maintenance, which only includes partial replacement of the components. During the war activities (1992-1995) the infrastructure was totally destroyed and put out of operation, and since the end of the war, no regular maintenance activities have taken place. That was leading to further decrease of the operational capabilities of the line. Consequently, there are many speed reductions on the line due to the poor condition of the track.

The number of trains which are presently in operation in the project section is 11 trains a day - 4 passenger trains and 7 freight trains.

Presently, a railways reconstruction project carried out under EIB/EBRD financing, is ongoing in Bosnia and Herzegovina. Its main purpose is the rehabilitation of the "Pan European corridor" (from the Croatian Border through Sarajevo to the Adriatic Port of Ploče); this project entails the entire corridor Vc and consequently also the railway between Konjic and Mostar. The three main areas of activity of such project are: (a) repair and renewal of the most serious infrastructure damage and deficiencies to allow basic functioning of the key railway corridors; (b) assist with labour restructuring and (c) help strengthen the institutional structures in the railway sector.

Hadžići

The railway Sarajevo-Ploče is passing all through the territory of Hadžići municipality. Together with the main road, the railway is a spine of development along which the settlements were formed. In Hadžići, there are railway station and railway terminal for goods that enable faster and good quality transportation and offer great possibilities.

Konjic, Jablanica

Expected increase in transportation of passengers and goods was almost 50% for the period from 1981 to 2000 in the municipalities of Konjic and Jablanica. That did not happen from well-known reasons of war. Construction of the railway section Pazarić-Konjic was predicted by the Spatial plan, in order to avoid «Bradinska rampa».

Mostar (North)

One of basic preconditions for further planned development of north valley of Mostar area is a correct setting, and than realisation of road traffic network. However, the motorway alignment was predicted to pass over the best quality arable land, cutting of the settlements and creating barrier for east-west motorway direction and it doesn't exclude need for continued use of the main road Sarajevo-Ploče.

The existing railway network is crossing, approaching or passing parallel to the planned motorway alignment in the zones of the following stations:

Table 47

Corridor	Conflict points related to the railway network :	
Alignment	**Railway network is crossing the motorway alignment – stations**:	**Railway network is coming close to the motorway alignment – stations:**
	km 9+250-9+300; 22+950-23+100;	km 2+150-2+850

Going further south towards the connection point to Lot 4, the motorway alignment does not get in conflict with the existing railway network.

4.16 Endangerment by mines

As a consequence of war actions, at the B&H territory, there are mine fields. They are partially registered and officially defined. The organisation for mine clearance BH MAC, prepared the respective maps, indicating the cleared areas, suspicious, risky and still mined areas.

This map can be considered as only indicative, since there is a probability that due to war actions, there was no time for collecting the precise data on the location of the minefields.

Even today, a large number of people, mostly children, are killed by mines.

Due to tectonic movement of land and influence of underground waters, which is a permanent process in the nature, it is realistic to expect, that mines may be moved. Thus such marked mine fields get relocated, without the possibility of being controlled.

Regardless of how much attention is paid to this problem, the mine concentration is extensive, since the mine clearance is performed slowly in comparison to the number of victims and to the registered number of mines to be still removed.

The "Mine situation map" for the Sarajevo-Mostar area, scale 1:50,000, published by the BH MAC SARAJEVO, printed on 14.02.2005 as official data source contains the following remarks:

- The symbols represent approximately the minefields.
- Only 60 % of the minefields are identified until today.
- This map is indicating the area with unknown presence of mines and unexploded devices. In all other areas it is necessary to implement measures of caution. The updated information could be obtained at the Mine Action Centre, Sarajevo Regional Office and EUFOR Department for Mines.

According to this map, numerous mine fields, suspicious and risky areas have been identified in the Project area. It can be concluded that just the highest parts of Prenj and Čvrsnica mountains are mine-free, while all other areas could be considered as belonging to the certain category of probable mine-contamination. In the map of the Project area, probable and identified minefields are located around the urban places: Hadžići, Konjic, Salakovac, Mostar, than along the Neretva River within the section Jablanica-Mostar and at the edge of mountain slopes of Prenj (diagonal direction Konjic-Mostar).

4.17 Coverage of the area by waste disposal services

One of the most important problems of the modern world, so as of Bosnia and Herzegovina, in the field of environment protection is a problem related to waste management, which due to increased production and consumption, generated by the development and civilisation progress, becomes its permanent problem.

Hierarchy waste management scheme concept proves that the most efficient solution for the environment is reduction of waste production. However, in cases where further reduction is not practicable, products and materials can be reused, either for the same or some other purpose. If there is no such possibility, waste can be recycled or composted or used for energy production. Only if none of the mentioned options offers a suitable solution, the waste material should be disposed at the waste area.

Important goal of all efforts in relation to waste disposal must be, primarily, human and environment protection from the damaging impacts, caused by collecting, transportation, treatment, storage and finally, disposal of the waste.

Final waste material disposal means collecting, classification, transportation, treatment, underground and above-ground storage, as well as transformation methods necessary for its treatment (recycling and its use) and restoration (secondary raw material and/or energy production).

The management of waste, whether municipal, hazardous or non-hazardous industrial waste, medical waste, obsolete pharmaceuticals or contaminated sites, is one of Bosnia and Herzegovina’s environmental priorities.

Aldough there is some potential for recycling and reuse, since much of the waste constitutes sources of secondary raw material such as paper, glass, metal and plastic, generaly, none of these waste disposal teckniques is used. Organic waste could be composted and used as fertilizer. The main problem with the separation of municipal waste is the unavailability of equipment for processing the separated components (paper, glass, metal, aluminium, organic waste). In the project area the biggest problem is hudge number of ilegal waste areas.

Each municipality on the planned motorway alignment has public or semi-public company in charge of collecting and disposal of solid waste. These companies encounter many problems such as economic and institutional. Their status is not solved and they don’t have even basic conditions for functioning. They are dealing with collection of waste and depositing without any treatment at the mostly unarranged depositing locations. Presently, municipal companies are not able to serve entire municipality population and waste collecting almost doesn’t exist in the rural areas. That’s why there are numerous illegal waste areas along the roads, in the abandoned mines or along the rivers. Waste areas or disposal sites are in many cases, provisional, without meeting any sanitary standards. In that way, the opposite environmental effects are provided, resulting with degradation and contamination of soil and water resources, aggravation of air quality and infectious diseases occurrence. Furthermore, use of unarranged waste disposal sites causes loss of valuable arable and construction land and biodiversity endangerment.

For the time being, in Bosnia and Herzegovina there is not organised collecting of hazardous waste, apart for some registered companies that mainly collect this waste in cooperation with foreign companies. Also, there aren't adequate plants for a hazardous waste treatment. Such waste is transported to the other countries for processing, through the companies authorised for transportation and treatment of such waste.

Removal of solid waste and garbage from the area of *Hadžići* municipality is done by the utility company JKP "Rad", Sarajevo, and mainly from the central city areas of Hadžići, Pazarić and Tarčin. At the edge of village settlements "wild" waste areas are being formed, around 150 of them.

The municipality of *Konjic*, before the war, was disposing its waste at the waste area "Ovčari". There is an arrangement design for this waste area, aiming at provision of possibility for continuation of waste disposal on this waste area.

Nowadays, waste is disposed on the two active waste areas. One is in town, at the location of "Repovački potok", so called Gradac. The other is active waste area Vrabač, located on the right side of the regional road Konjic-Boračko jezero-Glavatičevo, few kilometres far from the city of Konjic.

Gradac waste area is, in fact, a disposal site of the energy plant and the public company was using it before the location of Vrbač was established. During the winter months, transportation of waste to Vrabač waste area is impossible and the waste is disposed to the waste area of Gradac. Access to the waste area is provided through sufficiently wide macadam road. The closest watercourse is Repovački potok. It is channelled and protected with concrete tunnel. In vicinity of the waste area there is an overpass of railway line Mostar – Sarajevo. Mixed waste is delivered to this waste area. Close to the waste area there is a settlement of Roma people, who occasionally select the waste metal and other materials for their use. The waste area is not fenced in, and the waste is unloaded directly in the deep valley. Filling up with inert material isn't done and odour is spreading around the waste area.

Waste area Gradac on the locality Repovački potok

The waste area Vrbač is a newer waste area located outside the town. It is on the right side of the regional road Konjic-Boračko jezero-Glavatičevo. Concrete supporting walls protect entrance to the waste area. There is no a guardhouse, only garage for the tracklaying vehicle. In the deep valley where the waste is being disposed, there is a macadam road constructed, serving for the new waste transportation, which is pushed towards the lower terraces by the tracklaying vehicle. The waste area accepts a mixed waste (plastic, bottles, heavy waste and waste from the animals) that is not selected prior to disposal.

Close to this waste area, there is a water stream, in the zone of possible contamination. It is protected with constructed wooden barriers that prevent disbursement of waste in the water stream.

Vrabač waste area on the regional road Konjic-Boračko jezero

The waste area is surrounded by beech forest. It is characteristic that this waster area is crossed over by long-distance power lines and there is a danger from firebreak out. Distance of the area from the closest settlement is around 500m. Anticipated lasting of this waste area is 15 years.

Detail with garage and power line on the waste area Vrabač

In the municipality of Konjic nowadays there are the companies collecting waste oils, such as "Koni" and "Olma", while “Konjic karton” company collects paper and cardboard.

When cleaning of illegal waste areas is in question, like removal of heavy and other waste, the municipality is continuously undertaking actions such as cleaning of the river Neretva riverbed, both in the city itself and in the canyon part, where more and more attractive rafting is held during the summer months.

Additional problem in Konjic municipality, in respect of the waste disposal issue, is also number of touristy and catering objects that increased rapidly on the Jablanica water reservoir, where, beside the other, a weekend waste is produced too. On these localities, during the recent years, there is enlarged production of organic waste that facilitates eutrophication of water reservoir, what causes flourishing (excessive growth of seaweed and aquatic plants) and overgrowing which, in that way, resulting with the ecological misbalance. New-appearing vegetation changes aesthetic appearance of the landscape, in one hand and becomes the limitation factor for normal development of the original flora and fauna of these ecosystems, in the other hand.

Special attention should be paid to uncontrolled damping of the waste close to the water sources, what can have far-reaching consequences in respect of reduction of the drinking water source capacity, by which this municipality is one of the most famous in Bosnia and Herzegovina.

Construction of the regional waste area more far from the sensitive zones, by the opinion of the relevant people dealing with waste disposal in the municipality, is a good base for improvement and preservation of nature and environment in this area.

Future municipal strategy must lead towards protection of natural resources of the area, primarily drinking water, and not only inhabitants of this area shall in future benefit from that protection but also inhabitants in the region.

Active waste area in *Jablanica* municipality is placed on the locality “Bukovo”, 5km far from Jablanica, on the left side of the regional road R419 Jablanica – Prozor - Rama at the distance of 1km from that road. Waste material is disposed in the natural deep valley surrounded by hornbeam vegetation. At the bottom of the natural valley, there is the Rama river watercourse. Zlate village is located across the river, on the opposite side from the waste area, at the aerial distance of 2km.

Bukovo waste area - active disposal site of Jablanica municipality

Surface of this waste area is around 4,500-5,000m^2, and it was filled up to 10%. Roughly anticipated, a lifetime of this waste area is approximately 80 years. This waste area in unarranged, except that, from time to time, the waste is pushed downhill and covered with earth. No other activities have been undertaken in the last 25 years, since Jablanica municipality uses this waste area.

Surrounding villages dispose their waste directly in the streambed of the Rama river, what gives a negative impression from both ecological and visual point of view. By solving the final waste disposal issue in an organised way, these areas could be used for development of ecological tourism that is getting more and more important in the neighbouring countries.

Illegal damp area of Zlati village in the municipality of Jablanica

Lug village is damping its waste directly to the riverbed of the Neretva river

In the area of Jablanica municipality, the Public utility company “Jablanica” is collecting and dispose the waste, serving around 1,500 households. Daily average of waste production is 5-7 kg per household, what means that 10 tons of waste is being transported to the waste area a day. The waste is collected in containers capacity of 1,100 litres. Number of 220 containers is placed in different municipal zones and is discharged 2-3 times a week by mean of specialised vehicles of the utility company.

In the region of *Mostar*, there is one legal waste area and more illegal dumpsites. City of Mostar itself has got two utility companies dealing with waste management. Company Parkovi does not have arranged waste area for the final waste disposal, while the company "Komos" owns the waste area Uborak, which was arranged with few million dollars of donor's funds.

All waste management related technological processes such as collecting, storage and disposal of waste have to be in compliance with EU Directives, and the newest technological and ecological knowledge adopted by the developed European countries.

5.0 DESCRIPTION OF THE POTENTIAL PROJECT IMPACTS ON ENVIRONMENT

5.1 Basis for Environmental Impact Assessment

The Consultant collected data, reports and studies related to socio-economic and physical environment, spatial planning and transport issues as well as related maps. The documents collected up to date are presented below:

Socio-economic Data

The Consultant so far collected and analysed the data concerning the social and economic environment as summarised below:

- Geographical data
- Administrative division of the Project Area
- Towns and villages passed
- National population and demographic trends in the last 10 years
- Population and population density Cantons and Municipalities
- Average annual rate of change in urban and rural populations
- Land use
- Climate
- Socio-economic indicators
- Macro-and micro-economic data
- Education
- Price indices
- Labour market indicators (activity rates, employment/unemployment rates) – Regional distribution and sectorial distribution: Average per capita income; Net nominal salary earnings by activity; Costs of labour force
- Household expenditures
- Active local units, turnover, investments
- Information on agriculture/sylviculture, industry, tourism, trade, other services, transport

The data sets are presented in the Technical Study Report.

Sources used and documents evaluated for achieving the above-mentioned data sets are listed below:

- *Bosnia and Herzegovina – Agency for Statistics of Bosnia and Herzegovina:* Statistical Bulletin 3-2004-Wages, Forestry, Construction, Transport and Communications, Tourism, Hotels and Restaurants, Population, Trade; Statistical Bulletin 2 - 2003 Demography
- *Federation of Bosnia and Herzegovina – Federal Office of Statistics:* General and Geographic Data on B&H; Statistics on Population, Industrial Production, Transport and Communications FBiH, Agriculture, Registered business entities, Education, Employment/Unemployment, Social Welfare; Living Standards Measurement Study Survey 2001 in Bosnia and Herzegovina
- *GTZ – German Technical Cooperation:* Detailed Time Series of Fuel Prices in Europe – Bosnia & Herzegovina
- *World Resources Institute* - Earth Trends: Climate and Atmosphere; Economic Indicators; Population, Health and Human Well-being

- *Government of Bosnia and Herzegovina*: Assessment of sustainable development in Bosnia and Herzegovina – The Report of B&H for The World Summit on Sustainable Development (WSSD)
- *State Agency for Statistics (BHAS); Republika Srpska Institute of Statistics (RSIS); Federation of BiH Institute of Statistics (FIS); World Bank (WB):* Welfare in Bosnia and Herzegovina, 2001: Measurement and Findings
- *European Commission – Directorate Western Balkans:* Bosnia and Herzegovina Country Strategy Paper 2002-2006
- *European Commission – Directorate-General for Economic and Financial Affairs;* Occasional Papers: The Western Balkan in Transition
- *Bosnia and Herzegovina Council of Ministers – Unit for Economic Policy Planning and Implementation of BiH Mid-term Development Strategy:* Poverty Reduction Strategy Paper BiH
- *UNDP BiH:* Bosnia and Herzegovina Human Development Report – Millennium Development Goals 2003
- *Bosnia and Herzegovina - Federation of Bosnia and Herzegovina: Federal Development Planning Institution:*
  - Analysis of changes in Population Structure FBiH (Bosnian language)
  - Analysis of economic trends 1999 2002 (Bosnian language)
  - Macro-economic indicators of FB&H and Herzegovina-Neretva canton for 2003 and I-VII 2004; (Bosnian Language): Makroekonomski pokazatelji Federacije BiH i Hercegovačko-neretvanskog kantona za 2003 i I-VII mj. 2004
  - Macro-economic indicators of Sarajevo Canton; (Bosnian Language): Makroekonomski pokazatelji Sarajevskog kantona za 2003. i I-VII 2004.
  - Socio-Economic Indicators by Cantons and Municipalities of the FBiH; (Bosnian language): Socioekonomski pokazatelji kantona i općina Federacija B&H
  - Federation of Bosnia and Herzegovina - Consolidation Reforms
  - Prof. Midhat Aganović, Želimir Jovanović, Sarajevo University: Bosnia and Herzegovina Spatial Structures and Regional Policies

In order to obtain all necessary data we consulted the Federation Institute for Statistics, Ministry of work, social politics, Master thesis from the Economic and the Faculty of Political Science. Most of the data have been found in the Federation Institute and in the Master thesis from the Faculty of Political Science.

Population – there have been colleted statistical data on the number of inhabitants, age structure, sex structure, employment, population density and return of population.

Land use – there have been defined the urban areas (historical settlements, grouped residential settlements, grouped industrial zones, mixed zones, public structures, green areas and parks, spontaneous urbanisation), agriculture areas, forests, pastures, sports-recreation areas, spoil areas etc.

Infrastructure – there have been colleted the infrastructure network (electrical, gas, water supply and sewerage), the hydroelectric power plants, the steam power plants, the dams and reservoirs, road and railway networks.

Change Processes – there have been colleted urban planing studies and designs (completed or ongoing), geological maps (stratigraphic maps), program of public works at the local level. Surveys are being carried out and submitted to the Local Authorities, Business Community and to the stakeholders in the frame of the socio-economic study.

Environmental data

Geological data

For the Technical Study has been carried out the identification and collection of all available documents and studies. The Investor (Council of Ministries) has delivered to Energoinvest the Geology map at scale 1: 25,000 (in electronic form) showing the wider area of project alignments.

The previous development of a complete geological documentation for the construction of hydroelectric facilities (Jablanica, Grabovica, Salakovac and Mostar), has helped to Energoinvest-Sarajevo to analyse the geology of a wider area of the project's Corridor. Based on the mentioned facts, the following documentation has been collected:

- Base geological map, scale 1: 100,000 (Sheets: Sarajevo, Prozor, Mostar and Kalinovik);
- Explanations of the listed base geological maps;
- Engineering-geological map of Socialist Federative Republic of Yugoslavia (SFRJ), scale 1: 500,000;
- Instructions for the development of the Base geological map of SFRJ, scale 1:100,000;
- Hydro-geological map of SFRJ, scale 1:500,000;
- Instruction for the development of the base hydro-geological map of SFRJ, scale 1:100,000;
- Seismology map of SFRJ for returning period of 500 years.

In addition to the above documentation, two field surveys and recognition of the terrain have been carried out. During the survey, different alignment alternatives have been analysed. Field inspection has started from km 0, near Tarčin. Special attention has been paid to the risky sections: the ones with risk of land slides and local instability (Drežnica and Aleksin Han), as well as the active landslide "Kukovi", 2km far from Ostrožac. In fact, the landslide was formed after the construction of the dam of the Jablanica hydroelectric power plant. The big level difference between maximum and minimum water level has caused the activation of the foot of the conditionally stable slope. The landslide has impacted the road traffic in the tunnel "Crnaja", as well as the railway tunnel that is sliding down hill toward the lake due to the complex disturbance processes. It has been pointed out the existence of landslides at the railway Sarajevo-Ploče, section Bradina-Konjic, that were formed during the construction of both tunnels.

The following documents and cartography are in preparation:

- Compilation of geological map scale 1: 25,000
- Geological map scale 1:100,000
- Engineering-geological map scale 1: 25,000
- Engineering-geological map scale 1: 100,000
- Hydro-geological map scale 1: 25,000
- Seismology map for the returning period of 500 years, scale 1:500,000
- Tectonic map scale 1:100,000
- General report-text.

The geologic classification of rocks and soil should be done according to the UNESCO's Instructions.

Water Resources

- Underground waters: The main directions of the underground water flows have been given in the frame of the Technical Study (Hydrogeological map). These directions have been determined by the earlier research (using paint marking) while making the Base hydro-geological maps.

- Surface Waters: Water balances of the main stream and of the main affluent streams in a domain of big waters, have been given in Hydrological-hydraulic part for the purpose of Conceptual Design. Moreover, the maximum water levels of lakes under the normal operation conditions, as well as extreme levels that would arise in the case of dams collapsing by domino effect have been given.

Air Quality

Data on the air quality have been requested from the Federal Meteorological Institute of Bosnia and Herzegovina (FMZBiH) and received results on the air quality measurements are from the meteorological stations Mostar and Ivan Sedlo.

These two meteorological stations are located in the area of the planned motorway, but at this time just Mostar meteorological station is operational. Ivan Sedlo meteorological station stopped working at the beginning of the war and it is still not operational.

- Meteorological station Mostar: Collected results of air pollution monitoring from the Meteorological station Mostar content statistically processed data on the concentration of SO_2 and smoke in the following periods:
  - From 1975/1976 to 1991/1992
  - From 1999/2000 to 2001/2002
- Meteorological station Ivan Sedlo: Air pollution monitoring results at the MS Ivan Sedlo are related to the period January-December of 1991. Included are the measurements of the average monthly SO_2 and NO_2 concentrations, as well as the average monthly pH values of precipitations in the mentioned period.

Noise environment

Since in Bosnia and Herzegovina, the noise measurements are not carried out yet, there are not relevant data on this subject.

Up to now, Government of Bosnia and Herzegovina did not specify standards on the noise level. The only applicable standards on a noise levels are given in the Law on Protection from Noise passed by the Sarajevo Canton (Official Gazette of Sarajevo Canton, No. 10/99). This law establishes allowed noise levels, noise protection measures and ways of noise measurement; noise limitation values by space use and time of day, so it would not jeopardise life and work of people and especially their health.

Elements of aquatic and terrestrial ecology (flora, fauna, ecosystem)

- *Biological Resources:* Biological resources of this area (flora and fauna of the area), have been described in the different documents about the ecology of the Former Yugoslavia. Extensive and detailed ecosystem analysis should form part of the project documentation.
- *Endangered animals***:** The Government of Bosnia and Herzegovina does not have the official list of endangered animals. Different lists of flora and fauna have been formed to qualify them as endangered. The low that could provide an official recognition and protection of these animals still does not exist. Endangered animals are identified and listed in the Table "Endangered species in B&H". World Centre for Animal Preservation and Monitoring, based in UK, lists ten species of mammals, ten species of birds, one specie of reptiles, six species of fishes and seven species of invertebrates as the extremely endangered, endangered or vulnerable in B&H.

Protected areas

- *Natural Values:* According to the Law on the Spatial Planning, the following is considered by natural inheritance:
  - Natural areas, i.e.: national parks, regional parks, historical areas and natural beauty areas, areas for recreation, sea sides, sides of the rivers and lakes, mountain and seaside areas for recreation,
  - Monuments of nature and other natural sights and rarities,
  - Nature reservations.

Cultural - Historical Values

Study of historical values encompasses sufficient review of situation, valorisation, categorisation, as well as of the goals of the most valuable culture-historical monuments from prehistory to until the World War II, together with the most important recent memorial sites (until Dayton Agreement). Analysis has been made based on positive legal regulations and recommendation (international, national and republic) that regulate this matter.

Spatial planning data

Data collected for the purpose to make an analytic-documentation base for the Background and Planning Study for Corridor Vc (section Tarčin-Mostar North) have been taken over from the spatial plan documentation created earlier, as well as from different studies and statistical data. The background database has been prepared according to the applicable "Law on Spatial Planning - Methodology of spatial plan documents preparation" and the data shall be reviewed and taken in consideration while choosing the most favourable alignments or alignment of the motorway. Consequently, the legal obligation is fulfilled, since the data are going to be presented in a way compatible with the form in which spatial plans are normally made (use of data possible in GIS format - Geographical Information System).

The collaboration with the persons involved in spatial planning in the municipalities of Hadzici, Konjic, Jablanica and Mostar has been established. They are at the source of information related to the planning and development trends in the respective areas, what is of a great importance for the project.

Data have been taken from the following spatial plan documentation:

- Spatial Plan for Konjic, Jablanica and Prozor, made in 1985 by the Institute for Architecture, Urbanism and Spatial Planning of the Architecture Faculty in Sarajevo.
- Urban Plan for City of Konjic
- Regulation Plan «Centar»
- Regulation Plan «Stari grad» (Old City)
- Regulation Plan «Lijeva obala» (Left Riverside)
- Regulation Plan «Boračko jezero» (Boracko Lake)
- Spatial Plan of the particular area for construction of hydroelectric power plant Konjic (planned).

<u>Studies made for Konjic municipality:</u>

- Food production development in the area of Konjic municipality (Year 1992)
- Economic development strategy of Konjic municipality, (Year 1996)
- Economic development strategy of Konjic municipality– water as basic factor of municipal development (Year 2001)
- Program of Economic-social development of Herzegovina-Neretva Canton (Year 2002)

- Regional Strategy of Economic Development (Year 2004) EU RED.
- Urban plan for Jablanica for the period 1988-2010, made by the Institution for Urbanism B&H, Sarajevo
- Regulation plans for narrow city area

Studies made for Jablanica municipality:

- Strategy for Agriculture Development, year 2003,
- Strategy for Tourism Development as a base for development..
- Traffic intensity at the network of main and regional roads of Herzegovina-Neretva Canton in the year 2003 (Ministry of Traffic and Communications).
- Spatial plan for the city of Sarajevo for the period from 1986 to 2000 and to 2015 (the part related to Hadžići)
- Spatial plan for the city of Sarajevo for the urban area of Hadžići for the period from 1986 to 2000 and to 2015.
- Urban plan of Tarčin.
- Spatial plan of Mostar municipality until the year of 2000- created in 1982 by the Institution for Spatial Arrangement Mostar
- Urban plan of the North Valley of Mostar for the period from 1985 to 2015, made in April of 1990.
- Spatial plan of Mostar municipality (year of 2000)-Separat o saobraćaju, made in 1987.

From the above-mentioned documentation, data for the following fields have been extracted: population, land use, infrastructure, natural monuments, monuments of culture and social activities (schooling, health care, culture, religious activities etc.) The mentioned data have been presented in a draft maps and will be submitted in the frame of the project about environmental impact.

Maps

The Consultant has obtained the following maps:

- "Spatial Plans of Konjic municipality, Jablanica municipality and Prozor municipality, analytic-documentation basis", Institute for Architecture, City Planning and Spatial Planning of the Architecture Faculty in Sarajevo, July 1985.
- "Draft Spatial Plan of Bosnia and Herzegovina for the period from 1981 to 2000", Socialistic Republic of Bosnia and Herzegovina, Executive Council of the Bosnia and Herzegovina Assembly, Sarajevo, January 23, 1982
- SPATIAL PLAN OF BOSNIA AND HERZEGOVINA 1981-2000; Scale 1:1,000,000
  - Hypsometric Scale
  - Geology
  - Agriculture Land Indemnity
  - Distribution of Industry
  - Mineral Resources and Appearances of Mineral, Thermal and Thermo-mineral waters
  - Tourism and Recreation
  - Forestry
  - Road and Railway Traffic
  - Telecommunications, PTT and Radio-television Communication
  - Traffic Infrastructure
  - Energy Infrastructure
  - Spatial Planning Projections

- Land Use
- Infrastructure System
- Natural and Culture-historical Values
- Water Management and Energetics
- Map of Historical Values and Natural Beauties (scale 1:200,000)

5.2 Social impacts (population and settlements)

5.2.1 Impacts during construction period

The investigation on the socio-economic status along the motorway shows that direct impact on population is a critical issue related to indirect impacts on residential areas as noise, impacts on landscape, historical and archaeological sites, and impacts on air quality which are described in the other chapters.

The further analysis of impacts on the socio-economic environment during the construction period presented here below included the on-site analysis and the consultation of literature, statistical data and other reports and documentation. The potential impacts of the road project on the socio-economic environment during construction period have been identified and analysed regarding: *Type of impact (positive or negative); nature of impact (direct of indirect); magnitude and significance (low, medium, high etc.), extend/location of impact.*

The indicators that have been evaluated for the construction period are:

1. Population and settlements:
   - *Impact on settlement development prospects*
   - *Population directly affected by construction works*
   - *Resettlement/ displacement of people*
2. Social structure and cultural values
   - *Social disturbance*
3. Property values
   - *Removal of houses and other buildings*
   - *Loss of agricultural land*
4. Safety
   - *Accidents due to construction works/machinery*
5. Economic Development

In detail, the following impacts during the construction period have been identified:

Population and settlements:

- Impact on settlement development prospects: Settlements or construction land in the corridor of Alternative 3 being crossed /passed by the motorway without having an intersection will be affected by interruption of traditional settlement structure, including interruption of social cohesion. The location of the intersections will influence settlement development characteristics due to possible extension of settlement elements along access roads to the motorway. Intersections of Alt3 will be at Konjic and Jablanica. The impact is a long-term impact and requires mitigation measures regarding adoption of the urban plans of the affected municipalities

- Population directly affected by construction works: Population in the area of direct impact will be affected by the construction works regarding noise and air pollution and dust caused by the construction works (see also noise and atmospheric environment). Furthermore, disturbances will be related to construction camps in the vicinity of settlements and traffic congestion. Population will be directly affected by the construction of the new motorway in the following sections:

Table 48 Population / Settlements affected by construction works

FROM km	TO km	LENGTH (km)	NAME OF SETTLEMENT / VILLAGE PASSED
0+000	1+825	1.83	**Tarčin:** Do, Smunica, Vrbanja
2+750	6+000	3.25	**Raštelica, Vukovići,** Džanići
7+250	9+325	2.08	**Ivan Sedlo Area: Bradina,** Gornja Bradina, Polje, Gradac,
12+375	23+825	11.45	**Podorašac (km 12.3-15):** Ribići (km 13.5), Vrbljani (km 14.5), Podkanjina (km 15.5), Kanjina (km 16), Borovac (km 16.5), Živašnica, Ovčari (km 17.5-18.5), **Donje Selo Area (up to bridge over Lake Jablanica):** Repovica (km 19), Galjevo (km 18), Čovici (km 18.5), Jurići (km 20), Gredina (km 19.3), Cerići, **Pokojište**
24+075	31+250	7.18	**Čelebići (km 24.07):** Matići, Ušanovici, Seljani (km 26.75), **Ostrožac (km 31):** Zakaljača (km 28), Vode (km 28.5), Ribići (km 28.75, Ćosići (km 29), Osište (km 30), Jasike (km 29.8)
32+175	34+500	2.33	**Jablanica:** Dobrigošće, Donje Paprasko, Gornje Paprasko, Donja Jablanica
39+000	42+625	3.63	**Djevor:** Glogošnica, Šanica,
50+375	52+750	2.38	Bijela
53+125	53+750	0.63	Grabovica
54+500	60+000	5.50	**Mostar North Area:** Lajpur, Zeleni Dol, Bresnica, Vala, Lijeska, Makanovina

The impact will be related to the construction period (short-term) and will require mitigation.

- Resettlement/ displacement of people due to construction of the motorway: The construction of the motorway will require expropriation and in some areas resettlement of people. The sections of the motorway passing directly through settlements have been identified and the areas probably being subject to resettlement activities are listed below. The impact is a long-term impact and requires mitigation.

Table 49 Area possibly subject to resettlement

From km	To km	Name of Settlement / Village
0+800	1+100	Tarčin - Smunica
4+100	4+375	Džanići (Raštelica)
8+000	8+375	Bradina
13+375	13+65	Ribići
14+000	14+300	Vrbljani
14+450	14+625	Podorašac
16+250	16+625	Borovac
18+300	23+825	Donje Selo Area: - Repovica, - Gradina, - Cerići
24+075	26+750	Čelebici, - Ušanovići, - Seljani,
27+400	28+125	Zakaljača
28+825	29+175	Ćosići, Ribići
29+875	30+550	Ostrožac
33+000	33+350	Dobrigošće
39+375	39+875	Glogošnica
53+125	53+750	Grabovica
58+375	58+625	Makanovina

Social structure and cultural values

- Social disturbance: The construction of the motorway will require *construction camps* and most of the crew are likely to live in temporary facilities. Camps can harm local social system in various ways e.g. the camps can promote undesirable behaviours. Although local labour is expected to be used where available, the project contractors are likely to employ semi-skilled and skilled workers from outside the area and a number of 150-200 workers, are not uncommon. The arrival of 150-250 workers, mainly men, to the camps can have severe impacts to the local community. In general the camps are well accepted due to employment opportunities also for local people. The possibility of ethnic conflicts is small, however, occasional and personal conflicts will be expected due to many reasons, often due to drinking. The more cash availability among migrant workers might cause personal conflicts. If careful planning, liaison and other mitigation measures are undertaken, social problems concerning conflicts between workers and local communities will be minimal.

Indirect disturbances during construction works are likely in not directly through-passed settlements too. These impacts are related to traffic congestion during the construction period in locations of interchanges/overpasses or crossings with the existing road. Mitigation measures as traffic management or other measures should be implemented to minimise this impact. Locations of intersections/overpasses likely to be affected are: Intersections at Konjic and Jablanica, crossings of existing road at the stations: km 1+800, 4+225, 8+175, 9+425, 23+750-24+050 (bridge over Lake Jablanica), 25+375-26+125.

Property values

- Removal of houses and other buildings: The construction of the motorway will require expropriation and in some areas houses will have to be removed. The sections of the motorway passing directly through settlements have been identified and correspondingly the areas probably being subject to expropriation. Removal of houses and buildings is likely in the settlement areas listed below. The impact is a long-term impact and requires mitigation and a detailed analysis of expropriation requirements has to be conducted according to the related legislation.

Table 50 Areas probably being subject to expropriation

From km	To km	Name of Settlement / Village
0+800	1+100	Tarčin - Smunica
4+100	4+375	Džanici (Raštelica)
8+000	8+375	Bradina
13+375	13+65	Ribići
14+000	14+300	Vrbljani
14+450	14+625	Podorašac
16+250	16+625	Borovac
18+300	23+825	Donje Selo Area: - Repovica, - Gradina, - Cerići
24+075	26+750	Čelebici, - Ušanovici, - Seljani,
27+400	28+125	Zakaljača
28+825	29+175	Ćosici, Ribići
29+875	30+550	Ostrožac
33+000	33+350	Dobrigošće
39+375	39+875	Glogošnica
53+125	53+750	Grabovici
58+375	58+625	Makanovina

According to the Consultant's estimations, land acquisition and compensation consider also the removal of houses and other buildings. Estimation of compensation and quantity of houses to be removed for Alternative 3 is as follows:

Table 51

LAND ACQUISITION AND COMPENSATION		
	Unit	Quantity

Buildings	pcs	42
Buildings, loose material	pcs	30

- Loss of agricultural land: Due to completely new construction of the motorway there will be an impact on agricultural land properties. The impact on agricultural land is high and has to be considered for the whole Motorway section. The impact is a long-term impact and requires mitigation and a detailed analysis of expropriation needs has to be conducted according to related legislation.

  The construction of the road will cause loss of agricultural land where the motorway alignment is planned. Loss of land here will be permanent and mitigation measures are required. Agricultural land affected by the Project has been identified as follows:

Table 52 Agricultural area affected

From km	To km	Length (km)	Category I	Category II or III
0+000	2+500	2.50	-	x
3+750	+000	1.25	-	x
5+075	5+325	0.25	-	x
9+750	10+500	0.75	-	x
+000	8+000	1.00	-	x
10+400	11+750	1.35	-	x
12+875	14+300	1.43	-	x
16+250	16+625	0.38	-	x
17+375	17+750	0.38	-	x
18+375	23+825	5.45	-	x
24+075	26+750	2.68	-	x
27+400	31+250	3.85	-	x
31+875	33+40	1.53	-	x
35+500	36+50	1.00	-	x
36+750	39+000	2.25	-	x
39+375	39+875	0.50	-	x
40+500	42+500	26.53	-	x
45+700	46+375	50.55	-	x
48+625	50+825	99.85	-	x
53+125	53+750	199.45	-	x
55+000	56+000	398.15	-	x

Furthermore, the motorway will interrupt present structures and access roads to these areas. The access to agricultural land for owners should be guaranteed by the provision of local access roads and accordingly mitigation measures are required.

According to the Consultant's estimations, total loss of land due to construction of the motorway has been determined as follows for Alternative 3:

Table 53 Total loss of land

Land Location	Quantity (ha)
Land in mountain zone	70.00
Land in rural zone	60.00
Land in urban non-inhabited zone	15.00
Land in urban inhabited zone	4.00

There will be also temporary losses of agricultural land during construction due to access roads to the construction site, construction camps, storage sites, asphalt plants etc. Site locations have not yet been identified, however proper planning should be done in advance and compensation should be paid and based on the value of the lost crop for one or two years, depending on the time the area is used.

Safety

- Accidents due to construction works/machinery: Road construction works will cause accidents due to construction traffic and machinery used during works. Furthermore, drivers on local roads interfering with the motorway under construction are more vulnerable to road accidents and congestion and mitigation measures are required.

Economic development

- During the construction phase, the Motorway will have a positive effect on the economic development in the area due to the creation of job short-term opportunities related to construction works. Construction works will bring people into the area for a relatively long period. Local suppliers can profit from the influx of workers on the site and income-generating activities will be developed, which could remain also after completion of works. Mitigation measures regarding contract obligations could support and facilitate the positive nature of the impact.

5.2.2 Impacts during operation period

The analysis of impacts on the socio-cultural environment included the on-site analysis and the consultation of literature, statistical data and other reports and documentation. The potential impacts on the socio-economic environment during operation of the motorway have been identified and analysed regarding: *Type of impact (positive or negative); nature of impact (direct of indirect); magnitude and significance (low, medium, high etc), extend/location of impact*

The indicators, which have been evaluated for the operation period, are:

1. Population and settlements:
   - *Population directly affected by motorway operation*

2 Social structure and cultural values
   - *Social disturbance*
   - *Impacts on cultural heritage sites*

3. Access to social services
   - *Improved access to education facilities, health facilities, transport, urban centres*

4. Safety
   - *Reduction of accidents due to upgrading of road and improved design*
   - *Increasing accidents due to increasing motorisation and travel speed*

5. Economic Development

In detail, the following impacts during operation period have been identified:

Population and settlements:
Population directly affected by motorway operation: Population will be directly affected by operation of the new Motorway due to noise and air pollution as described in the previous chapters *5.6 Impacts on atmospheric environment* and *5.14 Impacts on noise environment.* The impact will require mitigation measures in order to minimise disturbance and impacts on health of the population living in the vicinity of the road.

Social structure and cultural values

Social disturbance: The realisation and operation of the motorway will have a direct impact regarding social disturbance in case of through-passed settled areas. Traditional settlement systems and settlement functions as well as communication between inhabitants will be disturbed and interrupted. This impact is a long-term impact and requires mitigation. The affected settlements correspond to the settlements listed in Paragraph *5.2.1 "Population / Settlements affected by construction works"*.

Impacts on cultural heritage sites: During the road operation, the road will not degrade the cultural resources as most monuments and important sites areas located off the road and will not be affected by operation of the motorway. Nevertheless, a positive impact is the decrease of bypassing traffic on the existing road, diminishing possible negative impacts due to air pollution. On the other hand, sites could be easier accessible and better recognised due to better transport infrastructure.

Access to social services

Improved access to education facilities, health facilities, transport, and urban centres: Road improvements can greatly affect accessibility to facilities and services as roads provide a crucial link between physical resources and users in rural and suburban centres. The project road is important for providing possibilities of improved transport on local and regional level. However, as this is a motorway, improvement of local access will be limited. It can be said that the motorway improves the access to education or health facilities located at Sarajevo or Mostar, but improvement will only be for those people who can afford a car or public passenger transport.

Safety

Reduction of accidents due to upgrading of road & improved design / Increasing accidents due to increasing motorisation and travel speed: The realisation of the motorway will bring reduction of accidents due to improvement of design, pavement and signalling, and due to avoiding the dense settled areas and difficult terrains of the existing alignment. On the other hand, the project will contribute to the increase of accidents due to higher travel speed and increasing motorisation. During the road operation, accidents are caused by various means: over speeding, careless/negligence, improper overtaking, mechanical defects, road obstructions, driver inexperience, passenger disruptions, and other. Traffic accidents on the motorway in the future are likely to be more a function of traffic volume, rather than condition of improved road.

During its operation, the new road can improve traffic safety overall, but emergency response and service capabilities need to be developed. Traffic related safety difficulties due to operation of the road are expected to be significant at intersections. Mitigation measures to improve overall safety and emergency response are required

Economic development

The new motorway in general will have a positive effect on the economic development in the area due to:

- Creation of job opportunities related to maintenance / management works in the operational phase;
- Creation of income opportunities during operation of the motorway due to the development of related economic activities along the motorway, especially in the area of intersections;
- Improvement of the connection between the major economic centres Sarajevo and Mostar.

The alternative is passing through an area with potential for development related to tourism and related services, development of industry, or the development of forest industry due to the presence of large economic forest areas. The motorway can support various economic development possibilities, as for example the development/revitalisation of unused industrial areas. The better transport connection can attract new investments and can support the sustainable development of urban areas. Due to positive nature of impacts, no mitigation measures are required.

5.3 Impact on micro-climate

5.3.1 During construction period

Obviously, during the motorway construction that usually lasts over longer time period local and occasional microclimate modification will occur, as a result of higher dust concentration. This is particularly related to construction of bigger structures (bridges and tunnels), however, without any permanent consequences.

5.3.2 During operation period

After the motorway construction is finished, in any case, certain changes will take place as a result of the new-built structures: embankments, cuts, bridges and tunnels, as well as of possible deforestation. This is primarily related to air circulation, changed temperatures due to enlarged pavement surfaces, as well as to increased air pollution resulting from a traffic density. However, these changes are of a local character and microclimate can not be a consequence of them.

5.4 Impact on geological environment

During the field research (core drilling and geophysics) there were found the zones of geologically unfavourable characteristics for foundation of specific structures. One of these sections is the section in the village Džanići-borehole S-03. On this borehole, in the interval from 15.3 to 18.0m, the drilling tool has dropped due to cavern and mud occurrence. These findings caused the alignment dislocation. Apart that, it is necessary to mention the landslides, which in relation to the alignment length have a small spread. Most of the landslides are in a wider area of Donje Selo, in polifacial Neogene complex.

Majority of these occurrences is characterised as dormant landslides. Based on this fact, active and potential endangerment in the motorway construction phase has been defined. In the case of linear structures, depending on the alignment position, the dormant landslides should be treated as unstable areas.

Talus is widely spread and was formed at the steep slopes. Talus – colluvium, in respect of stability under natural conditions are in status of limitation balance. Therefore, cutting and loading of such terrains can cause instability occurrences, especially in the river Bijela canyon.

In carbonate rocks that are more tectonically damaged and cavernous, e.g. in fault zones, possible are occasional short-lasting penetrations of significant quantities of underground water in the tunnels. It happens in a certain hydro-geological periods, with estimated quantity of 10-100l/sec, but generally underground water level is lower than the motorway grade line.

5.5 Impact on waters

5.5.1 During construction period

Opening of the big construction sites always has some negative environmental impacts. Certainly, Contractor must comply with all technical regulations, especially in respect to the water. Fundamental requirement is to avoid endangerment of underground and surface water quality which would have permanent consequences to water supply systems, as well as to flora and fauna of open watercourses.

Also, it must be taken care of the excavated material in order not to endanger a flow profile of the open water courses. Similarly, during the bridge construction, strict attention must be paid to both temporary and permanent protection of the open watercourses.

5.5.2 During operation period

During the motorway operation period, adequate measures for pollution prevention of both surface and underground waters are the primary task. Technical solution must provide precipitation water treatment (which are polluted by heavy oils and lead and washed of the pavement) so it wouldn't contaminate natural water streams.

The traffic's influence over time on the flowing water quality in the area is considered to be small, thus an improvement in water quality is not to be expected as a result of improved traffic conditions and infrastructure design, as long as the other pollution sources are not eliminated or minimized. In the horizons of deeper aquifers, the motorway construction does not represent a factor of risk in respect of pollution.

In this situation, important danger for underground waters is related to a qualitative modification induced by pollutant substances which change physical, chemical and biological quality of water. The more significant contamination may appear in presence of pollutants in the waters that runs on the road surfaces and in case of accidents or failures in the freight transport and transport of special liquid products. In fact, the potential polluting substances, if not handled and disposed of properly and if discharged directly into the watercourses, will modify their water quality class.

<u>*Existing and Potential Water Polluting Sources*</u>

The main sources of water pollution during the operation phase of the project are the followings:

- direct deposition on the water surface of the pollutants generated by the vehicles;
- the discharge of untreated water in the surface streams; in this case waste water are considered to be the waters, coming from the roads surface, as for example the rain water that washes the roads off and flowing into the river bed;
- discharge of polluted water or chemical compounds generated due to the traffic accidents of tank cars that transport dangerous substances on this road.

The main pollution of surface water bodies as a result of the operation of this road occurs in the raining period by washing of the solid particles and others soluble compounds temporarily settled on the road.

The pollutants transported by rainwater are than drained into the canals/trenches along the roads and than discharged into the neutral waters, respectively in the surface water crossed by the roads.

The flow rate and the nature of the pollutant substances that come from the traffic accidents, potential pollutants for surface water bodies and groundwater cannot be easy calculated. For accidents events the main, and in some cases the alone measure to minimise the risk for water pollution, consists in the rapidity of measures taken in order to limit the spread and in order to collect the leaking pollutant.

Storm water collected along the road is the main polluting source. During rain season, especially during heavy rain, the road surface and the slope road fills collect water, which is then taken in by the ditches and trenches along the road route.

The problems that may arise when the "first rain" (heavy rain, after a longer period of time) sets in relation to water washing off the road surface with polluting substances, such as: non-combusted fuel residues, resulted from exhaust gases, residues resulted from tyre wear (especially on powerful braking), metallic residues resulted from vehicle wear, oil and mineral grease leakage, residues resulted from carriageway wear. In winter time there can also be substances used for glaze removal: the entire range of solid or liquid products drained onto the road during accidents.

5.6 Impact on air quality

5.6.1 Introduction

The goal of this chapter is to analyse the impacts on atmospheric environment during operation period of the project "Corridor Vc Motorway" Lot 3 - Section Sarajevo South (Tarčin) - Mostar North by computation of theoretical data about the main air pollution.

5.6.2 Description of air pollutants and their effects on humans and on environment

The goal of this section is to describe the origin of air pollution and to define the impacts on humans, animals and plants describing the effects of each air pollution components.

5.6.2.1 Main air pollutants

The combustion of gasoline and other hydrocarbon fuels in vehicles produces several primary pollutants. Relevant air pollutants emitted from engines are:

- Carbon monoxide (CO);
- Carbon dioxide (CO_2);
- Sulphur dioxide (SO_2);
- Nitrogen oxides (NO_x): nitrogen oxide (NO), nitrogen dioxide (NO_2);
- Lead (Pb) (if leaded fuel is used);
- Diesel soot (black carbon);
- Particulate matter (including black carbon and abrasion of wheel rubber and dispersion of particles from the road surface);
- Benzene

The amount of vehicle pollutant emissions depends on a variety of factors like:

Single vehicle:
- Type and power of engine;
- Type and composition of fuel;
- Efficiency of combustion;
- Presence of emission control equipment (eg. catalyser);

- Actual speed of the vehicle.

Overall traffic:
- Traffic flow (number of vehicles per hour or day);
- Composition of vehicle types (e.g. abundance of trucks, average age and actual performance of engine types);
- Traffic flow characteristics on a specific road section (average speed, free flow, or traffic jam);
- Road characteristics (i.e. incline).

In the presence of sunlight, nitrogen oxides combine with hydrocarbons to form a secondary class of pollutants, the photochemical oxidants, among them ozone and the eye-stinging peroxyacetylnitrate (PAN). Nitrogen oxides also react with oxygen in the air to form nitrogen dioxide, a foul-smelling brown gas.

5.6.2.2 Impacts of air pollution on humans, animals and plants

Carbon monoxide
Carbon monoxide (CO) is a toxic gas, which is emitted into the atmosphere as a result of combustion processes. It is also formed by the oxidation of hydrocarbons and other organic compounds. In European urban areas 90% of carbon monoxide is produced from road traffic emissions. Carbon monoxide survives in the atmosphere for a period of one month before it is eventually oxidised to carbon dioxide.

Carbon monoxide impacts on humans by linking with haemoglobin and then limiting oxygen transportation through the body. Negative impacts of carbon monoxide (CO) can occur even at relatively low concentration.

The poisoning by CO causes disorder in balance, problems with eyes, weakening of concentration, problems with breathing and headaches.

A concentration of CO in haemoglobin up to 2% can be considered insignificant while a concentration bigger than 2.5% is estimated as a critical value.

The impact of CO on plants is not really significant.

Carbon dioxide
Carbon dioxide (CO2) is a greenhouse gases and affects the global climate since CO2 contributes to the greenhouse effect.

The greenhouse effect is a warming of the Earth's surface and lower atmosphere that tends to intensify with an increase in atmospheric carbon dioxide.

The atmosphere allows a large percentage of the rays of visible light from the Sun to reach the Earth's surface and heat it.

A part of this energy is reradiated by the Earth's surface in the form of long-wave infrared radiation, much of which molecules of carbon dioxide and water vapour in the atmosphere absorb and which is reflected back to the surface as heat. This is roughly analogous to the effect produced by the glass panes of a greenhouse, which transmit sunlight in the visible range but hold in heat.

The trapping of this infrared radiation causes the Earth's surface and lower atmospheric layers to warm to a higher temperature than would otherwise be the case. Without this greenhouse heating, the Earth's average temperature would be only about -73 C (-100 F); even the oceans would be frozen under such conditions.

Alternatively, a "runaway" greenhouse effect like that found on the planet Venus would result in surface temperatures as high as 500 C (932 F). Owing to the rise in atmospheric carbon dioxide caused by modern industrial societies' widespread combustion of fossil fuels (coal, oil, and natural gas), the greenhouse effect on Earth may be intensified and long-term climatic changes may result.

Nitrogen oxides

The oxides of nitrogen- Nitrogen oxide and Nitrogen dioxide are collectively known as NOx.

They are formed during high temperature combustion processes from the oxidation of nitrogen in the air or fuel. The principal source of NOx is road traffic, which is responsible for half the emissions in Europe. Nitrogen oxide and nitrogen dioxide concentrations are therefore greatest in urban populations where traffic is heaviest.

Other important sources are power stations, heating plants and industrial processes.

Impact of nitrogen monoxide on humans is similar as the impact of carbon monoxide; when oxygen is being pushed out from the blood system that endangers the supply to organic tissue. Large concentration of nitrogen monoxide in blood causes death. Nevertheless, nitrogen monoxide (NO) in air is barely damaging while concentrated quantities of nitrogen dioxide (NO_2) are toxic and cause breathing problems.

Indeed, nitrogen dioxide is considered the more toxic of the nitrogen compounds. Nitric and nitrous acids are formed on the moist surfaces of the airways. Lipid peroxidation takes place on the cell membranes and many structural and functional molecules are damaged by free radicals. Particularly strong free radicals are formed when nitrogen dioxide oxidises lecithin in cell membranes.

The health effects of Nitrogen dioxide differ between healthy individuals and those with existing lung disease. Exposure to 1.5-5 ppm Nitrogen dioxide causes bronchoconstriction.

Hydrocarbons

Fuel combustion in car engine produces numerous hydrocarbons including paraffin, naphthenes, olefins, and aromatic hydrocarbons. The major concern is due to the emission of polycyclic aromatic hydrocarbons that cause cancer. The impact of hydrocarbons on plants is quite complex. High concentration of hydrocarbons can cause necroses of flowers and leaves.

Sulphur dioxide

Road traffic contributes only in small quantity to the air pollution by sulphur dioxide. The most common sources of sulphur dioxide include fossil fuel combustion, smelting, manufacture of sulphuric acid, conversion of wood pulp to paper, incineration of refuse and production of elemental sulphur.

Coal burning is the single largest man-made source of sulphur dioxide accounting for about 50% of annual global emissions, with oil burning accounting for a further 25-30%.

It reacts on the surface of a variety of airborne solid particles, is soluble in water and can be oxidised within airborne water droplets. On contact with water vapour or water bound to particulate pollutants, sulphurous acid is formed that rapidly dissociates to give acidic solutions. Sulphur dioxide pollution is considered more harmful (DANNOSO) when particulate and other pollutant concentrations are high. This is known as the "cocktail effect."

Sulphur dioxide is absorbed by water vapour in the airways and by the mucus and epithelial fluid in the bronchial walls forming sulphuric acids and bisulphates. This results in bronchoconstriction.

Symptoms of SO_2 exposure are bronchoconstriction, dyspnoea, nose and throat irritation.

Impact of sulphur dioxide on plants is significant. It causes damages to chlorophylls as well as some tissues. Some kinds of conifer forests are extremely sensitive to sulphur dioxide and cannot bear concentration higher than 0.05mg/m^3. This polluter has the biggest impact on structure objects.

Sulphur dioxide associated with moister reacts as sulphur acid and can then destroy organic materials or damage cultural/historical assets.

Lead and its compounds
Particulate lead in the air results from activities such as fossil fuel combustion, metal processing industries and waste incineration. Its single largest industrial use worldwide is in the manufacture of batteries.

Studies related to this issue indicate that human take important quantity of lead and its compounds through food, water and air. Permanent exposure causes chronic poisoning and lost of appetite, stomach problems, tiredness, dizziness, kidney problems and unconsciousness.

The quantity of toxins directly provoked by lead affecting to vegetation is small. Concentration of lead in plants is in high correlation with contents of lead in soil.

Particulate Matter
Particulate Matter is the general term for a mixture of solid particles and liquid droplets found in the air. Their chemical and physical compositions vary, depending on the location, time of year and weather. The particles have a wide range of diameters.

- Those with diameters less than 2.5 micrometers are FINE PARTICLES PM 2.5. They are emitted due to the fuel combustion
- Those with diameters less than 10 micrometers are COURSE PARTICLES PM 10. They are emitted from sources such as vehicles on unpaved roads, material handling and crushing and grinding operations.

The particles are of major concern as they are small enough to penetrate deep into the lungs where they can cause inflammation and the worsening condition of those with pre-existing heart and lung conditions. It is thought that the particles can easily find their way from the lungs into the bloodstream and then lead to systemic inflammatory changes that may affect blood coagulation. They may also carry surface absorbed carcinogenic compounds into the lungs. Therefore they potentially pose significant health risks. Small rises in concentration of particles in the air are associated with epidemiologically measurable increases in death rates and hospitalisations for heart and lung conditions in urban populations of more than one million people.

5.6.3 Description of methodology

The goal of this section is to describe the methodology used for analyse the impact of proposed motorway project; section Sarajevo South (Tarčin) – Mostar North, on atmospheric environment.

5.6.3.1 Domain

The area interested to the new road is characterized by mountainous orography, scarcely populated. In fact, there are only few buildings in the neighbourhood of the project. They are present mainly in tree points:

- In proximity to place-name Smucka (from km 0+950 to km 1+150);
- In proximity to Jablaničko Jezero (from km 21+150 to km 22+150);

- In proximity to km 24+700

Some infrastructures are already present in these zones, in particular the existing road from Sarajevo to Konjic and the railway.

Moreover, the proposed motorway is located in a predicted National Park area characterized by forest and agricultural zones.
The new road is 60.4km-long and tunnels represent app. 64% of total length.

5.6.3.2 Emission sources

The emission sources of the proposed motorway project are represented by vehicles that will use the new road (section Sarajevo South (Tarčin) – Mostar North).

Information about the number of vehicles comes from the Traffic Study of the Lot 6 Sarajevo south (Tarčin) - South Border - Corridor V, done by the Civil Engineering Institute of Zagreb in September 2005. That information is about the Average Daily Traffic ADT along the present M17 alignment (2004) and along the M17 alignment in future (2013) in case of no intervention and with intervention, as well as along the proposed alternative alignment (2013).

The data are synthetically reported in the Table 54.

Table 54 Number of vehicles expressed in Average Daily Traffic (from the Traffic Study of the Lot 6 Sarajevo south (Tarčin) – South Border - Corridor V).

ADT (Average Daily Traffic)							
From	**To**	**2004**	**2013 without intervention hard scenario**	**2013 with intervention hard scenario**		**Length (km)**	
		M 17	**M 17**	**M 17**	**New road**	**M 17**	**New road**
Tarčin	Konjic	7,122	10,528	2,692	10,000	20	17
Konjic	Ostrožac	6,343	10,180	2,376	10,048	13	11
Ostrožac	Jablanica	6,953	10,706	2,902	10,048	8	5.5
Jablanica	P. Jablanica	6,003	10,002	4,796	10,048	3.5	2.5
P. Jablanica	Potoci	6,003	10,002	568	11,456	24	21.6

5.6.3.3 Estimate of emission

The analysis of emission caused by vehicles has been elaborated on base of the next medium daily traffic using a model for the estimation of air pollution emissions related to road traffic developed by STP s.r.l.

For computation have been used the following data input:

Table 55 Data input used for computation.

Scenario	**Length (km)**	**AADT**	**Flow A>B (vehic/day)**	**Flow B>A (vehic/day)**	**Flow A>B (vehic/h)**	**Flow B>A (vehic/h)**	**Speed A>B (km/h)**	**Speed A>B (km/h)**
M 17 in 2004	68.5	6,505	3,253	3,253	136	136	45	45
M 17 in 2013 without new road	68.5	10,272	5,136	5,136	214	214	45	45
M 17 in2013 with new road	68.5	2,020	1,010	1,010	42	42	45	45

New road in 2013	57.6	10,562	5,281	5,281	220	220	100	100

Fleet of vehicles setting (default data):

- Fuel 65%
- Green fuel 15%
- Diesel 18%
- GPL 2%

5.6.4 Results

The Table 56 shows the emission factors of CO, COV, PM10, CO_2 and NO_x for one kilometre in g/hour for the four different scenarios: M 17 in 2004, M 17 in 2013 without new road, M 17 in 2013 with new road, New road in 2013.

The results of computation[7] are schematically represented in the following tables:

Table 56 Emission factors of CO, COV, PM10, CO2 and NOx for one kilometre in g/km/h.

Scenario	Flow A>B (vehic/h)	Flow B>A (vehic/h)	Emissions (g/km/h)				
			CO	COV	PM10	CO2	NOx
M 17 in 2004	136	136	1,615	257	7	4,3102	435
M 17 in 2013 without new road	214	214	2,550	406	10	6,8062	686
M 17 in2013 with new road	42	42	501	80	2	13,385	135
New road in 2013	220	220	1,582	216	11	73,465	1123

Similarly, the Table 57 shows the emission factors of CO, COV, PM10, CO_2 and NO_x in g/h for total length of the two roads during four different scenarios: M 17 in 2004, M 17 in 2013 without new road, M 17 in 2013 with new road, New road in 2013.

Table 57 Emission factors of CO, COV, PM10, CO_2 and NO_x for the total length in g/h.

Scenario	Flow A>B (vehic/h)	Flow B>A (vehic/h)	Emissions (g/h)				
			CO	COV	PM10	CO_2	NOx
M 17 in 2004	136	136	110,604	17,596	449	2,952,493	29,765
M 17 in 2013 without new road	214	214	174,654	27,786	709	4,662,261	47,002
M 17 in2013 with new road	42	42	34,346	5,464	139	916,839	9,243
New road in 2013	220	220	91,106	12,427	623	4,231,590	64,657

As said in Chapter 8.0, there are no indicators for determination of the present status of air pollution; in fact, air quality has not been measured systematically for many years in Bosnia and Herzegovina.

For want of air quality measure, is possible to understand the theoretical data by comparison with Croatia's emission factors for road transport sector. This data are part of the ETC-ACC Air Emissions Spreadsheet for Indicators 2004 (emissions 1990-2002) of European Environment Agency.

For the comparison we consider two of the main air pollutant: Carbon monoxide (CO) and Nitrogen oxides (NO_x).

[7] Done by a specific SPT s.r.l. software elaboration

Table 58 Croatia's emission factors for road transport sector (from European Environment Agency).

Issue	Units	Name	2002	EEA_sector
NOx	mg	Croatia	33,780.0	Road Transport
CO	mg	Croatia	191,900.0	Road Transport

The computed annual emissions of CO and NOx for M 17 in 2004 are:

- for nitrogen oxides (NOx) is 260.7414mg/year, what is 0.77% of the total NOx production of Croatia's road transport sector;
- for Carbon monoxide (CO) is 968.891mg/year, what is 0.50% of the total CO production of Croatia's road transport sector;

This comparison shows that the calculated emission factors are very low values.

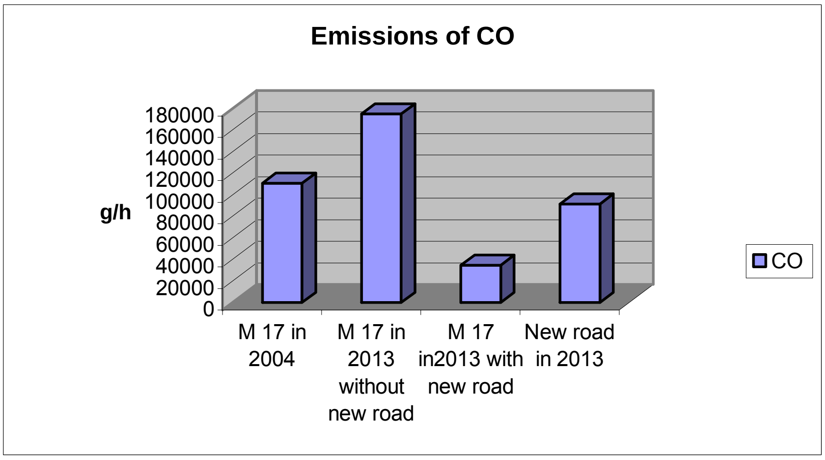
5.6.5 Conclusions

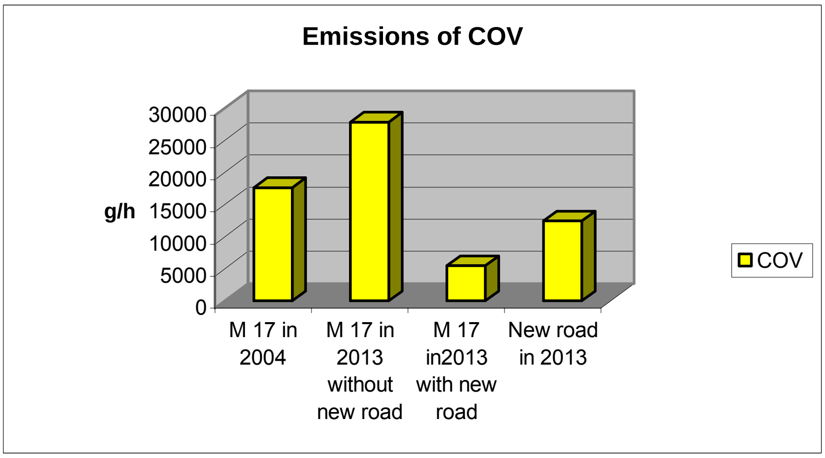
As showed in the following graphics, the proposed motorway will strongly reduce the air pollutant caused by traffic on M17. In fact, the emissions of M17 in 2013 with construction of new road will be like 30.95% of present emission for PM10 and like 31.05% for the other pollutant.

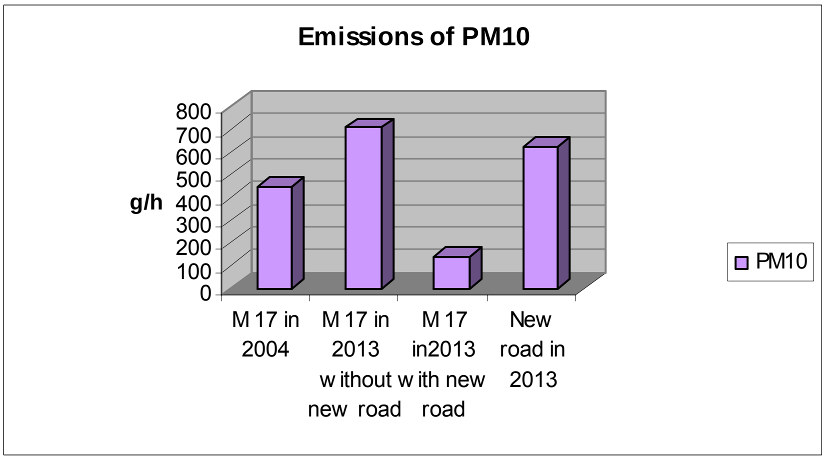
It represents a very important improvement for local population since M17 crosses the urban settlements and the villages actually affected.

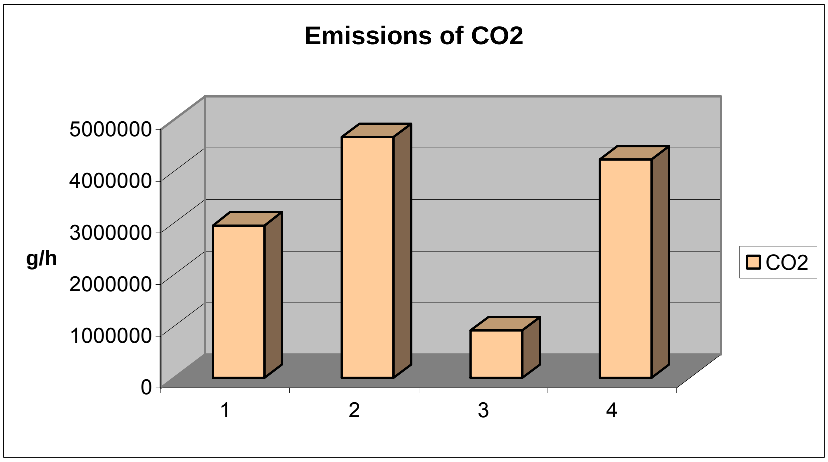
However, an increasing air pollution can be expected along the forest and agricultural areas crossed by the new road. The computed emissions for the new road are lower that the present emission of M17 for all pollutants except for NOx. The values are not so high to expect any remarkable impact on plants present in the predicted National Park area.

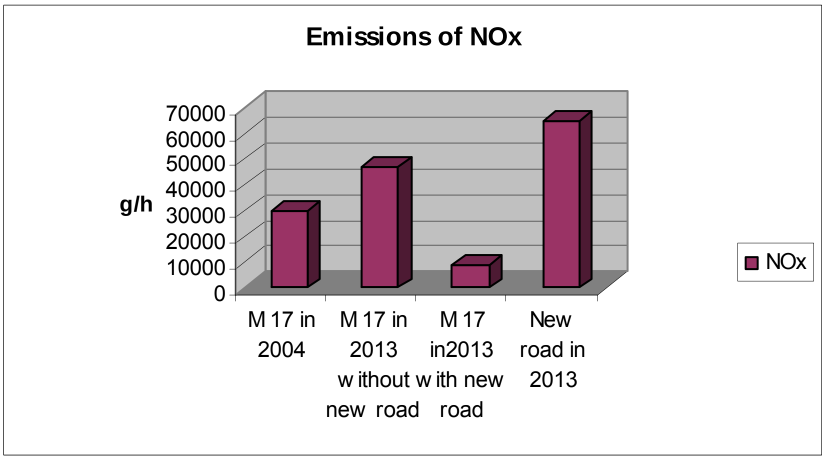
At the same time, by adopting the Law on air protection in Federation of B&H (Official Journal of FB&H, 33/03) and implementation regulations related to this Law, significant improvement can be expected in the system of air quality management. It is also expected that air pollutant emissions will be decreased in the coming period, as a result of engine technology development and decreased fuel consumption, optimised combustion and treatment of exhauster gases in catalytic converters. In addition to the mentioned, legal limitations will be changed, i.e. diesel will be forbidden as a fuel for motor vehicles from January 1, 2010 if the content of sulphur per weight is higher than 0.2%, and from January 1, 2015 if the sulphur content is higher than 0.1%. Lead emissions will decrease as a result of lead-free gasoline use, as prescribed by the Law on air protection. This law will forbid use of leaded gasoline from January 1, 2010.


Emissions of CO
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
g/h
M 17 in 2004
M 17 in 2013 without new road
M 17 in2013 with new road
New road in 2013
CO


Emissions of COV
30000
25000
20000
15000
10000
5000
0
g/h
M 17 in 2004
M 17 in 2013 without new road
M 17 in2013 with new road
New road in 2013
COV


Emissions of PM10
800
700
600
500
400
300
200
100
0
g/h
M 17 in 2004
M 17 in 2013 w ithout new road
M 17 in2013 w ith new road
New road in 2013
PM10





5.7 *Impact on soil and agricultural areas*

Soil generally belongs in category of the most important natural resources. Special importance and specificity of the soil as natural resource, in a modern analytical concept, is defined by its non-renewability or very hard and slow renewability. Because of such soil's importance, our analyses for the purpose of the Project are important from the following aspects: a) ecological, b) production, c) social and d) economic.

At the very beginning, we want to unreservedly stress, that the soils, serving to essential human purposes, will be subjected to certain negative impacts at some sections of the proposed Project alignment.

Negative impacts on soil will have two-stage character. Such staged negative impacts on soil will reflect as direct and indirect negative impacts.

Direct negative impacts will occur during construction of motorway structures and carriageway lines as planned by the Project.

The following positions have been defined as places of direct negative impacts:

- Section from 0+000.00 to 1+100.00 with reach of 50m to 300m in form of embankments on agricultural land of land use category II. Reach of permanent negative impact is conditioned by construction of entrance/exit at the "Tarčin" interchange.

- Section from 1+150.00 to 1+750.00 with reach of 80m in a form of notches and embankments on agricultural land of land use category II.

- Section from 3+000.00 to 3+200.00 with reach of 50m to 80m in a form of embankment on the land of land use category III.

- Section from 4+050.00 to 4+180.00 with reach of 50m, in a form of cuts on agricultural land of land use categories V and VI.

- Section from 4+420.00 to 4+610.00 with reach of 50m to 80m in a form of notches and embankments on agricultural land of land use categories V and VI. In this zone, acess roads for removal of the material excavated from the tunnel. Apart from the acces road construction, the land will be endangered by construction and operation of construction canmps. That could permanently damage the land in radius of 300m.

- Section from 7+650.00 to 8+350.00 with reach of 50m to 150m, containing notches and embankments, as well as the viaduct foundations. In a wider zone, radius of 300m to 500m, direct negative impacts will be generated by construction camps, disposal sited for excavated material, service areas and parking lots. Agricultural land in this zone belongs to the land use category IVb.

- Section from 10+450.00 to 10+750.00 with reach of 50m to 80m in a form of notches and embankments in a meadow agricultural land of land use categories V and VI.

- Section from 11+050.00 to 11+500.00 on the land of different use and different inclination, of land use categories V and VI.

- Section from 20+150.00 to 20+570.00 with reach of 50m to 80m in a form of bigger notches and embankments on steep mixed agricultural-forest land of land use category V and VI.

- Section from 20+600.00 to 20+850.00 with reach of 50m to 80m in a form of notches and embankments on steep mixed agricultural-forest land of land use category VI

- Section from 20+970.00 to 27+650.00 with reach of 50m to 80m in a form of bigger notches and embankments on agricultural land of the land use category V.

- Section from 21+700.00 to 22+000.00 with reach of 50m to 300m in a form of embankments and structures for Konjic interchange. The direct negative impact will take place on the land of land use category II.

- Section from 22+000.00 to 22+250.00 with reach of 50m to 80m in a form of notches on agricultural land of the land use category V.

- Section from 23+550.00 to 23+740.00 with reach of 50m to 80m in a form of notches and embankments on inclined agricultural land of land use category V.

- Section from 23+800.00 to 24+000.00 with reach of 50m to 80m in a form of smaller cuts and bigger embankments on agricultural land of land use category V.

- Section from 24+600.00 to 24+650.00; from 24+670.00 to 24+760.00; from 24+810.00 to 25+200.00 with reach of 50m to 100m in a form of notches and embankments on a mixed agricultural-forest land.

- Section from 25+370.00 to 25+460.00 with reach of 50m to 80m in a form of cuts on a mixed agricultural-forest land.

- Section from 27+540.00 to 27+700.00 with reach of 50m to 80m in a form of cuts on agricultural land of land use category VI.

- Section from 27+770.00 to 27+850.00 with reach of 50m to 80m in a form of cuts in mixed agricultural-forest land of land use category VI.

- Section from 28+550.00 to 28+630.00 with reach of 50m to 80m in a form of notches and embankments on the forest zone.

- Section from 29+200.00 to 29+350.00 with reach of 50m to 100m in a form of notches and embankments in agricultural land of land use category VII. In this area, in a radius of 300m, acess roads for machinery and supporing services for the tunnel construction will be located.

- Sections from 33+500.00 to 33+560.00; from 33+620.00 to 33+970.00 with reach of 50m to 80m in a form of notches in agricultural land of land use category VI.

- Sections from 34+070.00 to 34+200.00; from 34+260.00 to 34+560.00 reach of 50m to 80m in a form of notches and embankments in mixed agricultural-forest land of land use categories V and VII.

- Section from 37+790.00 to 37+910.00 with reach of 50m to 80m in a form of notches on agricultural land of land use category VI.

- Section from 38+650.00 to 40+000.00 with reach of 50m to 80m in a form of notches and embankments on agricultural land of land use categories III and IVb.

- Section from 57+400.00 to 59+750.00 with reach of 50m to 80m in a form of notches and embankments on agricultural land of land use category V.

Apart the impacts of the mentioned Project elements, direct negative impacts on the soil will be present in the areas where the following will be realised: disposal sites of excavated geological materials, construction material storage places, asphalt and concrete plants, service areas, construction camps, different technological plants and similar objects to be constructed for the purpose of the Project realisation. Direct negative impacts on the soil will take place in the motorway entrance and exit zones, since these are locations of wider spatial range and different structures to be realised under the ground and on the ground.

In addition to a negative impact, in continuity, the indirect negative impacts on the soil will take place in all distinguished agricultural land areas, along entire motorway alihnment of Lot3. Indirect negative impacts will be going on occasionally during construction and continously during the operation period of the motorway and its ancillary infrastructural and other structures. Negative indirect impacts, observed in a wider context, will be caused by existence of the motorway as a structure in space which will change communication systems during the operation period as well. These impacts on soil will be caused by contaminating factors (contaminants, pollutants) of different forms and intensities, which will have cumulative character and reach of 200m, that is significant, until the buffer soil characteristics are reached. After natural buffer soil characteristics are reached, long-term indirect negative impacts on soil assume a character of the indirect negative impacts. Due to the mentioned indirect negative impacts, it is very much important to analyse the defined locations of indirect negative impacts and width of zones with negative impacts on the soil.

Good quality and deep soils, at the sections from 0+000.00 to 1+100.00; from 4+420.00 to 4+610.00; from 7+650.00 to 8+350.00; from 21+700.00 to 22+000.00, having good productivity and deep solum, are used for food production. Such natural land represents primary land use/production purpose of soils. Therefore, such land is being defined as extremely valuable agricultural land.

The proposed Project, in the context of agricultural land, is going to have at least two important locations of direct negative impacts-Interchange “Tarčin“and Interchange “Konjic“.

After detailed analysis of the entire motorway alignment carried out especially for the sections passing through the most quality agricultural land we believe that certain modifications and technical solutions would significantly mitigate direct negative impacts on the studied agricultural land.

The direct negative impacts of the Project on the agricultural area will be manifested in a physical disappearance of parts of agricultural parcels, as well as in physical sectioning of big parcels and their disturbed continuity. Major direct negative impacts on agricultural land will be shown by modified communication network between productive surfaces. On the locations bordering to the water streams, direct negative impacts will be manifested as completely modified ambient and reduced biological diversity. Most certainly, the irrigation potentials on some parts of agricultural land, in the zones of Tarčin and Konjic will be significantly reduced and consequently economic effects of agricultural production will be also reduced.

Indirect negative impacts on agricultural area will show in form of changed production habits. Another important specificity of indirect negative impacts will be modification of agricultural products and agricultural production character in the zones of indirect negative impacts on soil. This means that, for example, the first class production zones, e.g. the zones with possibility to produce ecologically certified products, will lose such possibilities due to contaminating effects along the motorway impact zone.

Above indicated models of indirect and direct negative impacts on the soil and agricultural land convinced us in necessity of showing the stations of the direct negative impacts.

Apart the stations of direct negative impacts, along the entire Project alignment; we will explain narrower and wider zones of potential negative impacts on the soil and agricultural land.

The motorway alignment predicted in the Project, from the station 0+150.00 to the station 1+750.00 is passing through a good quality soils and the best agricultural area. In addition to the mentioned, in this zone, the Project provides for the interchange e.g. the motorway entrance and exit. Anticipated designing solutions would have direct negative impacts on the soil and agricultural land that would be permanently reduces for app. 50% (precise measurements of future permanently lost land are haven't yet been done). Permanent destruction of agricultural productive land will probably have a negative impact on the social status of the population in possession of the parcels, since part of the population is strongly agriculture-oriented.

Indirect negative impacts are expected in the agricultural area from the station 0+000.00 to the station 2+100.00, and on both sides of the motorway alignment within the 500m-wide strip. Along the section from 2+150.00 to 2+350.00 on the left side of the Project, stronger potential negative impacts are expected within the strip of 250m. Weaker negative impacts are expected within the less than 500m-wide strip, in the agricultural area, that is exposed to the north and north-east, representing, in fact, a favourable location for contaminating polluters disposal.

Direct negative impacts on the soil will be shown through its permanent loss at the following stations: from 3+050.00 to 3+250.00; from 3+700.00 to 3+800.00; from 4+050.00 to 4+170.00 and from 4+440.00 to 4+630.00 on some locations within the total width of 100m from the motorway axis. Direct negative impacts on the agricultural land, within the same strip, will be manifested in a way the productive land will be reduced for the same amount of area. In the zone of the station from 4+440.00 to 4+630.00, direct negative will be shown through disturbed continuity of agricultural land.

Potential negative impacts will have a larger range on the right side. Particularly at risk will be the parcels at the distance less than 200m from the motorway. Those are the parcels at relatively flat or moderately steep sections, having thus bigger importance in terms of productivity. The stated potential impacts are relevant to the parcels exposed to south and south-west, around the settlement of Raštelica Donja.

The Project stations from 7+660.00 to 8+000.00 and from 8+230.00 to 8+360.00 will have negative impacts to the soil in a way that very deep and high quality soil will disappear within the strip of 100m.

Around these stations, the direct negative impacts on the agricultural land will be manifested as permanent reduction of productive agricultural area.

Current is the thinking of constructing the big rest area with complete infrastructure in wider zone of the section from 4+440.00 to 4+630.00, on the right side of the Project. If such idea comes to realisation, it would mean additional permanent loss of soil and loss of important agricultural land.

Stronger potential negative impact on soil will occur in the zone 150 to 200m, on both sides from the motorway axis, and will be manifested in soil contamination by different polluters coming from the carriageway. The same elements, with the same range, will also have potential negative impacts on the agricultural land. Weaker potential impacts on agricultural land will be present in the areas distanced more than 500 m and will be under the impact of the most frequent and the strongest winds.

Looking from the social and environmental aspect, an important agricultural land subjected to the direct negative impact of the motorway alignment is located around the stations from 10+450.00 to 10+750.00; and from 11+050.00 to 11+500.00. Around these stations there will be the case of physical loss of the soil, within the 100m-wide strip, as direct negative impacts on the soil. Direct negative impacts on agricultural land will manifest in reduction of agricultural land area, that are, in spite of being of the lower value, very important for the local population.

Indirect negative impacts on the soil will have a soil contaminating character. These impacts in respect of agricultural land will mean a decreased quality of products. More significant potential impacts are expected within the strip which is wider on the right side, probably more than 200m. Weaker negative potential impacts are expected along the 500m-wide strip.

The stations from 17+600.00 to 17+900.00 and from 18+300.00 to 18+700.00 represent the zones in which some weaker potential impacts on the surrounding agricultural land. Favourable circumstance in these zones is existence of prevailing forest vegetation systems that will significantly mitigate potential negative impacts.

Another important agricultural zone endangered by direct and indirect negative impacts of the Project planned is starting at the station 19+500.00, and ending at the station 22+720.00. In this part, from the station 21+550.00 to 22+000.00, planned is construction of interchange for the city of Konjic.

Due to expositions, climatic impacts, physical and chemical characteristics of the represented geological substratum, this agricultural area is very important for the population of the area, owning these agricultural areas.

In the zones of the mentioned stations where cuts, notches and embankments will be constructed, physical disappearance of soil will happen, within 100m strip, in reference to the motorway axis. Such physical losses will represent direct negative impacts on the soil. In the interchange zone and its supporting structures, reach of direct negative impacts and physical loss of the soil will be up to 600m. Direct negative impacts on agricultural land will be shown in significant reduction of production land, changed communication habits and probable rise in prices by unit of area.

Potential negative impacts will be important for this area in the strip of 200m from the motorway axis. Bigger significance of potential negative effects will be on the left side, towards Jablanica Lake, since in that area, there are the high land use categories. Somewhat weaker potential negative impacts are expected also on the left side of Jablanica Lake, in the agricultural areas exposed to the Project. Potential negative impact in this agricultural area will be reflected on vegetable cultivations, fruits and on bee-keeping. Maximum distances by which we can expect potential negative impacts are 1,000 m far from the motorway axis.

The following zone, with smaller agricultural areas, which, in respect of productivity, have a character of gardens or vegetable plots, is located in the corridor less than 200m away from the motorway axis, around the stations from 23+450.00 to 24+000.00, and than from 24+600.00 to 25+500.00. Potential negative impacts of contaminants, arising as a product of fuel combustion in car engines will be significant in the said parts of the Project. Weaker potential negative impacts will take place at greater distances, around above stations, and at the meadows exposed to the motorway.

In a wider zone of Ribići, agricultural land is mixed with forest systems, what is conditioned by the relief plasticity.

The motorway alignment in the indicated area does not show direct negative impacts on agricultural land. In this area, the stronger potential impacts on individual agricultural parcels are expected, as they are present as such. Stronger potential negative impacts, as stated, are possible at the stations from 27+800.00 to 28+750.00, in the corridor not exceeding 200m.

The next agricultural land zone, having no large total surface, but of great importance for the local population, is located in the canyon part of the terrain that is the Project alignment passing through. In this part of the alignment, starting from the station 33+500.00 to the station 34+500.00, possible are strong potential negative impacts due to fuel combustion in car engines, products of braking and littering. The area of impact on the left side of the motorway in places can be wider than 200m. On the right side, these impacts will have smaller range, by our estimate not exceeding 100m. Potential negative impacts with radius up to 500m can be expected also in the section between 35+100.00 and 35+740.00, although this section is outside visual reach of agriculture land.

Jablanica interchange will directly negatively impact the soil and agricultural land. Direct negative impacts on soil will manifest as its permanent physical loss. Direct negative impacts on agricultural land will be shown in loss of such area in the zone that very much suffers from shortage of productive agricultural area.

Potential negative impacts will not reach more than 150m. By our estimate, somewhat stronger potential negative impacts can be expected on the left side of the Project planned.

In the canyon part of the river Suhava, represented are very small agricultural areas, having a character of individual parcels. Whole agricultural area, within this motorway section, is placed on the right side of the Project planned and it's not wider than 200m. There will be only small extent of direct negative impacts on the soil and agricultural land and they will take place between the station 38+700.00 and the station 38+850.00. In the canyon part of the Suhava, expected are stronger indirect negative impacts in a form of contamination of soil and agriculture land with fuel combustion products, particulate matters resulting from car braking and residues resulted from tyre wear. Since the total width of agricultural land does not exceed 200m, the negative potential impact is expected on its entire width.

Increased potential negative impacts in the canyon part of the river Suhava are expected as a result of gasses exhausted by ventilation systems from the big tunnel leading under the mountain of Prenj.

From the station 38+850.00 up to the end of the Lot 3 section, at the station 59+750.00 the analysed Project does not have significant contacts with a typical valuable agricultural land. In that sence, evaluation of direct negative impacts can be done just aprocsimately, since they will be minor due to rocky composition of the land.

Potential negative impacts are also evaluated to be weak, since in the zones of notches and viaducts, in places (i.e. from 53+500.00 to 53+950.00; from 55+800.00 to 56+050.00; from 57+100.00 to 57+500.00) there is rocky and undeveloped agricultural land. Such undeveloped agricultural enclaves are characteristically surrounded by underbrush and degraded forests which will significantly adsorb contaminating matters, 200m away from the project on both sides.

5.8 Impact on flora

The evaluation of the impacts on the relevant area was carried out considering the following factors:

1. impact on the whole natural system along the land corridor, and
2. potential impact on plants and habitats (during the different construction stages).

5.8.1 Impacts during construction period

The main direct impacts will be represented by the cutting and destruction of vegetation cover both in the areas where the motorway passes through and where the construction sites are operating, as well as where the disposable material is stocked. However, there will be many indirect impacts: damage caused to vegetation by different agents (oil, oil derivatives from heavy machinery, different chemicals and other waste, as well as dust from basement excavation both where the motorway runs parallel to the ground and where viaducts will be constructed, vaporising organic compounds during the motorway asphalting), increased impact of air pollution on the surrounding vegetation, contamination of the water flow vegetation, possible negative effects on the water-bearing stratum following the tunnel construction, possible fire etc.

Impacts on flora during construction period are as follows:

- Impact on forest complexes,
- Permanent loss of forest, caused by occupying productive forestland by the motorway will have reflection in water regime and hydropower system, oxygen production and atmosphere purification, as well as recreation, tourist and health care functions,
- Forest stands fragmentation by additional forest roads, since many of the existing ones will be cut of by the Project,
- Impact of flammable materials and open fire on the forest ecosystems,
- Impact of game passage construction on the surrounding flora,
- Impact of neophytes and some other species which haven't been inhabiting the area before on the autochthonous vegetation in the area of the Project planned,
- Impact of the tunnel construction on the possible underground flora,
- Impact of viaduct construction on plant habitats,
- Impact of disposal of surplus excavated material, specially under the viaducts on the vegetation cover,
- Impacts of municipal, construction, hazardous and other waste on the vegetation cover.

5.8.2 Impacts during operation period

A series of impacts were identified, such as permanent impact of air pollution coming from traffic and its consequences on the neighbouring or farer surroundings; reduction of land quality along the motorway (quality status of pastures, orchards and surrounding forestlands), with negative effects on the vegetation thinning out and reduced biodiversity within the area near the motorway, constant danger from the leaking out of oil and oil derivatives (especially in case of accidents), fire.

Flora, vegetation

The biggest impact on flora and vegetation will manifest in habitat reduction, as well as in disturbance of natural landscape, particularly by construction of access roads, parking lots, service facilities and waste material disposals.

Forests

- Impact of flammable materials especially during summer time and in the areas extremely vulnerable in respect of fire (Black pine and Alpine pine forests)
- Damaging impacts are present also after the bypass roads are set in operation (pollutant emission coming from traffic, traffic accidents, hazardous liquids leaking out, throwing garbage).

5.9 *Impact on fauna*

The evaluation of the impacts on the relevant area was carried out considering the following factors:

1) the impact on the whole natural system along the land corridor and
2) the potential impact on animal species and habitats (during the different construction stages).

5.9.1 Impacts during construction period

Reduced biodiversity of fauna along and around the area of interest (following the destruction of habitats, disturbance of ecological balance, the interruption of the natural corridors used by fauna, the visual impact of the construction work and the noise produced), impact on water fauna of the watercourses, on pedofauna (small animals living in the soil), impact of tunnel construction on possible underground fauna**.**

Impacts on fauna during construction period are as follows:

- Impact of topsoil (humus) removal on pedofauna,
- Fragmentation of space and animal world of different niche,
- Habitat reduction,
- Disturbed ecological balance,
- Endangerment of endemic, strictly protected and protected animal species,
- Reduced biodiversity,
- Impact of tunnel construction on possible underground fauna.

5.9.2 Impacts during operation period

Impacts can be summarized as follows: injuring and killing of animals due to traffic; noise, air and water pollution; reduced biodiversity of the area near the motorway.

- Game getting killed and injured,
- Endangerment of endemic, strictly protected and protected animal species,
- Disturbed migration of certain animal groups (for the purpose of gene exchange, search for food and water etc.),
- Reduced biodiversity.

5.10 Impact on landscape

Impacts during construction period

Besides the landscape changed by the new structures, to be erected during construction, construction activities also impact the scenery, however only temporarily. During the construction work of the project, some areas will be temporarily used for implementing the construction sites and for the road works. Although only temporary used, the areas will lose their cover vegetation, the soil productivity and the original morphology.

Localized significant impacts on the scenery are most likely to occur at construction sites of interchanges and the tunnel entrances. Infect local borrow areas, storage and dumping of surplus excavated material will also have an adverse impact on the scenery.

Then the construction work will bring about a series of unfavorable impacts on landscape, in which, the following two points are most prominent:

- The temporary camps of construction workers, construction road access and construction sites, all will damage the existing landscapes in the areas affecting its harmonization and producing visual disfiguration;
- Noise, dust and wastewater generated from construction works and construction vehicles will pollute the local roads, buildings, cultural elements and vegetation system, thus affecting landscape and sightseeing.

As said above, the present impossibility to locate the construction sites does not allow to localise the exactly impact areas. At the same time, it is possible to identify that the major construction sites are placed in correspondence of the tunnels entrances, of the interchange areas and of the several viaducts and bridges along the alignment. The temporary impacts during the construction period include landscape infringement (Interference with landscape continuity, Interference with visual continuity) and degradation of cultural resources.

Impacts during operation period

While setting the layout of the motorway the maximum attention should be paid not to divide and not to interfere with the valley settlement and agriculture systems, as well with natural system of the hilly and mountain areas.

The landscape system of the valleys is very delicate. This is the result of the old and permanent culture of the local communities; that is a combination among residential settlements, cultural historical heritage, agriculture activities and natural vegetation. Also, after having suffered remarkable transformations and intensive processes of decline, those areas represent a decisive factor for the development of a sustainable local economy. This is because they guarantee the environmental quality and development and they can help the tourism economy.

The other principal resource of this territory is represented by the natural systems of the forest areas and of the river habitats. For those ecosystems the motorway insertion is a factor of high risk. Thus, the alignment and his structures will have to be evaluated on base of the general impacts on the landscape especially in the way of its ecological efficiency.

Thus, the landscape of area interested by the project will be already significantly changed due to the presence of the motorway alignment.

Landscape impacts are recognized to occur in two forms:

- Impacts on the physical structure and aesthetics of landscape (Interference with landscape continuity, Alteration of value landscape);
- Impacts on the visual amenity of the scenery to receptors (Interference with visual continuity, Development of residual areas, Degradation of cultural resources).

Regarding the former issues, changes in scale and dimensions, introduced by project structures to the present flat and homogeneous landscape are the most obvious impact factors.

Regarding residential receptors (e.g. the people living in the local villages and settlement) are considered to be the most sensitive receptor groups owing to their property interest and permanent exposure to the project once it is build. Also, the future road users can be considered as receptors. However, their transient nature to experience views ranks their sensitivity much lower then those who are permanently exposed to views of the structures and traffic using it.

The project will significantly change the landscape, as almost for the complete length of the alignment, the main body of the road is not at grade with the prevailing terrain level. In particular the high embankments section (more than 3 m) and the motorway viaducts and bridges will significantly alter the topography. The kind and the level of impact however are different on the different section of the project in correspondence of the different landscape sensibility and of receptors presence.

The road insertion could strongly alternate the main sensitive agriculture and natural landscape.

The sections with *interference with landscape continuity* are:

km 2+800 - km3+200
km 4+200 – km 4+500 near Džanići
km 7+750 – km 7+900
km 10+300 – km 10+750
km 17+600 – km 17+950
km 18+250 – km 18+700
km 24+550 – km 24+700
km 28+200 – km 28+450
km 34+850 – km 35+500

The sections with main impacts (for visual and functionality interference) on *alteration of agriculture landscape value* are:

km 0+000 - km 2+700 in correspondence of Smucka valley (see photo 1);
km 7+700 – km 7+950 in correspondence of farmland near the Rosulje settlement ;
km 21+100 – km 22+150 in correspondence of the farmlands on the slope of Jablanica lake (Konjic interchange) (see photo 2);
km 27+750 – km 28+500 in correspondence of farmland above Ćosići settlement;
km 57+600 – km 58+700
km 58+960 – km 59+560

The sections with the main natural landscape value are the highest areas of Prenj and Čvrsnica mountains and north parts of Čabulja. Those areas have to be subject to particular care by the Spatial Plan of B&H, as said above, for the abundance of endemic and relict species of flora and fauna as well as geomorphologic phenomena.

In particular the following areas present an *alteration of natural landscape value*:

km 25+250 – km 25+374
km 29+050 – km 29+150

km 32+800 - km 33+050
km 33+300 – km 33+450
km 33+500 – km 34+300
km 35+900 – km 36+900 (see photo 6)
km 37+050 – km 37+300
km 38+400 – km 39+100 (see photo 7)
km 46+300 – km 49+550 (see photo 8)
km 51+150 – km 51+650 (see photo 9)
km 52+750 – km 53+600
km 55+600 – km 57+000
km 57+850 – km 59+687

In general, it should be foreseen an *interference with visual continuity* in correspondence of the next bridges and viaducts (see annex Impacts and Mitigation measures map):

Table 59 Bridge and viaduct along the alignment that might cause interference with visual continuity

Start	End
2+800	3+200
4+000	4+200
7+950	8+200
9+350	9+400
10+045	10+197
10+754	11+150
12+700	12+750
17+700	17+750
18+400	18+550
19+650	19+750
22+150	22+250
22+450	22+650

Start	End
23+000	23+360 (see photo 3)
24+300	24+400
25+250	25+374 (see photo 4)
27+850	28+000 (see photo 5)
28+450	28+500
28+850	29+000
33+325	33+425
33+750	33+900
48+950	49+050
51+150	51+650 (see photo 9)
58+700	59+025

Landscape impacts with *development of residual areas* will be foreseen in correspondence of:

- km 1+400 - km 2+750 in correspondence of Smucka village;
- km 3+100 – km 3+200
- km 7+750 – km 7+950;
- km 21+600 – km 21+950 in correspondence of foreseen Konjic interchange;
- km 28+550 – km 28+625;
- km 35+900 – km 36+900 in correspondence of foreseen Jablanica interchange;
- km 38+350 – km 39+150 in correspondence of the retaining wall in Potok valley.

1. Section in correspondence of Smucka village (km 0+100 - km 1+500)

2. Area of Konjic interchange (km 21+800)

3. Section in correspondence of Jablanicko Lake Bridge (km 23+000- km 23+360)

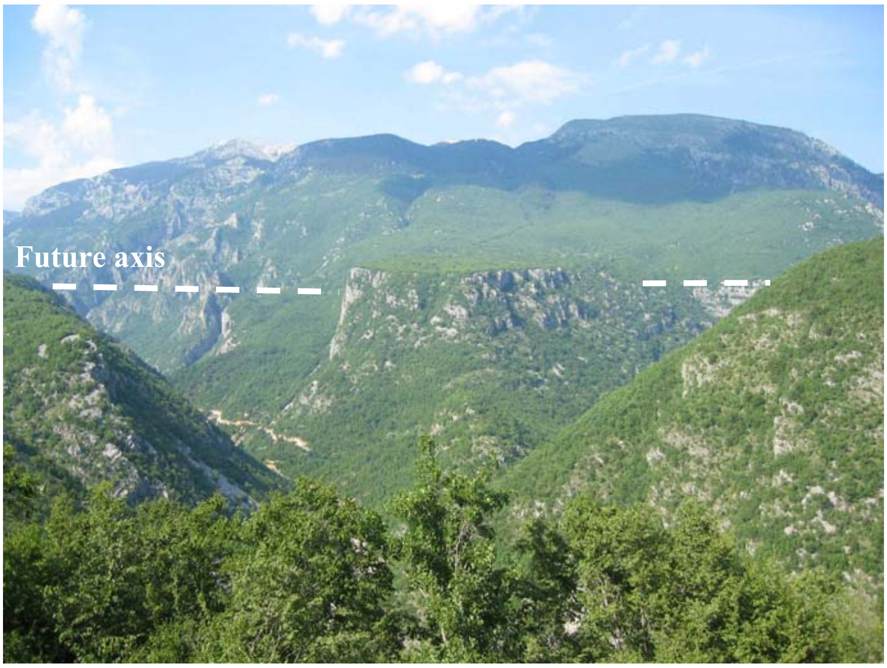
4. Section in correspondence of viaduct at km 25+350

5. Section in correspondence of viaduct at km 27+900

6. Section in correspondence of Draganka valley (km 35+900 – km 36+900) and area of Jablanica interchange (km 36+100)

7. Section in correspondence of the Potok valley (km 38+400 – km 39+100)

8. Section in correspondence of Bjela river valley (km 46+400 - km 49+500)



9. Section in correspondence of the river Bijela Bridge (about km 51+400)

5.11 Potential impact on protected areas

According to the Law on the nature protection (Official Journal FB&H, 33/03, Articles 27 and 30) the motorway Vc 2km-wide corridor (the analysed corridor) covers also the area protected by the mentioned law.

The motorway alignment's south and middle parts are passing through the area proposed to be pronounced a National Park and which currently have status Park of nature. The alignment is passing close to the Kuhija cave.

Assumed negative impacts are minor, since the alignment in this area is mostly passing through the tunnels.

Following is a description of the potential impacts on the main components of protected areas affected by the project

Landscape

The main potential impacts would be represented by:

- habitat fragmentation (degrading through their barrier and disturbance effects on the carrying capacity of ecosystems);
- visual impact during construction stage and operation phase.

Atmosphere

The main potential impacts would be represented by air pollution, noise and powders during construction stage and operation phase.

Flora and vegetation

The potential impacts during the construction stage are several. The main direct impacts would be represented by the cutting and destruction of the vegetation cover both in the areas where the motorway passes through and where the construction sites are operating, as well as where the disposable material is stocked.

The vegetation of the protected areas is representative of the continental part of the country. Among the most common species, it is possible to find: common beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*), wich elm (*Ulmus glabra*), common oak (*Quercus robur*), oak (*Quercus pubescens*), hazel trees (*Corylus avellana*), walnut (*Junglans regia*), lime-tree stands (*Tilia cordata*), crab apple (*Malus sylvestris*), sycomore stands (*Acer pseudoplatanus*), cornelian cherry (*Cornus mas*), alder stands (*Alnus glutinosa*), juniper tree (*Juniperus communis*), poplars (*Populus tremula* and *Populus nigra*), willow (*Salix alba*)

However, there would be many potential indirect impacts:

- damage caused to vegetation by different agents (oil, oil derivatives from heavy machinery, different chemicals and other waste, as well as dust from basement excavation both where the motorway runs parallel to the ground and where viaducts will be constructed, vaporising organic compounds during the motorway asphalting);
- contamination of the water flow vegetation;
- possible negative effects on the water-bearing stratum following the tunnel construction.

The potential impacts during the operation period would be represented by:

- reduction of land quality, air pollution and powders along the motorway, thinning out of vegetation and reduced biodiversity within the area near the motorway;
- constant danger from the leaking out of oil and oil derivatives (especially in case of accidents);
- fire.

Fauna

In the protected areas of the future motorway, different habitat types are present: groves, meadows, rocky grounds as well as several types of aquatic and forest habitats. In respect of habitat variety there is a large number of different animal species, which makes the area extremely rich in terms of biological variety as well as vulnerable and sensitive to any future fragmentation of the area.

The main potential impact during the construction stage would be represented by:

- the reduced biodiversity of fauna along and around the area of interest (following the destruction of habitats, disturbance of ecological balance, the interruption of the natural corridors used by fauna, the visual impact of the construction work and the noise produced), disturbance of water fauna in and along the watercourses;
- disturbance of pedofauna (small animals living in the soil);
- disturbance of possible underground fauna (during tunnel construction).

Wildlife killing and injuring (particularly little birds and fauna crossing the street) is the main potential impact during the operation phase.

5.12 Impact on cultural-historical heritage

5.12.1 Potential negative impacts

For quantitative and qualitative evaluation of negative impacts on identified property coming from the motorway construction and operation, relevant are the following data:

- Spatial relationship-closeness to the alignment (distance measured in horizontal and vertical direction);
- Kind of property (above-ground structure, underground structures and findings);
- Property condition (good, structurally unstable etc.);
- Kind of the motorway structure (tunnel, bridge, viaduct etc.).

Among the mentioned information, cultural heritage vulnerability is strongly determined by distance from the motorway. Therefore, we have defined “the highest risk” strip – the first zone of impact-determined by physical contact and by range of all kinds of physical, dynamic and chemical impacts that can cause material degradation. That strip is also determined through possibility of direct contact; possibility of identification within a common view (“visual pollution”) and devastation of cultural-historical ambient (character). The “high risk” zone encompasses the zone of 200 to 300m on both sides of the motorway alignment, depending on the specific terrene morphology, kind of the motorway structure and property kind.

Generally speaking, negative impacts on the recorded assets can be divided in two main groups:

- Impacts on physical structure-material degradation
- Impacts on aesthetical/visual quality, historical and cultural character of the Property.

Conditionally, it can be also defined the third group of impacts, which, by its degradation mechanism, can belong to each of the mentioned groups. It would include an impact on ambient and environment what is frequently an integral part of heritage property. This is particularly important in cases of natural, architectural or rural entities, or vernacular architecture, since space quality results from natural and artificial component and/or their full complementation.

The most potential and the strongest negative impacts in the "risky zone", during construction period are the ones directed to degradation of physical composition of a recorded property. During operation period, however, relevant are also the negative impacts belonging to the second group, related to a visual quality, historical and cultural character of property, locality or entity. Damaging effects in operation period are getting their weight in rheological observation. If we take in account a time factor, we can conclude that long-term motorway operation can cause effects that are initially harmless, becoming more and more serious in time.

It is important to mention that all statements concerning possible negative impacts on a recorded or categorised property are also applicable on so far unexplored and non-recorded property. Possibility of discovering new archaeological sites during construction works is not small, thus, this segment is separately treated in the chapter on mitigation measures and recommendations.

Negative impacts during construction period

Damaging impacts during construction period depend on the factors mentioned in the previous text and can be, for the first zone of impact, grouped in several groups by kinds of goods.

Table 60

	Known / recorded archaeological sites	**Archaeological sites unknown until now**	**Structures-individual buildings and entities**	**Cemeteries and individual tombstones**	**Natural and architectural entities**
Excavations, cuts and all kinds of earthworks	*Possible disturbance of cultural layers, damage or complete destruction of the existing archaeological findings of all kinds*	*Possible complete destruction of potential archaeological findings and locality devastation, due to non-existence of the data and unexplored area.*		*Moving and sinking of tombstones, depending on a position of cuts in reference to the cemetery, engineering-geological category and geological composition of the treated rock.*	*Ambient devastation (depending on distance)*
Material disposal	*Destruction of surface findings, if any*	*Destruction of potential surface findings*		*Ambient devastation (depending on distance)*	*Ambient devastation (depending on distance and kind of the material*

					disposed)
Drilling, explosions and other “aggressive” excavation technologies applied in hard rock mass.	*Possible is a disturbance of cultural layers, damage or complete destruction of the existing archaeological sites (i.e. at tunnel entrances)*	*Possible is a complete destruction of findings on so far unknown archaeological localities in surface layer (i.e. at tunnel entrances) due to data non-existence and unexplored area.*	*Technologies are followed by vibrations that can cause cracking or other deformations. These disturbances are dangerous since they cause further rapid physical degradation, especially on structures of unsatisfactory preservation status.*	*Technologies are followed by vibrations whose damaging effects on the material can manifest through cracking, dislocation from post, sinking etc.*	*Technologies are followed by vibrations whose damaging effects on the material can manifest in different ways, depending on distance and characteristics of the specific good.*
Communication, construction site organisation, Construction of access roads, heavy machinery traffic	*Destruction of surface findings, if existing*	*Destruction of potential surface findings*	*Physical damage and devastation of ambient, depending on distance*	*Physical damage and devastation of ambient, depending on distance*	*Physical damage and devastation of ambient, depending on distance*

Each of indicated impacts, in the zone of risk, is present to a larger or smaller measure; acting dominantly or in combination with the other impacts. Therefore, each specific location has been analysed separately.

Negative impacts during operation period

Damaging impacts during operation period depend on the factors mentioned in the previous text and, for the first impact zone, can be grouped in bigger groups by kinds of goods.

Table 61

	Known / recorded archaeological sites	**Structures- individual buildings and entities**	**Cemeteries and individual tombstones**	**Natural and architectural entities**
Damaging effects of the road traffic with physical and dynamic impact mechanisms	*On the localities with above-ground remaining in situ: negative vibration impacts on the matter, depending on distance and geological composition of the ground*	*Can be manifested through negative vibration impacts on physical structure of the building depending on distance and geological composition of the ground*	*Can be manifested through negative vibration impacts on structure of the tombstone depending on distance and geological composition of the ground*	*Can be manifested through negative vibration impacts on structure of the tombstone depending on distance and geological composition of the ground and through negative noise*

				impacts in the zones of significant ecological character and valuable natural component
Possibility of direct physical contact	*Physical damage if there are above-ground structures*	*Physical damages*	*Physical damages*	*Physical damages*
Damaging effects of the road traffic with chemical impact mechanisms	*Impact of polluting materials on above-ground structures, if any*	*Impact of polluters on natural construction materials during longer time period*	*Air quality modification-chemical impact of polluters on natural stone during longer time period*	*Air quality modification-chemical impact of polluters on natural construction materials and entire natural environment over longer time period*
Devastation of historical and cultural character	*Devastation of cultural-historical character. Possibility of visual disharmony and aesthetic degradation, if there are above-ground monuments in situ.*	*Devastation of cultural-historical character. Possibility of visual disharmony and aesthetic degradation*	*Devastation of cultural-historical character. Functional non-coordination, possibility of visual disharmony and aesthetic degradation*	*Devastation of distinct ecological character of built structures and devastation of preserved natural environment; possibility of visual disharmony and aesthetic degradation*

Each of the impacts indicated is, to a different measure, present in the risky area, acting dominantly or in combination with others. Therefore, the analysis is done separately for each specific station.

Table 62 Review of structures, localities and entities of cultural-historical heritage located in the First zone of impact

NAZIV / lokacija	ŠIFRA	OPIS
Ivan-sedlo	5/15	Memorial to the victims of fascism
Giaour's Cemetery (Crkvina)	6/15 1/188	1. Medieval necropolis, 2. Remaining of Roman architecture 3. Milestone
Vrbljani	6/16 1/354	Group of 3 medieval tombstones
Vrbljani	S/5	1. Rural entity 2. Individual residential buildings of ambient value
Breber (Crkvina)	1/30	1. Traces of Roman mausoleum and necropolis 2. Fragments of medieval church
Breber -Šćepanova ledina	1/ 30a	Medieval necropolis
Cerići , Munara, Trebeda	1/35	1. Remaining of Roman settlement. 2. Roman monument 3. Byzantium coins.
Razice - Stećak	S/ 18	1. Medieval monument

		2. Old Moslem standing tombstones
Razice - Stećak	S/ 19	Building of modest ambient value
Grebine	6/124 1/148	Necropolis with 9 medieval tombstones
Pokojište	S/3	Smaller group of residential-agricultural buildings
Zelovo polje	1/366	1. Prehistorically necropolis with tumulus 2. Roman necropolis
Čelebići, location of over flooded original Orthodox church under Jablaničko lake	5/16_OR	Over flooded remaining of the building
Čelebići, location of Orthodox church built instead of the one over flooded	5/16_SAD	Church with fragments of over flooded structures
Mravinjac	6/21 1/248	Necropolis with 7 medieval tombstones, over flooded or dislocated
Čelebići 1	1/46	1. Illyrian-Greek coins and Roman Republican coins
Čelebići 2	6/20 1/47	Necropolis of 109 medieval tombstones, over flooded by Jablaničko lake.
Ćupine (Mravinjac)	1/53	1. Prehistorically cult place
Dragan - Selo	S/7	1. Water mills 2. Autochthonous rural agglomerations
Ravna	S/8	1. Autochthonous rural agglomerations 2. Individual residential buildings of ambient value
Podkula	4/10 1/273	Group of 7 medieval tombstones
Ravna	4/11 1/293	Group of 4 medieval tombstones
Biešćak	4/12 1/10	Group of 20 medieval tombstones
Glogošnica	S/9	1. Old Moslem cemetery 2. Old Moslem cemetery 3. Remaining of autochthonous old cobble pavement, dry stone masonry
Glogošnica	4/15	Individual tombstone (locality)
Donja Jablanica - Glogošnica	S/20	The Old Bridge

5.12.2 Positive impacts / potential improvements

Evaluation of positive impacts was not analysed in detail for each individual case, since the potential status improvement, as well as heritage status conditioned by the motorway construction do not require design solutions that is a scope of this project. Together with a detailed analysis, evaluation and elaboration, this evaluation can be used as an input and a base for some aspects of future development, spatial and urbanism plans or other projects.

Positive effects are, generally expected during the motorway operation period.

One of the most important positive effects is a **physical accessibility**.

Major part of the registered cultural heritage localities is presently accessible only through long and tiring local roads of low category.

From the aspect of heritage preservation, absence of communications have a negative implication, since it can cause development stagnation, increased migration of younger population and support maintenance of any control by authorised protection bodies. Villages in picturesque natural environment, in vicinity of medieval tombstones and remaining of fortification structures, thus, usually just vegetate, weakening economically, what is very far from principles of revitalisation and modern integrated protection.

In the settlement zones, the motorway construction will certainly cause development of service activities, catering, trading and other various supporting activities. That makes the second positive effect-**an economic development effect**.

Namely, economic strengthening and general social-economic development of the area are directly proportional to the operational aspects of promotion, popularisation and presentation of cultural-historical heritage. If we intend to actively protect a cultural property, to include it in a modern living, to present and to use it, we have to ensure an appropriate economic base and environment, as well as tourist attractions for the visitor/user.

The third effect is the **information and communication** effect.

Many cultural heritage sites are located in the zones that are not in any way advertised or affirmed as a target points of cultural or tourist itinerary and they exist far from real life and development: forgotten, frequently abandoned and left to accidents and destruction by individuals.

In that sense, operation period of the crowded motorway should be understood as an exceptional possibility for presentation and affirmation of cultural, historical, natural, ethnological, traditional and all other values of the area, as well as well planned, long-term marketing activity of a tourist associations, based on the heritage property potentials. Along the entire alignment, it is possible, through a visual communication, to offer some relevant information, and thus to affirm the property values.

Assuming that the alignment corrections will be made on critical points and suitable mitigation measures will be conducted; that so far unknown and potential archaeological sites will not be in any way devastated, the above mentioned effects can have its full efficiency in sense of the cultural-historical property status.

5.13 Impact on hunting

Possible impacts of the motorway construction will be manifested in two aspects. The first one is the motorway impact on the hunting areas as spatial units, and the other is the impact on the game in immediate and wider surrounding.

The impact on the hunting areas will be expressed by greater or smaller reduction of hunting surface in the specific hunting areas.

For each hunting area, sectioned by the alignment or located in its vicinity, for the analysis of the motorway impacts and relationship, the hunting area boundaries have been analysed as well as 300m-wide zones, counting from the pavement edge. After that, the surface of specific hunting areas and the total surface have been calculated.

Total reduction of the hunting area along the entire alignment (for the zone of 300m) amounts to 2,212ha.

Furthermore, a negative impact is present in the hunting areas unfavourably cut in two or more fragments by the motorway in a way that the remaining part can not be efficiently included in the main hunting area. If the surface of the separated part is larger, it is necessary to obtain a good connection between such parts.

This kind of negative impact exists to a certain measure in almost all hunting areas.

Apart the direct loss of the hunting area due to the motorway itself, one has to have in mind also the areas of fenced in protective strip along the motorway, not encompassed by the hunting area. Furthermore, the motorway is directly disturbing ecological conditions of the habitat, determining numerousness of the game that can inhabit the considered area without having bigger impact on environment and other animal species.

In the other hand, the motorway alignment is cutting centuries-old natural migration paths of some game. In that respect, the most important is chamois which is, biologically and ecologically characteristic by having tenths and hundreds of kilometres wide movement area. Since the best habitats of this game are located on the mountains Prenj, Čabulja and Čvrsnica, and since this game seasonally leaves them, it is very important to determine their migratory routes.

It practically means that, after the final alignment is set out, it will be necessary to redefine the existing hunting area boundaries, in order to maintain them as one rounded continuous entity, in accordance to the law on hunting (Official Gazette SR B&H, 7/77) whose Article 25 unambiguously says that "the hunting area boundaries are set in the land and water areas representing natural and continuous hunting entity …"

Impact on game

Generally, in case of the motorway passing through the hunting areas, especially through the enclosed hunting areas and game rising areas, there are the following problems: game migrations (daily and seasonally), game disturbance, physical endangerment and theft. There is also a problem of game injuries due to the traffic, which will exist in spite of fence installation.

Impact on the game will result in decreased living area (habitat surface, surfaces for feeding, watering and movement) and more difficult communication during daily and seasonal migrations.

Gas stations and rest areas do not bring major negative impacts on the game, although they should not be designed near bigger watercourse complexes.

5.14 Noise impact

5.14.1 Impacts during construction period

Impacts related to the noise during the construction can be considered from two aspects:

- Noise produced by equipment at the construction site during the construction works (heavy machinery, possibly blasting at tunnel construction sites) such as works in borrow pits and quarries;
- Noise produced by the machinery and trucks in relation to the construction works.

As presently there is no information on the work areas, equipment and work schedules available, it is not possible to make predictions on construction site related noise emissions and possible impacts on communities.

The noise represents an environment factor omnipresent for which is difficult to establish the tolerance limit between the necessary level and the noxious one, depending on a multitude of physical factors (physical of the noise, personal of the receiver or other external variables).

The noise influence on the human body depends on a factor series:

- Factors related to noise: intensity, frequency, action times, noise feature (continuous or intermittent);
- Factors related to the human body: age, activity, physical state, individual sensitivity;
- Factors related to the place of the action: space dimension, field configuration, architectural structure, etc.

Generally, the noise effects depend on the characteristics and complexity of the activity to be carried out. The simple, repetitive and monotonous activities are less affected by noise.

Exposure to noise could bring about various types of reflex answers, especially if the noise is unexpected or of an unknown nature. These reflexes are mediated by the vegetative nervous systems and are known as stress reactions.

In order to limit the possible impact of the sound pollution on population health, there are recommended the following measures:

- Equipment operating within the limits of the functional parameters;
- Monitoring the noise levels in order to adopt the correction measures of the excessive sound pollution.

The construction site will generate problems linked to the noise emissions and vibrations connected either the working activities or the materials movement.

In order to accurately present the different aspects regarding the noise produced by various devices, three levels of observation are been considered:

- Sources of noise;
- Proximity noise;
- Distant noise.

Each of the three levels of observance presents its own characteristics.

In the case of source noises equipment has to be studied separately, and is presumed to be placed in open field. This phase of the study enables to understanding of the inherent features of the sources dissociated from its work environment. Noise measurements at the source are indispensable both for comparing the sound levels of machine tools of the same category and to receive information regarding acoustic power of machine tools from different categories.

In the case of proximity noise, the fact is that each machine tool could be located in an environment that may alter its acoustic characteristics is to be observed.

Therefore the point of interest is the acoustic level obtained at distance of a few meters and up to ten meters from the source.

For the accurate interpretation of the data, it will be necessary that the distance at which the measurement was taken accompanies the value of acoustic pressure level observed.

In the event that in open field condition are met, this level of acoustic pressure may be amplified in the proximity of the source (reflections), or muted by natural or artificial screens existing between the source and the measurement point.

When proximity measurements are taken at a certain distance from the machine tools, it is obvious that in this case the proximity noise actually represents the noise of a group of machine tools and seldom that of an isolated machine.

If in the case of the first two levels of observance the acoustic characteristics are strongly related to the nature and the location of the machine tools, the distance noise (>200 m from the sources) largely depends on additional external factors such as:

- Weather phenomena and in particular: speed and direction of the wind, gradient of temperature and wind;
- Higher or lower degree of absorption of the acoustic waves into the soils, phenomenon called “soil effect”;
- Air absorption depending on the pressure, temperature, relative humidity;
- Field operation;
- Vegetation.

At this level of study, the observations regarding the noise generally refer to the entire analysed objective. The construction of the motorway implies the use of machine with big mass, which cause vibrations with their movements. To these machines it is to be added the dumpers, which have big mass also when they are empty.

Construction machine and transport vehicles are the main noise and vibration sources during the construction period of the project. They are usually located at the central district of the construction site. The next table shows the general intensity of the noise source of common used construction machine.

Table 63 Intensity of the noise source of common used construction machine.

Name of construction machines	*Noise level (dBA)*
Excavator	80 - 100
Bulldozer	80 – 100

Carrying machine	75 - 95
Pile driver	90 - 110
Concrete mixer	75 - 90
Winch	95 - 105
Road roller	75 - 90
Heavy truck	70 – 80
Rivet gun	85 - 100

It will be put in evidence the situations on which is possible that during the work, will occur the necessity to proceed with monitoring of acoustic levels and eventually to install acoustic barriers.

About the transport activity, with reference to the traffics external of the construction site, it should be interested at the maximum extra-urban route.

The noise at source and the noise of the nearby area have acoustic characteristics corresponding to the equipment nature and location, during the construction period. The noise of the distant area, not of interest for the present evaluation, is influenced by the more external factors, like wind speed and direction, temperature and wind gradient, acoustic waves absorption by the ground/soil (ground/soil effect), air absorption (depending on the pressure, temperature, relative humidity, noise frequency), land survey and vegetation type.

5.14.2 Impacts during operation period

Due to conscious perception and interference with various activities noise is the most annoying environmental pollutant. At present, concerning transportation noise, 40% of the European population is exposed to rating levels of at least 55dB(A) and 20% to 65dB(A) and more. Noise load is expected to increase considerably during the next few years, more during the night time hours than during the day. Generally, the noise level depends on the traffic frequency, selected transport means and road quality.

Besides the disturbing impact, noise is dangerous for health. We distinguish two types of impacts:

<u>Hearing lesion due to noise</u>
In case of the hearing lesion, cause and consequence are known. The hearing lesion is the only determined health injury, caused by classic noise. According to the former knowledge, the hearing lesion of the healthy ear occurs after the longer exposure to noise over 90 dB(A). People are exposed to such noise only at work place. In addition to this, the hearing lesions are known only with people having a noisy hobby, such as hunters and visitors and employees of the disco clubs.

<u>Extra aural impact of noise</u>
The extra aural noise impact includes all human reactions regarding noise, excluding the hearing system. These reactions are proven with appropriate physical, chemical and psychological methods.

The extra aural noise impact is characterized by the fact that the human body reacts to any stimulation by sound in different areas such as neural, vegetative, hormonal and psychological. Reason for this is psychosomatic organisation of human being; in organisation of central neural system and its multiple connections to the hormonal glands system.

There are a number of regulation circles taking care of the maintenance of necessary tensions and balance of flows in the organism, under the changes of the outside conditions or the ones in the organism itself. In the literature that describes the impact of noise at man, there are a number of evidences on physiological impact of noise in the emotionally neutral situation of the laboratory experiment. The reactions of the awaken man to the noise over 65 dB (A) are proven, and with man who is sleeping even of the lower level noise. Gastric disturbances, enlarging of eye pupils, transitory raise of blood pressure, decrease of body temperature, amplitudes in fingers pulsation, causing the skin circulation downsizing, due to the peripheral blood vessels narrowing and reinforced hormones secreting of the adrenal gland were discovered

It is necessary to stress that the organism reactions related to the noise are equal to fear reactions. There is no habit in respect of vegetative nervous system reaction to noise. This is why we cannot get accustomed to noise. What is usually called by this name represents the consequence of the psychological customisation to noise, which at any moment can be interrupted with disease, mental load etc. The disturbance of sleeping by noise is particularly damaging for health, particularly with sick people.

The insertion of the new motorway alignment (in 2013) will involve two different situations:

1. Reduction of the noise levels, due at the reduction of the traffic flow along the present M17 alignment. In fact, the average traffic will be reduced from a maximum of 297 vehicles/ hour to 112 vehicles/ hour in the section Tarčin – Konjic and from a maximum of 250 vehicles/hour to 24 vehicles/ hour in the section P. Jablanica – Potoci, as show in the followed table.

Table 64 Noise levels along the M17 (2013)

ID	Average speed (km/h)	Average traffic[8] (veh/h)	Leq dB(A) [9]			> 50 dB(A) (m)
			25 m	50m	100m	
Tarčin - Konjic	45	112	57.10	52.24	47.38	65
Konjic - Ostrožac	45	99	56.61	51.75	46.89	60
Ostrožac - Jablanica	45	121	57.40	52.54	47.68	70
Jablanica - P. Jablanica	45	200	59.39	54.52	49.66	95
P. Jablanica - Potoci	45	24	50.95	46.09	41.23	25

[8] The data comes from the *Traffic Study of the Lot 6 Sarajevo south (Tarčin) – South Border - Corridor V*, done by the Civil Engineering Institute of Zagreb in September 2005. Those information are about the Average Daily Traffic (ADT) along the present M17 alignment (2004) and along the future M17 alignment (2013) in case of no intervention and along the proposal alternative alignment (2013).

[9] The analysis have been elaborated on base of the next medium daily traffic and calculated with the follow adopted formula (source ENEA - Agency for the New Technologies, the Energy and the Environment - Italy

Leq (dB(A)) = leq (Q,V,d) – A(divergence) – A (earth) where

Leq (dB(A)) = 9,1 log (Q eq) – 6,5 log (d) + 51,2

Qe =α(V) Ql + β(V) Qp+ γ (V) Qc

Qp light vehicles flow

Ql heavy vehicles flow

Qc motorcycles flow

α β γ factor of proportionality in function of speed flow

d reference distance

A(divergence) noise level decrease d(B) in function of divergence

A (earth) noise level decrease d(B) in function of earth

This traffic reduction involves a noise levels reduction that will upgrade the noise pollution situation of the present M17 alignment.

2. The traffic increase on the new alignment will cause pollutant noise emissions in some areas that now don't have this kind of problem (rural areas, natural zones), due to the assumed maximum average load of 477 vehicles/hour (section P. Jablanica – Potoci). On base of the foreseen noise levels, the main critical humans' receptors are these localised far less than 100 m from the alignement , as shown in the following table.

Table 65 Noise levels along the new alignment (2013)

ID	Average speed (km/h)	Average traffic[8] (veh/h)	Leq dB(A)[9]			> 50dB(A)
			25m	50m	100m	(m)
Tarčin - Konjic	100	417	69.14	64.27	59.41	380
Konjic - Ostrožac	100	419	69.15	64.29	59.43	380
Ostrožac - Jablanica	100	419	69.15	64.29	59.43	380
Jablanica - P. Jablanica	100	419	69.15	64.29	59.43	380
P. Jablanica - Potoci	100	477	69.67	64.81	59.95	410

Therefore, some settlements and isolated buildings along the planned alignment will be effected and in particularly:

- The isolated buildings in correspondence of km 1+425; km 2+050; km 2+400; km 7+950 – km 8+250;
- The settlement systems of Smucka (km 0+900 – km 1+100); Hasanovići (km 24+550 – km 24+700) and in correspondence of km 21+100 – km 22+150 (Konjic interchange).

5.15 Vibration impact

For the construction period, there aren't data about vibration impacts at this level of the study. Anyway it is possible to foresee some problems in correspondence of the tunnels, due to the use of explosives during the construction, and of the piles of viaducts or bridges where the foundation construction could produce vibrations.

The vibration impacts during operation period are solved in the next design phase.

5.16 Impact on infrastructure

Electricity network

The planned motorway alignment is intersecting the existing and planned transmission and distribution electrical power lines in several places.

Impact of the motorway on the existing distribution network is mostly of a technical nature. In the case of non-compliance with the prescribed construction and layout requirements, the underground and overhead HV power lines must be reconstructed in order to meet the conditions required. Those conditions are: prescribed distance between the poles, height of cables above the motorway pavement surface, mechanical protection of underground electrical cables against mechanical load of variable intensity that could damage the underground cables.

There are also the impacts of the overhead electrical cables, taking place especially at the motorway intersections. The first kind is concerning the rear but theoretically possible situations of cables falling down on the carriageway lines due to collapse of the poles under conditions of natural disasters. Further, during regular network maintenance, some shorter traffic gridlock can happen. Electromagnetic impacts of HV power lines are completely negligible at these voltage levels, under condition of minimal height of cables above the motorway pavement surface as prescribed and short time of car passing under the power line.

From the Elektroprivreda’s point of view, the adopted motorway alignment is acceptable under condition of undertaking some necessary reconstruction works on the electrical network (which are the subject of separate elaborate).

Telecommunication network

The planned motorway alignment is, in several places, intersecting the underground immovable telecommunication cables of different ranks and performances.

Impact of the planned motorway on underground telecommunication cables is mainly of technical nature since all cables have to be reconstructed and placed into hoses for protection against mechanical damage caused by variable intensity load.

Under condition of protection measures applied and some respective reconstruction works done, the planned motorway alignment is acceptable in respect of immovable telecommunication networks.

Transportation network

A motorway as the highest level of road arrangement has, at the same time, the strongest limitations in respect of spatial position and functional organisation, what makes it a rigid spatial element. The strongest disturbance and limitations occur in respect functional organisation of space and thus the impact on transportation and traffic system is important and must be adjusted to the new limitations imposed by use of the planned motorway.

Being the motorway fenced off, without the possibility of crossing over, the access roads to the motorway are limited to only few interchanges, planned in accordance with the standards defining minimum distance between them. Road network intersecting the planned motorway, by its role, should be subordinated to the planned motorway within complete transportation network. In conclusion, application of the elements for shaping the intersections of the existing classified roads depends on their category and role within the transportation network. The biggest impact of the planned motorway is expected on the systems of the existing country roads and forest paths (uncategorised roads). In some cases, the existing functional organisation of the space and primarily access to the agricultural land will be disturbed.

The planned motorway alignment will not significantly impact the local transportation systems functions, if sufficient number of passages for cars and passengers is provided in the motorway structure itself.

6.0 DESCRIPTION OF THE MITIGATION MEASURES FOR NEGATIVE IMPACTS ON ENVIRONMENT

6.1 *General mitigation measures for negative impacts on environment*

The focus of this paragraph is to summarize the main mitigation measure proposed by the Consultant. The aim of the following mitigation measure is to eliminate or in any case to reduce the potential impacts on the environment affected by the Project. The Consultant proposes also mitigation measure during the Construction phase.

Mitigation measures during design phase

1. Include physical barriers to noise in plans
2. Use an architectural design to "blend" with the landscape
3. Provide for disposal facilities
4. Provide in design for proper markers on roads, including lights
5. Realignment where possible to detour exceptional areas, identifies by prior surveys
6. Provide appropriately design and located crossings
7. Include slow traffic lanes and/or paved shoulders and sage crossings
8. Realignment to avoid wetlands
9. Realign to avoid important migratory routes
10. Provide drainage works as needed to reduce risk, according to prior surveys.
11. Plan national transportation route alignment according to location of fragile, unique, etc. areas.
12. Assess vector ecology in work areas and take steps where possible to avoid creating habitats.

Mitigation measures during construction phase

13. Collect and recycle lubricant
14. Install and operate air pollution control equipment
15. Periodically water down or light oil temporary roads
16. Protect susceptible surfaces with mulch or fabric, and plant erodible surfaces as soon as possible.
17. Periodic health examinations of workers with treatment when needed
18. Set up plant and animal sanitation service and related checkpoints.
19. Prohibit poaching under terms of employment

6.2 *Specific measures for mitigation of negative impacts on environment*

6.2.1 Inhabitants

Population and settlements:

Impact on settlement development prospects:

- Measures should be planned prior to commencement of construction works and in order to establish new communication structures for settlements where traditional ways of communication are interrupted by the motorway. This could be done through the provision of overpasses/underpasses;

- The municipalities/towns with a motorway intersection (Tarčin, Konjic and Jablanica) should update their urban plans and adopt extension areas according to the location and the possible effects of the intersection and the connection to the motorway. Development plans for industrial/residential areas should be revised and updated.

Population directly affected:

- The sites of construction camps must be selected in a way to not create conflicts with present settlements;
- Local Authorities should undertake measures to avoid that camps turn into permanent settlements;
- Mitigation measures related to air environment: see 6.2.4;
- Mitigation measures related to noise environment: see 6.2.12.

Resettlement/Displacement of People:

Where displacement is unavoidable, resettlement plans have to be developed. Main steps of a resettlement plan should include the following:

- Clarification of organizational responsibilities,
- Organisation of community participation,
- Site Survey,
- Analysis of legal framework,
- Valuation of and compensation for lost assets,
- Land tenure, acquisition, and transfer,
- Implementation schedule, monitoring, and evaluation.

Displaced persons should be (i) compensated for their losses at full replacement cost prior to the actual move; (ii) assisted with the move and supported during the transition period in the resettlement site; and (iii) assisted in their efforts to improve their former living standards, income earning capacity, and production levels, or at least to restore them. Particular attention should be paid to the needs of the poorest groups to be resettled.

Community participation in planning and implementing resettlement should be encouraged and appropriate patterns of social organization should be established, and existing social and cultural institutions of resettlees and their hosts should be supported and used to the greatest extent possible. Resettlees should be integrated socially and economically into host communities so that adverse impacts on host communities are minimized. The best way of achieving this integration is for resettlement to be planned in areas benefiting from the project and through consultation with the future hosts. Land, housing, infrastructure, and other compensation should be provided to the adversely affected population, ethnic minorities, and pastoralists who may have usufruct or customary rights to the land or other resources taken for the project. The absence of legal title to land by such groups should not be a bar to compensation.

<u>*Social structure and cultural values:*</u>

- Social disturbance by construction camps

  - In general the construction campsite should be located in less vulnerable areas. Furthermore the contractor must be obliged to meet the local regulations and location of construction plants and camps must be planned in co-operation with the local community;
  - Local regulations for the construction of camps must be respected;
  - To ensure that construction camps, temporary works and lifestyle of construction workers do not negatively affect adjacent communities, workers should be prevented from using resources held in common by local population.

- Social disturbance due to traffic congestion

  - Implement traffic management measures in locations where crossing the existing road.

- Impacts on cultural heritage sites

  - Specify rules and means regarding preservation and recovery of cultural remains discovered during construction;
  - Clarify exact localization of important sites;
  - Determine possible sensitive sites before project start up to avoid construction/excavation activities in these localities;
  - Contractor has to be informed in advance on exact location of the site;
  - The contracting documents for the construction works should specify the rules for the preservation and recovery of cultural remains discovered during the construction phase and specifies means to protect specific features or additional work that may be called for;
  - Movement of material has to be planned accordingly.

<u>*Property values*</u>

- Removal of houses and other buildings

The following steps required under Bosnian legislation for expropriation have to be followed:

- Detailed site surveys, showing the locations of all properties potentially affected by the project;
- Detailed design of the project is prepared, to the level that the extent of land requirements can be defined;
- Preparation of allotment plans, showing the relationship between the motorway scheme and the land or structures to be expropriated;
- The Federal Ministry of Physical Planning and Environment has to accept the proposal;
- Copy of the Land Plan has to be obtained from the Cadastre/Register of Municipality. This should be checked against latest survey information from the field;
- Detailed allotment numbers affected have to be submitted;
- The Federal Government of Bosnia and Herzegovina declares a public interest and provides the means for expropriation;
- Municipalities have to be informed about the construction of the project and the Municipalities have to be requested to provide teams for execution of the expropriation process for land and buildings;
- Site surveys to be carried out by values;

- Municipal authorities enforce resolutions;
- Request is made for premature entrance onto the property before statement on validity of the claim is issued by the Federal Ministry of Planning and Environment;
- Entrance onto the property is obtained for representatives of the responsible authorities;
- Arguments before the municipal authorities on compensation;
- Arguments before the courts on compensation.

- Loss of agricultural land:

Expropriation of agricultural land has to follow the procedure as described above. Furthermore, during construction the following measures should be implemented:

- The contractor must be obliged to carry out works so as not to interfere unnecessarily or improperly with the access to, use and occupation of public or private roads and footpaths to and from properties;
- Private property shall not be used for storage purposes, detour roads and other construction facilities and plants without written permission of the owner or lessee and payment to him if necessary;
- The contractor shall also select, arrange for and if necessary pay for sites for detours, for the storage of equipment or other uses necessary for construction works;
- After completion of works, the area used must be cleaned up and restored to the satisfaction of the landowner;
- Any long-term loss of agricultural land has to be compensated according to Law. If land is occupied for more than one cropping season, loss of crop has to be compensated accordingly;
- In case of usage of grazing land, reseeding immediately to minimize disturbance and losses should rehabilitate the area;
- Access roads to local agricultural property should be guaranteed after completion of the motorway.

Safety

- Accidents due to construction works/machinery

  - In general, safety rules for construction sites have to be fixed through contract obligations;
  - To reduce risks of accidents during construction (detour roads etc.) warning signs specifying speed limits, fencing of construction sites, lighting at night if necessary must be installed also at detour roads, access roads to base camp, quarry and other construction related sites. Detour and access roads must be regularly maintained to an adequate standard (provide speed bumps where necessary);
  - Speed limits have to be fixed on construction traffic, fencing of quarries and borrow pits and exclusion of the public where heavy machinery is working is to be provided, as well as appropriate safety training for workers;
  - Storage and construction activities have to be regulated and indicated clearly in the contracting documents to avoid danger or obstruction to passing traffic.

Economic development

To ensure that employment opportunities are available for local population, the contractor should maximize the use of local labour supply. It must be made sure, that the contractor recruits al large proportion of local labour force and provides training when necessary. This includes consultation with local authorities on establishing local labour relations.

6.2.2 Geology

At the motorway alignment where a slope height is more than 8-10m, one or more 3-4m-wide bermes have to be predicted. Slope in the polifacial complexes can be done with an inclination 2:1, while in the limestone it can be 3:1. In deluvial-aluvail deposits, e.g. on the last 2-5 m, the slope inclinations should be reduced to 1.5: 1.

Whole slopes should be covered with wire netting, since, apart the deluvial-aluvail deposits, softer complex members are also non-resistant to water and frost, e.g. they are easily weathered and washed off. It is here important to mention that a deeper weathering zones of a base rock of Perm, Perm-Triassic, Verfenian and Miocene sediments cohered with clayey cohesive material have been found during exploratory works of drilling and geophysics, thus in these environments, a slope instability can occur due to a large cutting.

Also, aiming at slope protection, an edge channels should be predicted for collecting and controlled drainage of surface waters from the background slopes to the closest water collector. If predicted, slopes steeper than the proposed ones, should be additionally secured with retaining walls, anchors, reinforced concrete ribs etc.

Portal slopes in limestone are much more favourable, since they are less physically and mechanically degraded. There are deluvial-eluvial and talus cover lying over them or they do not have cover at all. With careful explosions, the portal slopes can be performed with the inclination of 3:1 to 4:1. Upper slope edges are to be performed with smaller inclination and protected against weather agents, e.g. washing and falling off. If necessary, slope inclinations can be even steeper if minimum protection measures are applied.

6.2.3 Waters

6.2.3.1 During construction period

In a separate document of Hydrological and Hydraulic Report, it is shown that the motorway construction does not endanger surface watercourses since the designed bridges are so high above the floodwater levels that their structure does not change hydraulic flow conditions. Situation is the same with the proposed culverts which enable undisturbed flow of smaller watercourses through the designed embankments. Problem of erosion and bed load will be solved by the following interventions within the catchment:

- barriers in the riverbed of a depot character,
- anti - erosion works of biological character (forestation),
- administrative anti – erosion measures.

Certainly, some changes in flow conditions can occur in the construction period.

Some legal measures have to be undertaken in respect of pollution prevention. Periodical water system contamination, e.g. surface and underground waters can occur (strictly controlled) only within the construction site and only during specific construction phases.

The main aspects in terms of water pollution prevention within the construction area during the operation phase of the project to be analysed are the following:

1. Prevention of water system contamination by chemical substances used within the construction site;
2. Prevention of contamination by disposal of waste at the temporary disposal sites;
3. Recommendations concerning fuel distribution to the construction sites and refuelling;
4. Waste water drainage and treatment facilities;
5. Construction machinery maintenance.

Water quality preservation

It is possible during excavation and filling works that contaminating residuals/suspended solid particles be discharged into the surface watercourses. However, with the adoption of good site management practices, this will not cause a significant adverse impact. All construction activities associated with the project will accord with best construction management practice.

On a construction site, rainwater washes away the construction materials stocks (especially the dusty ones), and the fine particles are discharged over to the neighbouring land. Thus, the local lands morphology influences the pollutants distribution into the area. In order to avoid any inconvenience generated by the temporary stocks of construction materials, it is recommended that the storage platforms be arranged with retaining ditches.

Also, all works performed in vicinity of the brooks will inevitably load the waters with mud.

Special attention must be paid to slope protection in order to avoid material loss (especially mortar) that can increase a water alkalinity.

However, relatively small number of works will not have big impact on the water quality in the region.

Waste water treatment

Since the locations of construction site facilities and permanent stockpiles of construction material to be used for construction of the motorway section are not known yet, at the moment there is no need for specific structures for waste waters collecting and treatment. Torrent waters can wash away temporary storage of construction materials. The temporary stocks of construction materials may be washed off by storm water, thus it is recommended that guarding trenches surround the storage yards. These trenches shall be periodically cleaned in order to avoid clogging.

Outflow Rates and Pollutant Concentration vs. Environmental Legislation in Force

Concerning possible water body pollution, it is assumed not to be significant if the good practise of construction site management will be adopted. Fuel and other chemical compounds will be stored in the secured place, with no public access and in special tanks, in accordance with the regulation for each compound. Waste waters generated by washing construction and transportation vehicles will be collected in the channels and settled prior to discharge. As necessary, the sediment material will be pumped out into the car cisterns and will be transported to the nearest waste water treatment station.

Wherever possible, closed areas, isolated from the main water stream with smaller channels, will be established, in order to reduce turbidity of surface waters downstream of construction site.

The water pumped out from the excavations will be discharged into natural recipients, using sedimentation pits that have the task to decrease the loading in suspended particles, and to minimise the turbidity of the water and the erosion of the riverbed.

6.2.3.2 During operation period

In mentioned document-Hydrological and Hydraulic Report it is shown that the motorway construction does not endanger surface watercourses since the designed bridges are that high above the floodwater levels that their structure does not change hydraulic conditions. Situation is the same with the proposed culverts which enable undisturbed flow of smaller watercourses through the designed embankments. Proposed works of anti-erosion protection and protection against carrying the bed load during operation period are brought to the level of their regural maintenance during the operation period.

As for the operation period the prevention of water pollution will need to pursue the same measures.

The main measures for the control and prevention of the water pollution are:

- The presence of water drainage and wastewater treatment facilities;
- The periodical check-up of the collection, treatment and discharging system of the precipitation waters;

Water

Special attention must be paid to the protection and maintenance of groundwater and surface water quality.

In this case the followings measures have to be considered:

- Trenches along the roads to collect rain water that comes form the road platform;
- The sludge collected from the trenches and from the decanter chambers will be transported to specific landfill or to waste water treatment plant, to be treat together with the sludge resulted from the processes developed in this plant;
- A continues monitoring will allow to improve the solution has been adopted by this project.
- The drainage system on the base of the road embankment have to mitigate any possible land sliding;
- The run-off dissipaters will be protected with stone and concrete structures;
- It must be established which sectors of the road are restricted areas and thus permitted to transport only hazardous substances. These measures will be correlated with those imposed by the public health authority and public water company;

Wastewater Treatment

Wastewater treatment prevents exceeding limit indicators specified in the environmental legislation in force. Some comments about Waste Water Treatment are also necessary

- The water that comes from the roads pavement will be collected in the trenches along the roads; before being discharged into the streams it will be sedimented in order to ensure the sedimentation of solid particles transported by this water;
- Inflow will occur during the rain period so that the flow rate of all water courses will be higher than normal, and dilution will ensure decrease of the concentration; this water will have an increased turbidity so for time it will not be used in households;
- The future Technical project will analyse in details each of the discharge point along the road and appropriate measures will be proposed, in order to ensure the quality of water inflowing a natural river bed comply with the pollution level imposed by national regulations.

The storm water drained from the road surface shall go mainly into drainage canals. Thus, it is necessary to purify the water and bring its polluting nature bellow the indicator limitation values. With heavy rain, large quantities of water run of the road surface; the drained water contains different polluting substances, particles and other types of hazardous substances, dispersed on the whole length of the road.

According to the provisions in the Guide on Roads and Environment, prepared by the World Bank for surface water collected from road slopes, the following solutions may be applied:

Direct discharge into the environment	This solution is adopted for insensitive areas, but is not beneficial for environmental protection.
Ground trenches grassed in order to speed up the infiltration process	This solution is adopted in sensitive areas, but is not beneficial for environmental protection.
Macrophyte lagoons, ensuring better filtration	This solution is adopted for sensitive areas.
Full treatment: waterproofing the lagoon bottom, eliminating oil products and use of *macrophyte*.	This solution is adopted for highly sensitive areas; however, it requires permanent maintenance.

6.2.3.3 Treatment System of water collected and location

Within Preliminary Design of Corridor Vc Motorway, Section Tarčin – Mostar, the treatment of waters collected from road should be taken into account. Waters from road will be collected through gullies designed according to hydraulic analysis of gully. Further on, water will be treated through the drain, placed in dividing zone, up to the place of exhaust. Nearby water flows are most often used as recipients.

Water collected by this method contains huge quantities of contaminants. The most often are solid particles that are outcome of car brakes and various petroleum products (engine oil and motor fuel) which are, due to the various different causes, present at the road.

All above require treatment of water in corresponding manner in order to improve its quality before final exhaust.

Therefore, water treatment plants and separators are foreseen along opened alignment according to calculated quantities of water.

Also, rainfall on the bridges will be collected from the surface by bridge gullies and further on through vertical and horizontal pipe system carried out to the separators located on corresponding places along bridge poles.

It is necessary to foresee settlement tanks for separators, in case it is not integrated in separator. Settlement tanks volume should be 10 to 20 times bigger then flow, on which separator is dimensioned. Separator capacity is defined according to calculated quantities of water. Level of water treatment (purification) through removal of oiled particles is defined by classes. Separators of classes I and II will be used for water treatment from asphalt. They should be equipped with tapholes for control sampling.

Separators and settlement tanks are made of reinforced concrete, and obtained as finished (completed) elements. It is necessary to dig a hole in natural material and fill with layer of sandy material, grading 0-4 mm and thickness 10-15 cm. Further details on incorporation and connection to drainage system should be taken from manufacturer instructions.

Water treatment plants are foreseen nearby settlement that is improved measure of water treatment. Flows for all levels of treatment are calculated for designed water treatment plant type. Besides part for removal of oil derivatives, the lagoon owns settlement tank. Design flow for this type of water treatment is approx. 120 l/s.

Water treatment plants are foreseen to be of reinforced concrete, made in-site, according to Project details.

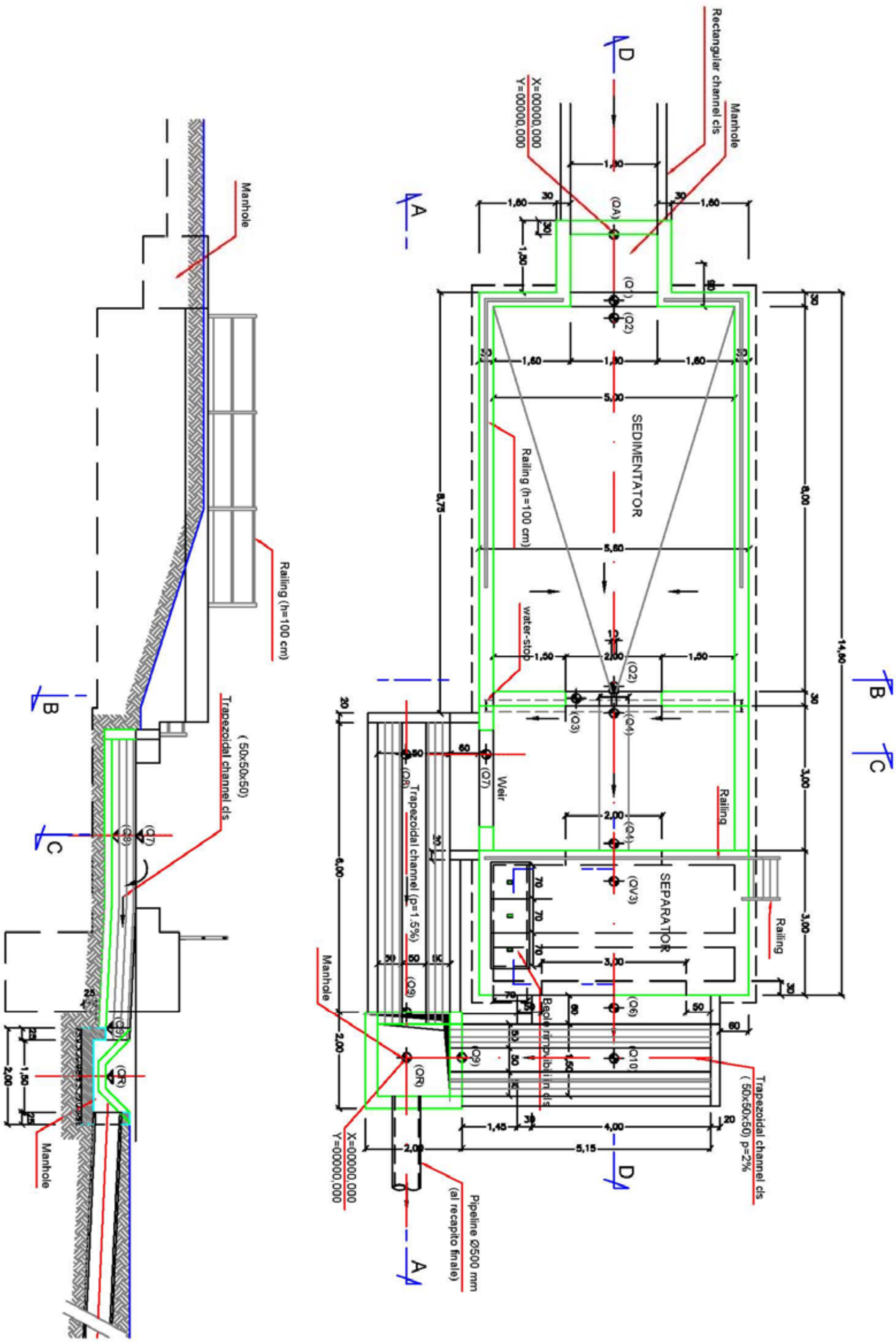
The locations of treatment plants are tabulary presented by stations as following:

WATER TREATMENT PLANTS (km)
0+350
0+850
1+350
1+850
2+350
21+630
21+870
22+225
36+320
36+580
58+080
58+650

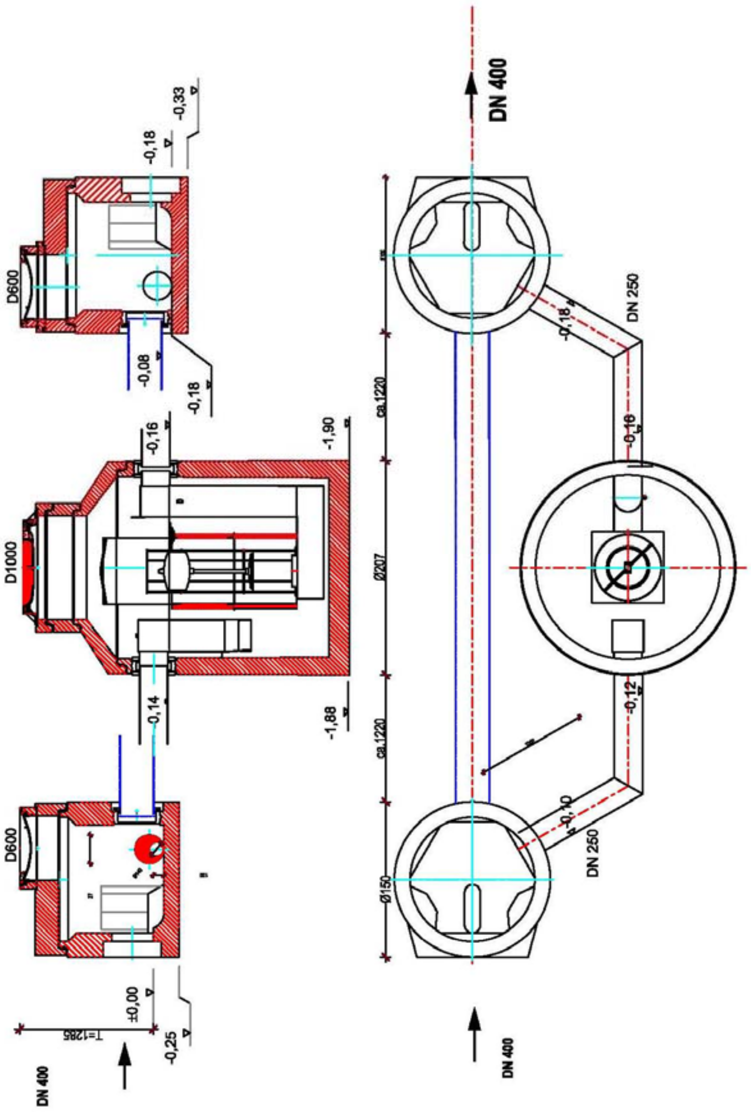
SEPARATORS (km)	
2+730	32+980
3+600	33+420
3+900	33+730
4+200	33+900
7+700	34+300

8+220	35+500
9+400	37+020
10+250	37+080
10+480	38+320
11+050	38+650
12+780	39+960
14+890	46+580
16+000	46+920
16+400	47+180
17+780	47+780
18+630	48+200
19+825	48+350
22+630	48+870
22+950	49+050
23+400	51+160
23+800	52+800
24+550	53+170
25+280	56+030
28+050	56+900
28+400	59+050
29+130	59+700

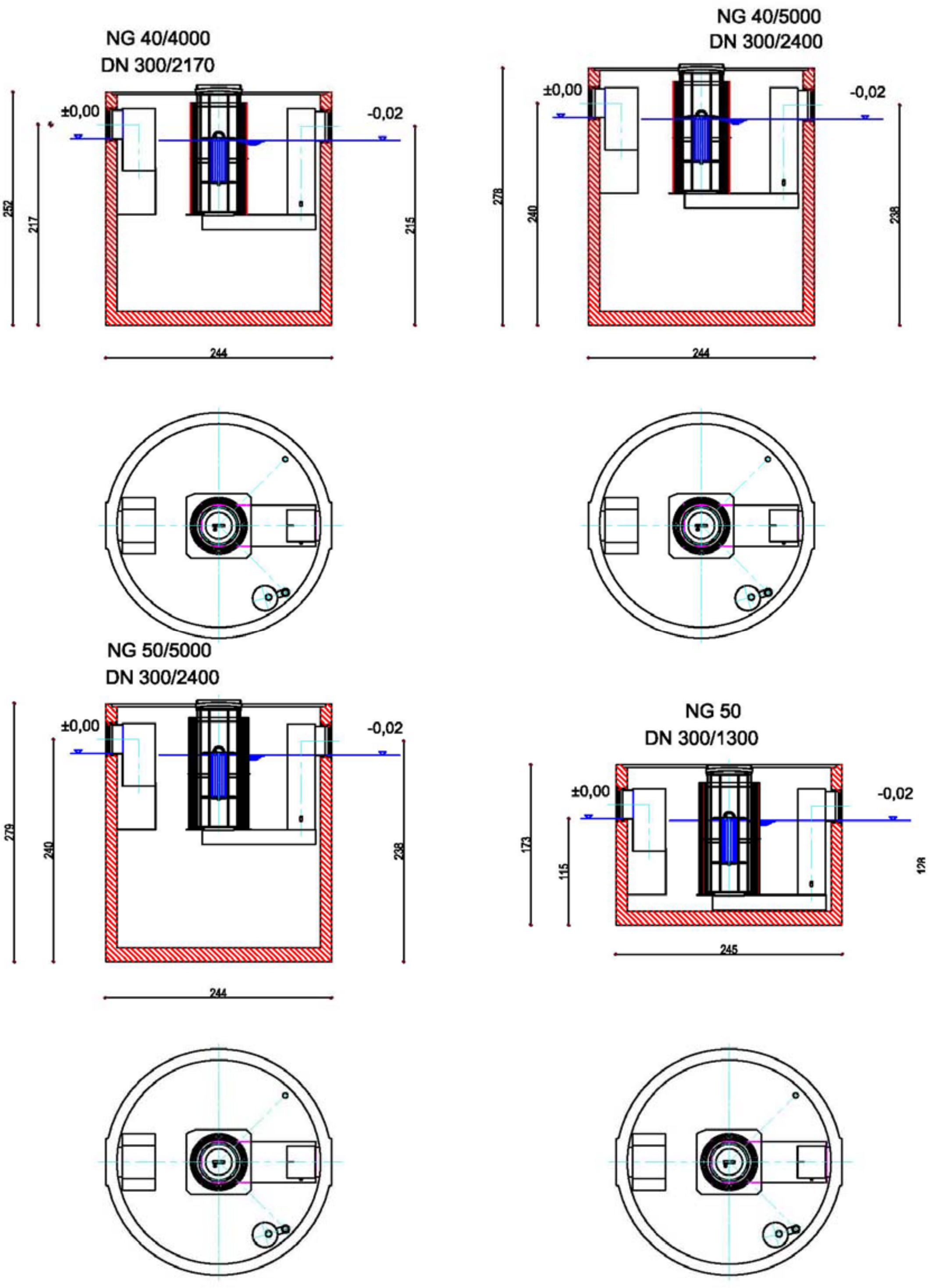
Settlement tanks, separators and water treatment plants are hydro-technical structures that demands maintenance, otherwise they will lose their function with time.
Drawings on mentioned structures are annexed.



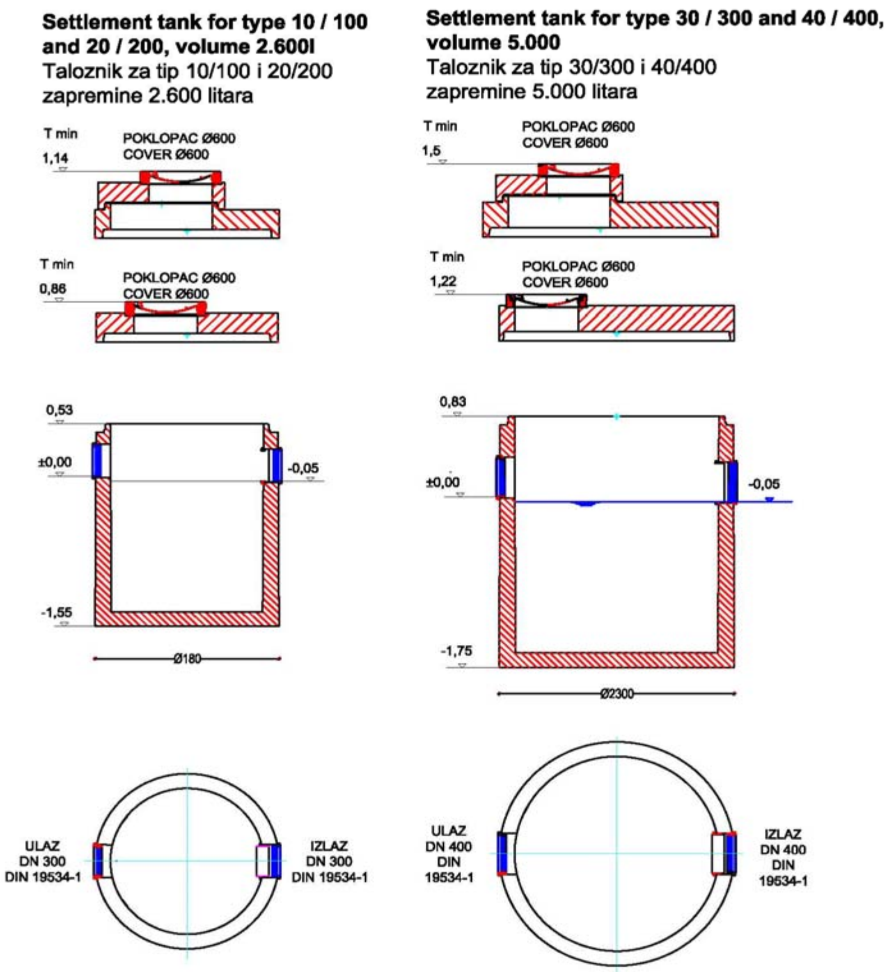
Layout and cross section of lagoon for rainfall waters treatment


DN 400
D600
D1000
D600
DN 400
DN 250
DN 250
DN 400

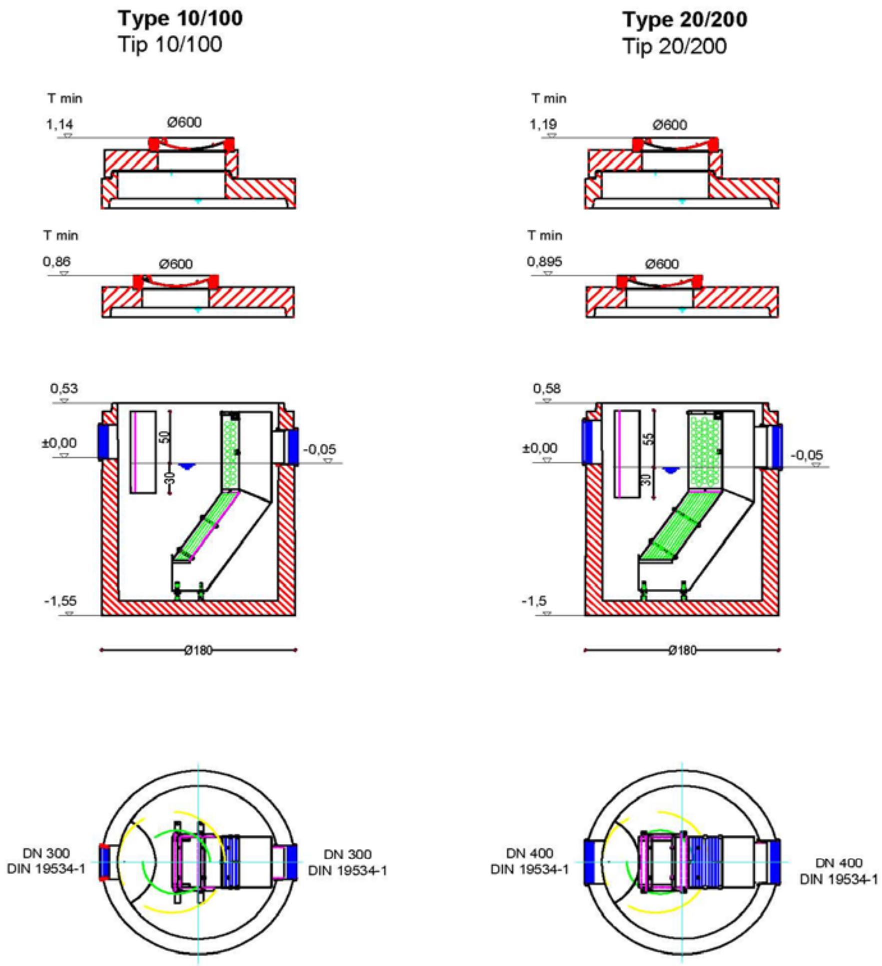
Detail of coalescent separator



Detail of coalescent separator



Settlement tank



Lamella separator

6.2.3.4 Disposal-water system in tunnel sections

The purpose of this paragraph is the dimension and the verification of the disposal-waters system in the tunnel sections of the switchback in design “Corridor Vc Motorway – Lot 3 section Sarajevo Sauth (Tarcin) Moster North. To protect the superficials and the undergrounds water bodies the project criterion followed, doesn’t go against the hydrologic vulnerability of the examinated area.

The disposal-waters system forecasts to share the buildups of the natural drainage waters from the platform waters.

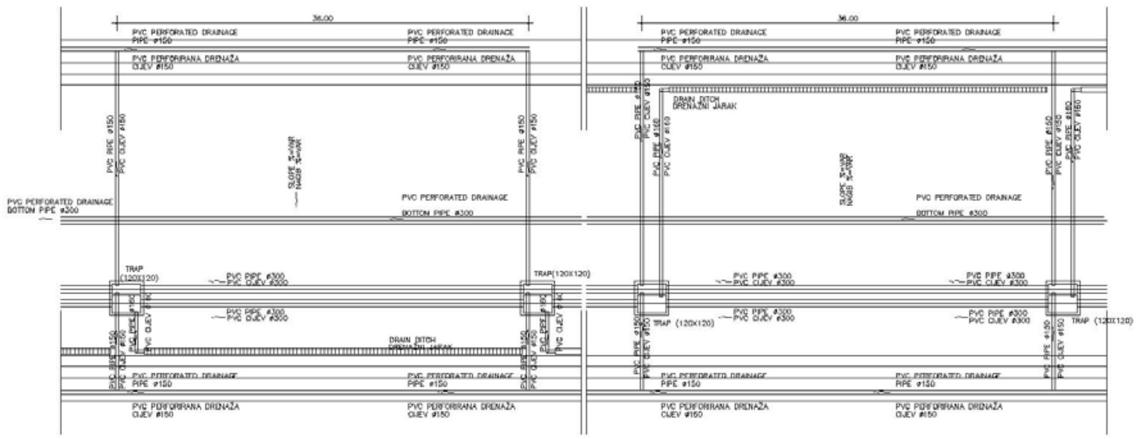
For the platform waters, is forecasted a close system made by gutters supported by manifolds of P.V.C cause of more pollution risk (oil-leakage and leakage of fuel from the tank of stopped vehicles).

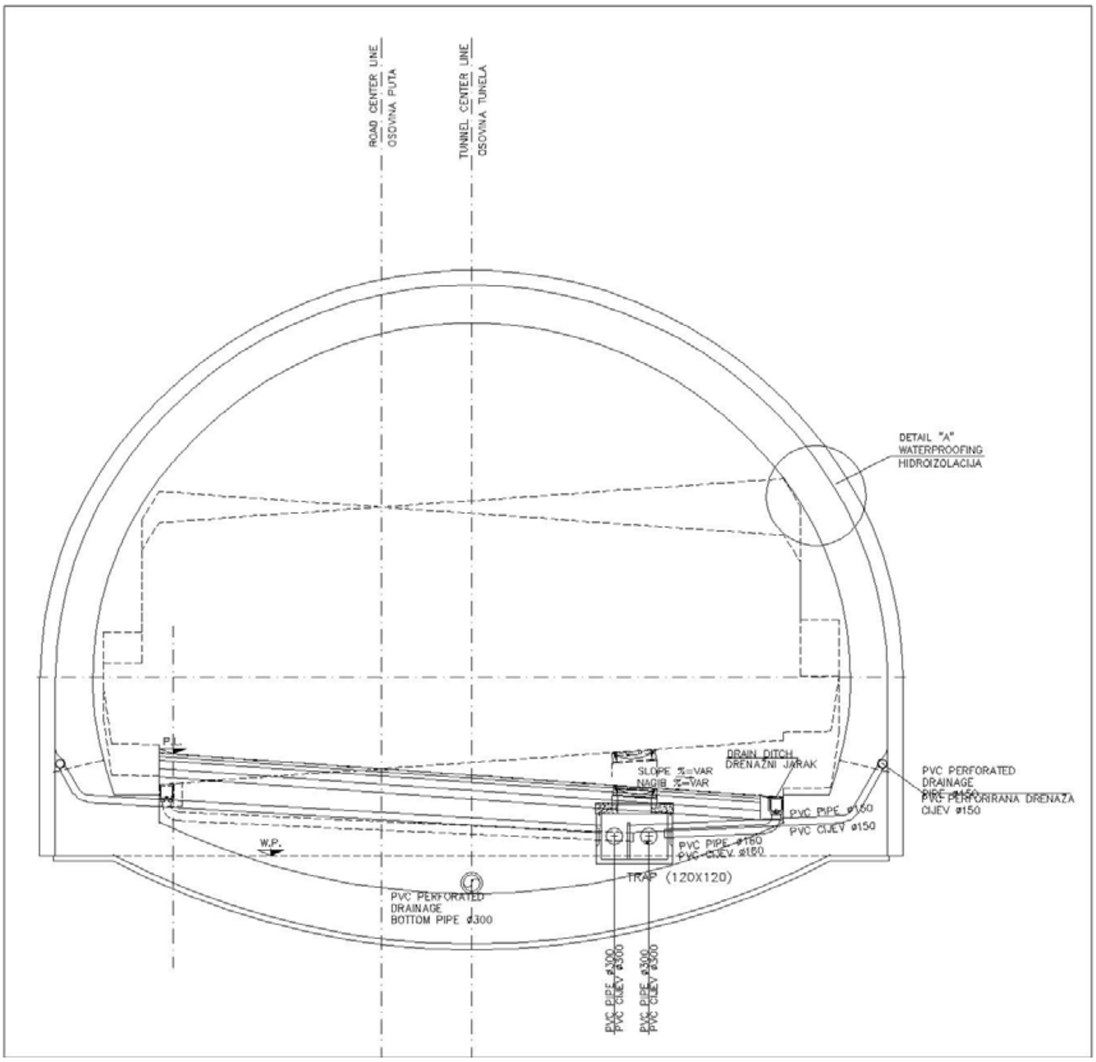
These waters are piped, before the final destination, to treatment plant (to remove the oil).

This peculiar system, where are holded oils collated during the rainwash on the roadway platform, is necessary for the requirements of protection of near acquifers.

The waters coming from natural drainage are directly piped into catcher bodies. The drainage system is composed by two pipelines (Diameter Φ 150 made by p.v.c, microfissured), located at exterior of dome with input into tunnel catch basin every 36,00 m, and it is composed too by pipeline (Diameter Φ 300), located at extrados of inverted arch.

PLANIMETRIC DIAGRAM OF HOOKUP

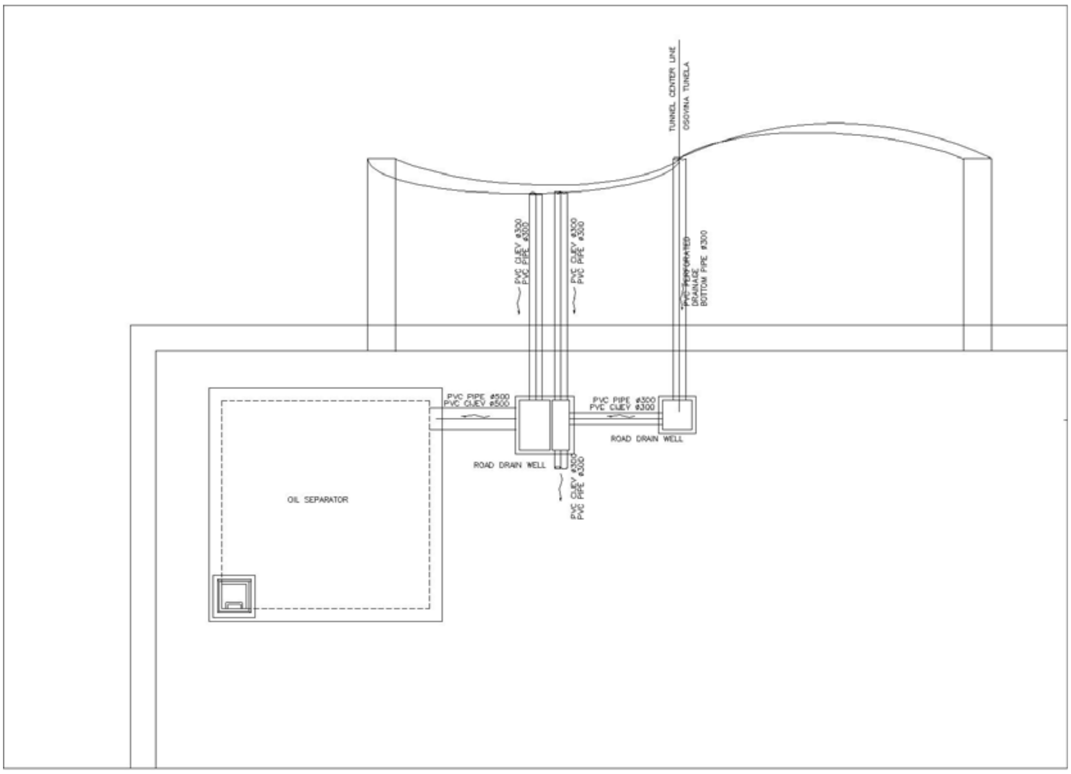



ROAD CENTER LINE
OSOVINA PUTA
TUNNEL CENTER LINE
OSOVINA TUNELA
DETAIL "A"
WATERPROOFING
HIDROIZOLACIJA
P.L.
DRAIN DITCH
DRENAZNI JARAK
SLOPE %=VAR
NAGIB %=VAR
PVC PERFORATED
DRAINAGE
PIPE ø150
PVC PERFORIRANA DRENAZA
CIJEV ø150
PVC PIPE ø150
PVC CIJEV ø150
PVC PIPE ø160
PVC CIJEV ø160
TRAP (120X120)
W.P.
PVC PERFORATED
DRAINAGE
BOTTOM PIPE ø300
PVC PIPE ø300
PVC CIJEV ø300
PVC PIPE ø300
PVC CIJEV ø300

Stilling pool

The stilling pool of black waters is made of reinforced cocncrete by square plant or rectangular plant and it has the peculiar function to accumulate the waters full of suspended solids and mineral-oils which there are on the roadway platform.

The dimension of the tank depends from design flow. The management and maintenance are easy: it will be necessary by periodicity, acting from inspections of cover, to extract oil accumulated on the surface and the sludges accumulated on the bottom of the tank by a tank-truck and to transfer it to checked burrow or to treatment plants.



Hydraulic study

Hydraulic verifications were made according to condition of uniform motion, adopting the formula of Gauckel – Strickler:

$$Q = K_S \cdot \Omega \cdot R^{\frac{2}{3}} \cdot \sqrt{i}$$

where:

Q	expressed flow	$[m^3 / \sec]$
K_S	coefficient of hydraulic conductivity expressed by	$[m^{1/3} / \sec]$
R	hydraulic radius	$[m]$
i	grade of bottom of manifold	$[m/m]$
Ω	hydraulic section	$[m^2]$

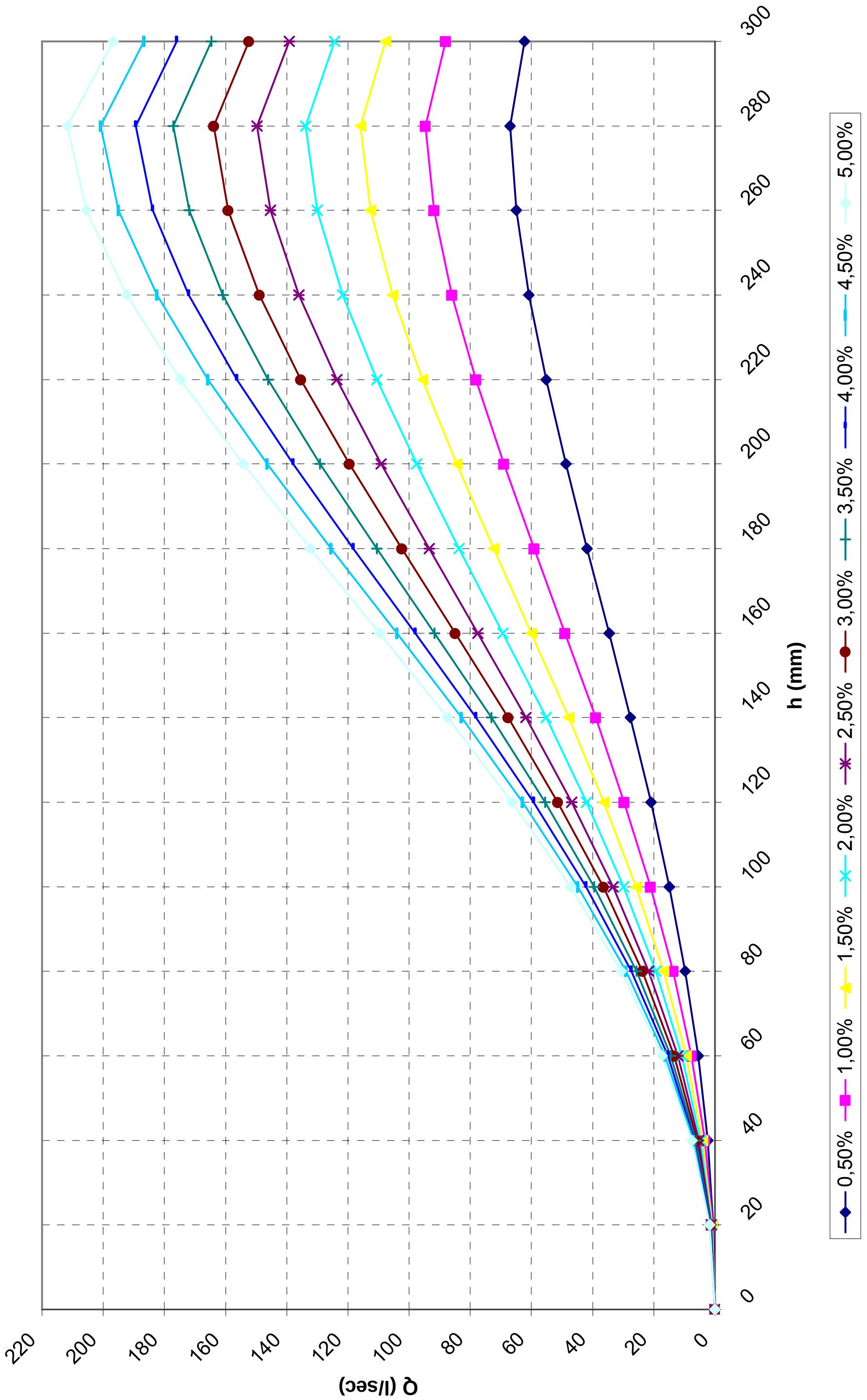
Since single pipelines are made by P.V.C. and the waters are rich of suspended substances, for the coefficient K_S is choosen the value of 70.

The grades of manifolds are assumed coincidence with the grades of relativ segments of road.

Hydraulic calculus consists to determinate the maximum flow, correspondent to value of filling of 100%, changing of grade of manifold.

The diameter of manifold (Φ 300) is the same for both drainage systems: natural (white waters), and artificial (black waters). For this reason the calculus refers to both drainage systems.

DEFLUXION SCALE OF PIPELINE Φ 300



6.2.4 Air quality

The area interested to the new road is characterized by mountainous orography scarcely populated. In fact, there are only few buildings in the neighbourhood of the project. They are present mainly in tree points:

1. In proximity to Smucka (from km 0+950 to km 1+150);
2. In proximity to Jablaničko Jezero (from km 21+150 to km 22+150);
3. In proximity to km 24+700

Some infrastructures are already present in these zones, in particular the existing road from Sarajevo to Konjic and the railway.

For receptors no.1, 2 and 3 is not necessary to take any mitigation measures because the installations of phono-absorbent panels or creation of green screens for reduction of sound transmission is enough for to contain the air pollutant.

Moreover, the proposed motorway is located in the predicted National Park area characterized by forest and agricultural zones.

The computed emissions for the new road are not so high to expect any remarkable impact on plants present in this Park.

6.2.5 Soil

Mitigation of direct and indirect impacts on the soil and agricultural land has a complex and continuous approach.

Mitigation measure complexity is shown in necessity to apply those measures in combination with a designer and technological elements. Continuity reflects in the fact that the mitigation measures must be taken during both construction and operation period of the motorway.

All mitigation measures are to be continuously monitored and improved. Some new, additional mitigation measures will be introduced, as a result of negative impacts monitoring, especially during operation period. Such additional measures are aimed at minimising all negative impacts.

Mitigation of negative impacts must be undertaken during the construction and operation phase of the motorway and its supporting facilities.

During construction period, a contractor will have to realise the proposed measures for minimising soil destruction and agricultural land take. All material storages, borrow pits, construction machinery bases and workshops, construction camps and similar objects must be established at the locations that are not characteristic by deep, fertile soil, outside the areas of agriculture land. Such approach during the motorway construction would represent the most efficient mitigation measure in respect of soil and agriculture land.

As mitigation measure of negative impacts on soil and agricultural land, at the locations of warehouses, construction material bases, service workshops or other temporary facilities, it will be necessary to install screens for protection against undesired contaminants. In addition to such screens, at the locations of heavy machinery and truck traffic, it will be necessary to place a water-spraying devices in order to avoid that the dust interfere with the agricultural production. The measures proposed should be taken on all localities with determined agricultural land whose stations have been indicated in the Chapter 4.6.

For the soil, as a natural resource, the most important mitigation measure would be to realise the concept of soil re-qualification to the status that it had before construction works had started, unless it was completely destroyed by construction of some permanent structure. Therefore, in order to realise the concept proposed, for the locations to be damaged or permanently destroyed, it will be necessary to completely remove a fertile layer or pedosphere and to dispose it at the location from which it will be possible to transport the soil back after the work completion and to use it for correction of damaged locations. Corrections will be made by layering the soil in quantities that will enable undisturbed growth and development of plants.

This concept of mitigation measures concerning soils will be realised along the entire Lot 3 section, at the stations where there will be direct negative impacts, as shown in the Chapter 5.7.

Construction of civil structures as a mitigation measure for negative impacts on the agricultural land are proposed at the stations where the negative impacts on soil and agricultural land will take place. These structures are to be realised as improvement of communication with the agricultural land. Proposed are design solutions as the motorway overpasses and underpasses, in order to maintain agricultural production in a profitable framework. Important mitigation measure for soil and agricultural land is also construction of specific combined civil structures in form of barriers. The barriers are concrete or metal, using Plexiglas panels which prevent contamination of soil and agricultural land by any contaminants from the motorway. The said barriers would provide excellent measure for mitigation of direct and specialy negative impacts on the stations stated in Chapters 4.6 and 5.7 and which significantly endanger the most quality productive agricultural areas.

Mitigation or complete neutralisation of indirect negative impacts should be realised by establishment of protective vegetation strips, with different dimensions, shapes and plant structure for each location. Special attention to vegetation protective strips will be paid in the agricultural areas of the highest quality, at the stations indicated in the Chapter 5.7. Protective strips will have natural, e.g. vegetation character and will mitigate contaminating effects of fuel combustion products and other contaminants coming from the motorway and they represent the most important ecological ambient-related mitigation measure for indirect negative effects.

In the frame of the proposed Project, there are tree locations at the motorway exits that are located in the agricultural zones. In these areas proposed are biological mitigation measures of forming one or two rows of suitable shrubby vegetation. Such vegetation systems for mitigation of negative impacts in the interchange zones are proposed due to large areas occupied by the interchanges and low traffic speeds in these areas. It is considered that application of such systems will result in achievement of strong mitigation effects in respect of negative impacts on agricultural land.

Precise stations with proposed mitigation measures are given on the map, containing a legend with symbols for specific mitigation measures.

6.2.6 Flora

Mitigations aim at minimizing and eliminating the negative project impacts (both during the construction phase and when the infrastructure is operating). They are important in order to identify the proper measures capable of ensuring the full merging of the project into the pre-existing environmental context.

Planting of autochthonous vegetation (trees, bushes and grasses) along the motorway and the surrounding areas, in order to also compensate vegetation cutting, improve visual effect of the surrounding area and to protect from dust. Safeguard of older trees in the construction sites and in the secondary roads leading to them and along water courses. Renaturation of the construction areas and the secondary roads leading to the construction sites. Control of air pollution and monitoring of vegetation status; monitoring of the biological and chemical status of surrounding watercourses, including flora and vegetation and soil status checking, fire protection measures.

6.2.6.1 Mitigation measures during preparation and construction period

Mitigation measures during the Project preparation

- Prior to the construction it is necessary to choose disposal sites for construction and other waste material, parking places and places for refuelling with a purpose of environment and nature protection;
- All temporary structures used for construction purposes must be located outside of the sensitive zones of the future National park;
- Preservation of older forest samples at the alignment sections wherever possible;
- Indirectly, prior to the construction start, it is necessary to chose disposal sites for construction and other waste material, parking, manoeuvring and refuelling places for construction machinery aiming at protection of vegetation cover;
- Before construction works it is necessary to develop a strategy for underground habitat protection (discovery of underground flora) which is to be applied in the case of its discovery while digging the tunnels that are much present in this Lot in both qualitative and quantitative sense (number and length);
- While constructing overpasses, in case of non-existence of natural protection, it is necessary to plant an autochthonous vegetation , for its complete insertion into landscape, enabling undisturbed and un-fearfully passing of game and animals;
- Design and shape of the bridges are to be taken in consideration aiming at its as good as possible insertion into river and lacustrian landscape;
- Minimising impacts of bridge construction on the environment, not to disturb natural balance of the canyons and other places;
- For arrangement of different surfaces along the motorway and around service facilities, vegetation species appearing in the systems in the wider area of the alignment are to be used.

Mitigation measures during the Project operation

- During earthworks, humus layer disposal is to be controlled and humus layer is to be used latter for arrangement of slopes and green strips or for other purposes in accordance with regulations;

- Heavy machinery movement is to be limited in order to reduce devastated surface, e.g. the existing road network is to be used and repaired after the works are finished;
- Controlled disposal of community, construction, hazardous and other waste at the disposal sites with approval from the authorised utility companies along the alignment. It is necessary to obtain impermeable containers for waste material and to take a good care of temporary and permanent disposal in the environment;
- Surplus excavated material is to be incorporated into embankments and disposal sites, and not by any mean „levelled" in the frame of natural vegetation, in order to prevent spreading of weed and neophyte species.
- Compulsory and efficient soil protection (especially agricultural land of higher value class) from the emission of solid particles by planting protective vegetation strips along the motorway edge, in order to provide good soil insulation in the zone of impact;
- Slope arrangement in order to prevent landslides and trees falling down at the new-formed edges. This particularly relates to the tunnels and ending parts of the viaducts;
- Minimising the damages on the forest, resulted from the motorway construction can be provided by careful work and by undertaking the prescribed measures and work procedures. This is primarily concerning damage on edge trees and its roots. To avoid this, it is necessary, immediately upon the alignment is cut through, to establish a forest order, e.g. to remove tree stumps, and to move away all wooden mass. It is necessary to cut all damaged and broken trees, so they wouldn't become source of decease. This can be particularly applied on cultivations of black pine and Alpine pine, which are particularly sensitive to wounds. During the last fifty years, the area around the settlements was forested with these species in some parts of the future motorway. In fact, the forest order establishment will enable the remaining trees, especially the ones at the new-created edges; form the new protective edge faster. That will protect the tree stands from the direct and indirect negative impacts;
- For these activities, especially for the forest clearance, according to the Federal law on forests, it is necessary to prepare Environment Impact Assessment;
- Special attention should be paid to flammable material and open fire handling in order to prevent forest fires. It is necessary to comply with all rules and regulations on forest fire protection. After construction is finished it is necessary to place signs of warning about limited use of fire, e.g. about the fire hazard;
- Existing vegetation is to be preserved while bridging over the water ecosystems;
- Provision of bio-speleologist's supervision during the tunnel construction;
- In case of discovered underground structures and underground flora, it is necessary to stop the works until the bio-potholing team defines the value and the required protection measures for the underground flora and its habitats;
- Provision of permanent monitoring of underground flora and its habitats discovered at the time of tunnel construction (if evaluated as important by the bio-speleologist) as well as application of all necessary protection measures of underground flora and floristic habitats;

- Surplus material, especially under the viaducts, that will not be used for construction activities, must be dislocated to the special location where the impact on flora has been considered;
- While constructing overpasses for game it is necessary to preserve surrounding flora in order to lead the game naturally towards the passage.
- Horticultural interventions are to strengthen inhabiting and development of autochthonous vegetation, on all places where planting is not predicted by the project (embankment and other), otherwise the neophyte and other species which earlier did not inhabit the area will develop.

6.2.6.2 Mitigation measures during operation period

- Selection of appropriate locations and ways of storing chemicals used for the motorway maintenance (salt, fertilisers, pesticides etc.), for the purpose of water flora protection;
- Avoiding use of defrosting salt and other chemicals if possible;
- In cooperation with the authorised Federal and Cantonal governments it is necessary to form appropriately trained and equipped teams for emergency interventions and to prepare appropriate operational plans of emergency interventions in different accidental situations;
- Temporary facilities (asphalt bases, concrete plants, and parking lots for the machinery etc.) are to be located outside of the water protection zones. If it is not possible, than it is necessary to apply the same underground water protection measures, by the same criteria like for the motorway itself;
- If the monitoring of the agricultural land status indicates an increased level of heavy metals, it means that the protection by vegetation strips is not well conducted or it is not efficient. In that case, in accordance with Book of regulations on agricultural land protection from pollution with hazardous substances, if the measured value exceeds maximum allowed quantities of hazardous matters in the soil, such soil is to be separated from the pool of agricultural land and turned to the forestland pool. In addition, it will be necessary to discover the reasons of the surrounding soil contamination, and to re-cultivate vegetation protective strip, with application of zeolite substances that can adsorb the heavy metals;
- Removal of weed has to be a part of regular maintenance of green belt, interchange area and ancillary service facilities;

6.2.7 Fauna

Mitigations aim at minimizing and eliminating the negative effects of the project (both during the construction phase and when the infrastructure is operating). They are important in order to identify the proper measures capable of ensuring the full merging of the project into the pre-existing environmental context.

Planting of autochthonous vegetation along the motorway and the surrounding areas, in order to recreate proper habitats for fauna; building of protection fences in the places where wild animals cross the motorway; noise control by planting additional vegetation (rows and edges) in the places where the impact on animals proved to be negative; sufficient number of fauna passages**,** their maintenance in order not to disturb game passing under the motorway; Providing protection of the open water courses along the alignment (water construction works with the help of bioengineering techniques; reforesting of riparian strips in case of cuttings, avoiding muddying up the stream, creating passages for water in case of transversal barriers), monitoring of biological and chemical status of surrounding watercourses in order to protect water fauna; well-planned intervention measures in case of accidents; maintaining records on places and how people and animals were injured, so as to improve protection measures and timely avoid such accidents

6.2.7.1 Mitigation measures during preparation and construction period

Mitigation measures during the Project preparation

- Since the future motorway partially passes along the important water ecosystems from biological point of view, while designing special care should be taken of drainage from the sensitive areas (places inhabited by endemic fish species and their breeding places and their recruiting places);
- All temporary objects of the construction sites must be located outside of sensitive zones of future National Park;
- Before construction works it is necessary to develop a strategy for underground habitat protection (discovery of underground fauna) which is to be applied in the case of its discovery while digging the tunnels that are much present in this Lot in both qualitative and quantitative sense (number and length);
- Passages for animals and green bridges are necessary for reduction of negative impacts through separation of protected animal species, e.g. prevention of and making difficult a gene flow within population of the specific species, especially wolf, bear and chamois. It is very important to leave an underpasses for fish and other mentioned species;
- At the river crossings it is necessary to provide a permanently dry part for communication of small fur-bearing animals also during high water level;
- While designing underpasses it is necessary to plant an autochthonous vegetation , for its complete insertion into landscape, enabling undisturbed and un-fearfully passing of game and animals;
- In order to prevent animals and game coming on the road, it is necessary to predict sufficiently high fences, whose lower part must be fixed in the ground.

Mitigation measures during construction period

- During earthworks, humus layer disposal is to be controlled and humus layer is to be used latter for arrangement of slopes and green strips or for other purposes in accordance with regulations (protection of pedofauna);
- Provision of bio-speleologist's supervision during the tunnel construction along the alignment;
- In case of discovered underground structures and underground flora, it is necessary to stop the works until the bio-potholing team defines the value and the required protection measures for the underground fauna;

- Provision of permanent monitoring of underground fauna and its habitats discovered at the time of tunnel construction (if evaluated as important by the bio-speleologist) as well as application of all necessary protection measures of underground fauna and faunistic habitats;
- During construction of viaducts, it is necessary to keep the impact on the habitats as little as possible since these migration corridors will be used by animals also during the construction period;
- Surplus material, especially under the viaducts, that will not be used for construction activities, must be dislocated to the special location where the impact on flora has been considered (mostly in respect of natural game passes);
- In cooperation with hunter's associations in the area of consideration, it is necessary to consider common game paths in order to mark them properly with traffic signalisation and avoid game getting injured by vehicles;
- Determination of directions and corridors for movement of people and vehicles in order to protect the area from unnecessary and uncontrolled movement within the hunting area;
- While constructing passages for game it is necessary to preserve surrounding flora in order to lead the game naturally towards the passage;
- Dislocation of hunting structures from the alignment (feeding places, shooting stands) in cooperation with hunter's associations

6.2.7.2 Mitigation measures during operation period

- During the motorway operation, water protection (water fauna) is achieved through the maintenance of drainage systems, choosing appropriate locations for maintenance service facilities, as well as choosing suitable materials used for the maintenance;
- Issuing specific Regulations regulating these activities;
- Choice of appropriate locations for storing chemicals used for the road maintenance (salt, fertilisers, pesticides etc.);
- Avoiding salts for defrosting and other chemicals as much as possible;
- Regular cleaning and quality maintenance of all plants and equipment for water protection; Definition of disposal methods of the material generated by cleaning in cooperation with local community, in accordance with the Law on waste management;
- In cooperation with the authorised Federal and Cantonal governments it is necessary to form appropriately trained and equipped teams for emergency interventions and to prepare appropriate operational plans of emergency interventions in different accidental situations;
- Temporary facilities (asphalt bases, concrete plants, and parking lots for the machinery etc.) are to be located outside of the water protection zones. If it is not possible, than it is necessary to apply the same underground water protection measures, by the same criteria like for the motorway itself;

- For the purpose of people and animals injury prevention, the motorway maintenance service is obliged to record such injury cases in order to respond timely with additional protection measures;
- All noticed damages to the fence are to be promptly repaired;
- If it is proofed that the injuries of people and animals in the traffic are increasing in spite of the fence, additional measures should be undertaken in form of placing chemical repellent for game.

6.2.8 Landscape

During construction period

As said before, at this phase of the project the exact locations of the construction sites are not identified yet, and thus it’s impossible to indicate the mitigation measures about the landscape impacts. But in general:

- Visible nuisance, like dust clouds from construction, can be mitigate by good site management practices like spraying water on unpaved sections and work roads and sites;
- Open cuts shall be re-vegetating as soon is possible that is also desirable to prevent soil erosion;
- Wastelands will retrain with green plantations or agricultural use.

During operation period

The nature of alteration of topography by a road project in general is permanent. However, landscape impacts can be mitigated to some extent by green shielding of structures and architectural design to integrate structures into surrounding environment. TEM standard recommends that where possible undesirable visual effects of the surroundings should be enhanced or corrected by implementing suitable landscape measures.

While seeding of grasses and scrubs show short term effects in covering open soil areas and exposed slopes, planting of trees and bushes will not show immediate scenery effects at these requires about 10 years in growth until significant green shielding effects are notable.

For the section of the Prenj Park area are to be foreseen working out educational measures aimed at informing the travelling public about the existence and importance of the protected area and the reasons for not feeding wildlife, removing plants, littering, etc.

Land rehabilitation

In the agricultural areas, the realization of the infrastructure could cause an alteration of the continuity of the agricultural soils with a consequent possible alteration of the soils use conditions from the farmers. The continuity in the managing of the soils, especially in regard to the operating of the agricultural machineries, it is to be foreseen in the next phases of the project, realizing flyovers and underpasses that allow the continuity of the farm road network.

Concerning the problems related to the potential impacts on the parcelling agricultural fund system, interventions will be underlined and analyzed only in the next definitive detailed phase, based on a precise reconnaissance of the current land structure and organization of the farms currently working on the territory. In fact, the projects and expropriations studies in depth of the next planning phases, considering the special features of the crossed agricultural landscape, could individuate mitigation measures or environmental compensation that, not strictly or necessarily linked with motorway layout, would especially refer to the division of agricultural land system.

The specific reference to the farm structure present in the organization of the mitigation or compensation activities will allow the use of residual areas of the agricultural funds, directly interfered with the route, avoiding the creation of marginal areas for the agricultural activity and the segmentation and an extreme alteration of environmental ecosystems existing along the crossed territory (watercourses system of the reclamation, the system of fences between the fields and along the road infrastructures).

In connection with the individuation of the compatible uses that produce a benefit in terms of compensation, on the territory crossed by the motorway, it will be necessary, with priority, to verify the possibility of interventions of fund reunification and/or of reattribution of funds to the neighbouring properties finalized to control the parcelling of the properties system. That intervention will be foreseen in correspondence of km 0+000 - km 1+750 in correspondence of Smucka valley.

For the other residual areas (km 1+400 – km 2+750; km 7+700 – km 7+950; km 21+150 – 22+150 in correspondence of Konjic interchange; km 38+350 – km 39+150) the morphological situation could be mitigate with fill interventions, using the residual materials of excavation activities.

The residual materials could be used for the foreseen parking area near Bradina (km 7+700 – km 8+000).

Interventions of environmental and landscape insertions

The morphology of the interested area shows a specific visual sensibility in presence of the motorway structures such as bridges and viaducts. The problems linked to the viaducts and bridges could be resolved in the next phases of the project, foreseeing the structures with a low number of piles and with a local stone covering. The same cover could be foreseen for the section with retaining walls (km 1+750 – km 2+763, km 38+000 – km 39+887, km 48+067 – km 48+554).

The estimated interventions of environmental and landscape insertion are focused to realize hiding elements of the motorway trough the creation of green screens along the motorway slopes in accordance with mitigation measures foreseen from the flora components. The interventions will be calibrated following the type of motorway (in low or high embankment) and will be shrubbery areas. The green interventions will be necessary also in correspondence of the tunnel gates, to mitigate the alteration of the green cover of the mountain slopes.

The proposed interventions, according to the flora mitigation measures and showed in the annexed maps 13.4, are:

- Arrangement of arboreal and shrubby community near the river;
- Green arrangement of interchange and residual area;
- Shrubby stripe arrangement;
- Renaturation systems.

6.2.9 Protected parts of nature

Within the strip, width of 1.00 km on both sides of the planned motorway axes, there is the area protected by the Law on nature protection.

The areas, evaluated as extraordinary natural values should be preserved as such and protection is to be provided in order to avoid disturbance of their original status with bringing the project impact to an optimal minimum.

Already in the designing phase, the foreseen negative impacts are brought to the minimum, by the design solution of the motorway passing through this area mostly through the tunnels. This area, recorded as a natural heritage asset was treated as a protected asset.

6.2.10 Cultural-historic heritage

Potentially endangering effects – concerning both material degradation of cultural property or reduction of visual quality and devastation of its cultural-historical character, must be avoided, neutralised or minimised (brought to the measure at which they can't represent any risk to the property) through implementation of protection measures that encompass technical solutions, instructions, recommendations and monitoring. In the implementation phase of the project, protection measures, according to the analysis stated hereby, for each specific case should be elaborated in detail at the operational level and implemented.

Protection measures are divided in three groups:

- Protection measures during designing period
- Protection measures during construction period
- Protection measures during operation period

The stated categories indicate **stages related to the motorway construction <u>during which the protection measures should be implemented</u>** and/or **development phases of the Project in which the intervention takes place for prevention, neutralisation and minimisation of the negative impacts.**

Practically, it means the following: if, for example, during designing phase, we determine that specific archaeological locality might be destroyed because the alignment is crossing it, than protection measures must be applied already during designing phase. In that case, they will consist of warning and recommendation for the alignment dislocation in a way that the cultural heritage remains outside the negative impact range.

Or: if we assume that tunnel excavation or more significant cuts in compact rock masses (for example a compact limestone) will be done by means of mining (as a standard technology in such cases), and that vibrations can endanger the monument located in immediate vicinity, than the protection measures will have to be applied during construction period (although, anti-vibration protection structures should be designed in the designing phase already).

The other division of mitigation measures is done on a base of the expected intensity of harmful impacts and spatial **relations between the alignment and a heritage asset.**

Properties located in the first zone of impact are exposed to different negative impacts whose quantity and quality depend of the alignment closeness, functional type, status of physical structure and kind of cultural property. That is why we have analysed each particular case and defined concrete protection measures for each station in the First impact zone.

Properties located outside the first zone of impact are not highly vulnerable, but are subject to general protection measures application, regulated by law.

Considering the above statements, we can conclude that the protection measures, by quantity and quality of the impacts expected can be divided to:

- **General protection measures**

These measures imply application of all, by the different laws prescribed measures for a construction site protection, protection of people and structures, as well as application of prescribed standards and regulations in order to avoid negative effects during the motorway operation period.

Partially, application of these measures is described in the other segments of this study or in specific chapters of the main design of the motorway. This ensure that levels of noise, vibration and air pollution are maintained within the range allowed, without a negative consequences or to make safety on work, as well as organisation and technology of a construction site and construction site complying with the applicable laws.

The measures are applied in the first zone of impact, and if deemed necessary, also at the other specific positions or in the whole area of consideration (1 km on both sides from the alignment)

General protection measures are regulated, in the other segment, by the applicable legislation in the field of cultural-historical heritage protection. In that sense, general protection measures include, in first place, prohibition of destruction or damaging to a heritage assets or to potential heritage assets.

Therefore, we can consider the following as a general protection measures:

- prohibition of alignment directly crossing over a heritage assets,
- prohibition of all activities in connection to technical-technological requirements of work performance, that can destroy or damage a heritage asset (formation of an access roads, material depositing, heavy machinery deployment, cranes and similar at archaeological localities)

These measures are applied in the whole area of consideration (1 km right and left from the alignment).

- **Specific protection measures**

These measures are related to mitigation and elimination of the harmful in the First zone of impact.

As stated earlier, in the First zone of impact, certain number of archaeological sites had been registered such as cemeteries and objects/architectural heritage entireties. However, we always have to count on possibility that, during construction works, some so far unknown (covered) archaeological sites or other potential heritage assets are discovered, inaccessible during the research. In that sense, necessary protection measures can be divided to:

Specific protection regime-specific measures

Mitigation measures in the frame of a specific protection regime encompass elimination or neutralisation of **concrete harmful effects** to be expected at the specific, recorded (known) locations and these measures are given for each conflict point separately. They are applied in the First zone of impact.

Specific protection regime-preventive measures

These measures encompass a general protection procedures to be complied with in order to prevent degradation of unknown (non-recorded) archaeological sites, objects (or entireties) of architectural heritage, tombstones, as well as degradation of known (recorded) assets that might happen in the case of the alignment shifting after this Study is completed.

Measures of preventive regime include:

- Control archaeological and conservatory control after the alignment is set out, using the "rapid survey" method;
- Informing bodies authorised for cultural heritage protection about all archaeological findings discovered during earth works and stopping the works until an insight and further instructions by the authorised body;
- Repetition of conflict point's identification procedure and mitigation measures prescription for each alignment correction/shifting, until the alignment is finally adopted. Practically, it is necessary to check each time whether or not the alignment correction endangers some location within the strip of 1 km right and left from the alignment.

Harmful impacts result in various negative implications In the table below there is given a comparative presentation of potential impacts,

- potential impacts,
- consequences to the cultural heritage
- mitigation measures that can mitigate (neutralise) these harmful effects.

Since this attachment represents kind of conclusion, for each cause-consequence series (kind of impact-kind of consequence) we have stated all protection measures that can be applied (the ones predicted on that or other locations with similar impacts and effects). However, in the part of the Study elaborating the conflict points we had analysed each case separately and afterwards predicted some concrete measures to be applied.

Table 66 Mitigation measures during construction period

	Devastation or destruction of known archaeological localities – disturbance of destruction of cultural layers, damage to/destruction of the finding (or entire location)	**Total destruction of potential (so far unknown) archaeological localities – surface findings, substructures, underground structures**	**Occurrence of cracks or any other physical damage and deformation to the matter, or movement and sinking – identified on the architecture heritage or tombstones**	**Devastation of ambient and cultural-historical character**
Excavations, cutting of the terrain and all kinds of earth works	1. Control archaeological survey using the “rapid survey” method after the alignment setting out, all along entire the alignment, 2. Continuous supervision by an archaeologist in a wider zone and permanent consultative involvement during the motorway construction,	1.Control archaeological survey using the “rapid survey” method, after the alignment is set out, all along the alignment, 2. Detailed archaeological reconnaissance, archaeological probing and protective archaeological excavations as needed 3. Continuous supervision	1. Control conservation survey using the “rapid survey” method, after the alignment is set out, all along the alignment, 2.Excavation technology analyse and selection according to the vulnerability level of the property – protection measures against all factors that can be harmful to the matter or change its features (anti-vibration	1. Control conservation survey using the “rapid survey” method, after the alignment is set out, all along the alignment, protection measures as required

	3. Archaeological probing and protective archaeological excavations as needed, after a detailed reconnaissance, 4. Recommendations for the alignment dislocation/correction.	by an archaeologist as needed (in the case of an identified locality)	structures or similar) 3. Monitoring-placement of permanent marks and monitoring of possible cracks, displacement or any other anomalies caused by the construction	
Material depositing	The access roads crossing over the locality, disposal of waste, and deployment of heavy machinery at the locality.	In case of determined archaeological localities, the following activities are forbidden: access roads crossing over the locality, disposal of waste and deployment of heavy machinery at the locality.		The following activities are forbidden: access roads crossing over the locality, disposal of waste, and deployment of heavy machinery at the locality.
Drilling, mining and other aggressive technologies of hard rock mass excavation	1.Control archaeological and conservation survey using the “rapid survey” method after the alignment setting out, all along entire alignment, 2. Recommendations for the alignment dislocation/correction. 3. Continuous supervision by an archaeologist in a wider zone and permanent consultative involvement during the motorway construction, 4. Monitoring-placement of permanent marks and monitoring of possible cracks, movement or any other	1.Control archaeological and conservation survey using the “rapid survey” method after the alignment setting out, all along entire the alignment, In case of determination of so far unknown locality endangered by the works: 2. Recommendations for the alignment dislocation/correction. 3. Continuous supervision by an archaeologist in a wider zone and permanent consultative involvement during the motorway construction,	1.Control conservation survey using the “rapid survey” method after the alignment setting out, all along entire the alignment, 2. Excavation technology analyse and selection according to the vulnerability level of the property – protection measures against all factors that can be harmful to the matter or change its features (anti-vibration structures or similar) 3. Monitoring-placement of permanent marks and monitoring of possible cracks, movement or any other anomalies that can be indication of structural disturbances caused by the construction works .	1.Control conservation survey using the “rapid survey” method after the alignment setting out, all along entire the alignment, 2. Excavation technology analyse and selection according to the vulnerability level of the property – protection measures against all factors that can be harmful to the matter or change its features (anti-vibration structures or similar)

	anomalies that can be indication of structural disturbances caused by the construction works . 5. Excavation technology analyse and selection according to the vulnerability level of the property – protection measures against all factors that can be harmful to the matter or change its features (anti-vibration structures or similar)	4. Monitoring-placement of permanent marks and monitoring of possible cracks, movement or any other anomalies that can be indication of structural disturbances caused by the construction works . 5. Excavation technology analyse and selection according to the vulnerability level of the property – protection measures against all factors that can be harmful to the matter or change its features (anti-vibration structures or similar)		
Communications, organisation of construction sites, formation of an access roads, heavy machinery traffic	The following activities are forbidden: access roads crossing over the locality, disposal of waste, and deployment of heavy machinery at the locality.	In case of a locality determination the following activities are forbidden: access roads crossing over the locality, disposal of waste, and deployment of heavy machinery at the locality	The following activities are forbidden: access roads crossing over the locality, disposal of waste, and deployment of heavy machinery at the locality.	The following activities are forbidden: access roads crossing over the locality, disposal of waste, and deployment of heavy machinery at the locality.

Table 67 Mitigation measures during operation period

	Physical damage to the matter, cracks etc.	Surface modification of the matter – various kinds of chemical decomposition	Devastation of cultural-historical character or natural environment; functional discordance, possibility of visual discordance and aesthetic degradation.	Noise and air pollution in the zones of distinguished ecological and cultural value that dispose with significant tourist potential (decreased interest of visitors).
Road traffic: physical-dynamical effects	*1.Construction of protective structures against vibrations caused by road traffic during the motorway operation* *2. Monitoring-observation of the road traffic related dynamic effects during longer period of time*			*If necessary, in case of noise levels exceeding legally prescribed limitation values, noise protection structures are to be constructed in accordance with the respective standards and norms*
Road traffic: possibility of direct contact	*In accordance with standards and technical regulations for protection of people and objects, while designing such objects*			
Road traffic: chemical effects		*Monitoring-follow up on the effects of air quality modification over longer time period*		*If required: Monitoring follow up on the effects of air quality modification over longer time period*
New function and spatial visual aggressiveness of a new-built structure			*1.Recommendation for the alignment section dislocation* *2. Gradual re-cultivation with autochthonous vegetation, general ambient revitalisation* *3. Structure designing and*	

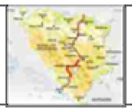
			shaping in accordance with cultural identity and landscape-consultative involvement of a conservators and landscape architects	

Analysis of possible negative impacts on objects, localities and entities of culrural historical heritage located in the Forst Zone of Impact

With

MEASURES PROPOSED

Environmental Study - CULTURAL HERITAGE **Corridor Vc**



ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Bradina	5/15	Bradina	1. Memorial to the victims of fascism

Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P131 - P134	6+500.00 - 6+650.00	tunnel	h=130-140 vmin=147.36 (P131 tunnel) vmax=151.67 (P133-tunnel) v is related to the elevation dif. h=0

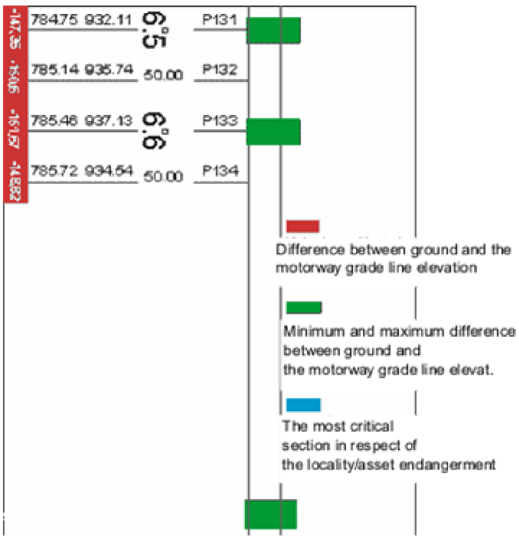
Environmental impacts

Construction period	Operation period
? Memorial plaque is located relatively far from the alignment (?h2+v2+natural fall, since the elevation difference between the terrain and the grade line was measured at the alignment). This is a micro location (point) and its value is represented by documentary-historical character and not by historical structure preserved in situ or by ambient/landscape. In the considered section the alignment is passing through the tunnel, thus no significant damaging impacts can be expected.	? Memorial plaque is located relatively far from the alignment (?h2+v2+natural fall, since the elevation difference between the terrain and the grade line was measured at the alignment). This is a micro location (point) and its value is represented by documentary-historical character and not by historical structure preserved in situ or by ambient/landscape. In the considered section the alignment is passing through the tunnel, thus no significant damaging impacts can be expected.

Mitigation measures and recommendations

!

Period	Measures
Construction period	General protection measures that are undertaken in all cases.
Operation period	



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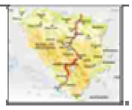
Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Vrbljani	1. 1/188 (6/15)	Glaour cemetery (Crkvina)	1. Necropolis with 200 standing tombstones 2.Fragments of Roman architecture, probably Roman [illegible] 3 Roman [illegible]

Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P276 - P263	13+750.00 - 13+100.00	tunnel	crossing, entrances: h=300 and 270

Environmental impacts

Construction period	Operation period
?Damaging effects of comprehensive earthworks on the tunnel excavation (particularly entrances): disturbance or destruction of potential archaeological findings in the surface zone (considering existence of two necropolis in the area, Roman milestone, fragments of Roman architecture and Roman roads recorded in the wider zone, it is possible to discover some new findings in the rock (soil) weathering zone at the critical section and in the contact zone ?Dynamic strike: negative vibration impacts during excavation (explosions, drilling etc.) on physical composition of the tombstones	? Damaging impacts of vibrations on physical structure of the tombstones, ?Impact of air modification on the material-chemical impact of polluters on natural stone, during longer time period ?Visual contact and noise-possible visitors on the locality ?Non-adjustment of function and character of the busy motorway with the cultural-historical character of the locality

Mitigation measures and recommendations

!

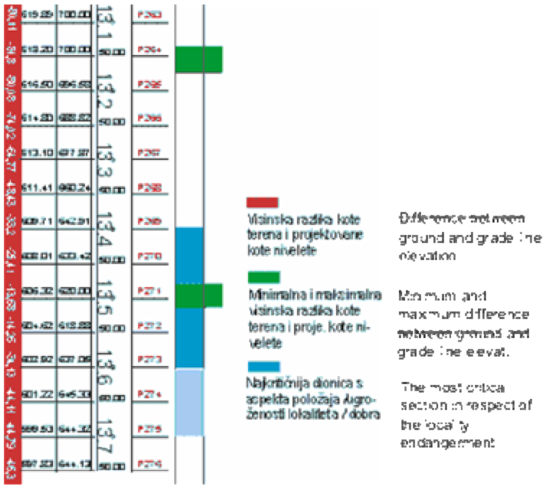
Construction period

Recommendation: correction of the alignment in a wider area-outside from range of negative impacts.

?Detailed archaeological reconnaissance in a wider zone before the work execution starts (before and during the alignment staking out). Further recommendations according the reconnaissance results
? Supervision by an archaeologist during all earth works
?Construction of structures for dynamic strike protection
?Monitoring-setting of the permanent marks and observation of fractures and fissures, e.g. monitoring of all possible movements and, generally, all modifications and anomalies caused by construction works.

Operation period

?Monitoring as needed-permanent marks, measurement stations



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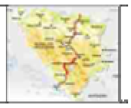
Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Vrbljani	**1. 1/354 (8/16)**	**Vrbljani**	**Medieval Necropolis**

Spatial relation between the alignment and the cultural heritage

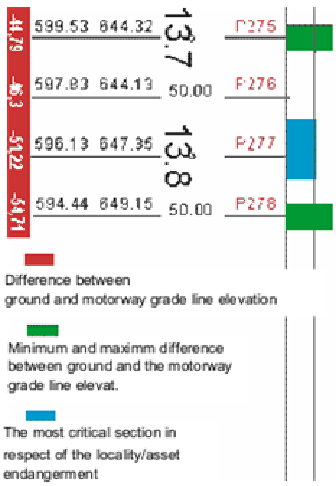
Critical section	Station	Structure	Distance from the alignment (m)
P278-P275	13+850.00 - 13+700.00	tunnel	h=0 (crossing in horisontal matrix) vmin=44.79 (P275-tunnel) vmax=54.71 (P278-tunnel)

Environmental impacts

Construction period	Operation period
? Earthworks in the wider zone (et the tunnel entrance section P258-P257) can cause disruption or destruction of potential archaeological findings. Since there are two medieval necropolises stretching in a wider area, on which there are also some findings from Roman Period, recommendations are given for the wider zone. ?Regardless of the minimum elevation difference of 44.79m between the tunnel crown and the ground level, possible physical-dynamic negative impacts of mining and other excavations should be taken in account (also by the applicable legislation)	?Noise-possible visitors on the locality ?Non-adjustment of function and character of the busy motorway with the cultural-historical character of the locality (tunnel immediately bellow the locality)

Mitigation measures and recommendations

!		Recommendation: correction of the alignment in a wider area-outside from range of negative impacts.
Mitigation measures and recommendations	Construction period	?Detailed archaeological reconnaissance in a wider zone before the work execution starts (before and during the alignment staking out). Further recommendations according the reconnaissance results ? Continous supervision by an archaeologist during all earth works ?Construction of structures for dynamic strike protection ?Monitoring-setting of the permanent marks and observations
	Operation period	?Monitoring as needed-permanent mark, measurement stations



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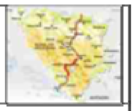
Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Vrbljani	1. S/5	Vrbljani	1. Rural entirety 2. Individual residential structures of ambient value

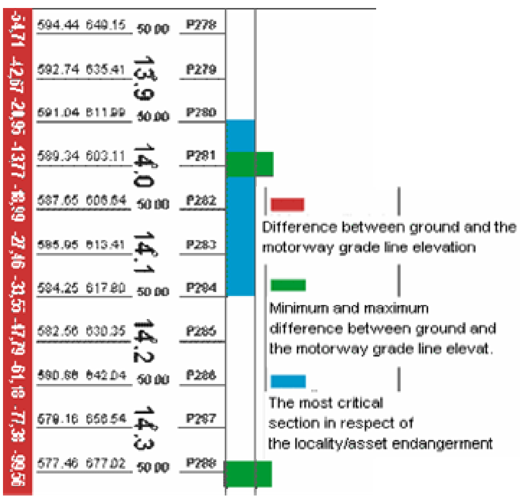
Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P288 - P278	14+350.00 - 13+850.00	tunnel	h=0 (crossing in horisontal matrix) vmin=13.77 (P281-tunnel) vmax=99.56 (P288-tunnel)

Environmental impacts

Construction period	Operation period
?Excavations in the compact rock masses - (drilling, mining etc.) - cause vibrations of various strengths resulting in fractures and other deformations of the asset's material. If the excavation is done in the hard and fractured rock masses, what can happen is "overexcavation" what is dangerous in cases of small difference between the tunnel crown and the ground level. In this respect, the most endangered is the profile P281, while the entire section P280-P284 should be paid special attention to (some buildings date from the Austro-Hungarian period and are not in a satisfactory preservation state and the mentioned disturbances must not happen, since that would cause further rapid physical degradation.	? Damaging impacts of vibrations on physical structure of the objects, ?Non-adjustment of the zone's character (ecological, rural ambient) to the new function

Mitigation measures and recommendations

!		
Construction period	Recommendation: correction of the alignment in a wider area-outside from range of negative impacts. ?Careful selection of appropriate excavation technology and definition of protection measures against all factors which might endanger the matter or modify its features-construction of appropriate structures for noise and vibration protection ?Monitoring-setting the reapers and observation of fractures and features, what means a monitoring of all possible movements and, generally, all construction-related modifications and anomalies	
Operation period	?Monitoring as needed-observation of dynamical effects coming from the traffic, as well as monitoring of the air quality modifications during longer period of time. ?Gradual re-naturation of ambient by landscape recultivation and autochthonous vegetation	Author M.S Nermina Mujezinović, B.S in Architecture

Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Donje Selo	1. 1/30 2. 1/30a	1. Breber (Crkvina) 2. Breber-Šćepanova ledina	1. Traces of roman mausoleum and necropolis, medieval church fragments 2. Medieval necropolis

Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P375 - P391	18+700.00 - 19+500.00	tunnel	h=0-200 (the tunnel touches wider locality in a horizontal matrix) vmin=18.78 (P375) vmax=114.81 (P384)

Environmental impacts

Construction period	Operation period
?Excavation technologies in the compact rock mass (drilling, explosions) result in dynamic strikes, which in dependence of explosive kind, distance etc. can cause significant damage to material and other historical structures. Spatially, the most critical is the section P379-P385. Difference between ground elevation and grade line elevation is ranging from 58.2m to 114.81m, what means that the material remaining are in in the range of physical-dynamic impacts, directly exposed to their negative impacts. ?Excavations and all other earth works in the rock (soil) weathering zone can cause disturbance or destruction of the existing and potential archaeological findings. Particularly endangered zones are tunnel entrances because of minimum elevation difference between ground elevation and grade line. During the tunnel entrance excavation, beside the base rock, more significantly treated is also the soil layer.	Possibility of vibration impact coming from traffic in the zone of tunnel entrance

Mitigation measures and recommendations

!

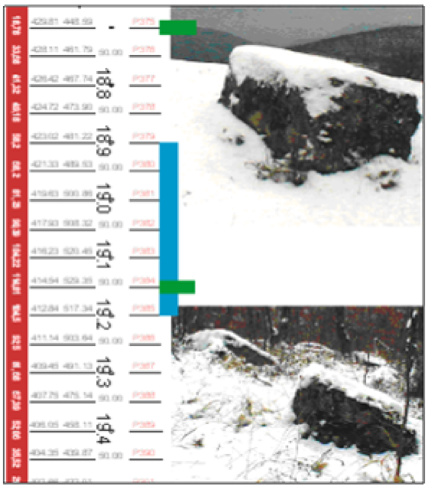
Construction period

Recommendation: dislocation of the alignment to the bigger distance from the said localities-outside from range of negative impacts.

?Excavation technology analysis-adjustment of technology to the value of material remaining, as well as construction of protective structures for vibration neutralization
?Detailed archaeological reconnaissance and assessment of the wider zone with stress on both tunnel entrances,
?Probe sounding archaeological investigation in the extent and at the section that depend on the detailed reconnaissance report.
?Continuous supervision of an archaeologist during the tunnel excavation and all other earth works in the rock weathering layer (soil) in entire wider zone and in contact zone,
?Tunnel lining (entrances) in respect of the existing recorded material

Operation period

?Monitoring as needed-monitoring of movement, fracture occurrences and general status of the material/locality



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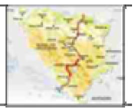
Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

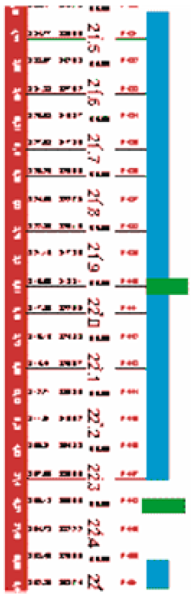
Location	Code	Name of the property	Description
Cerići	1/35	Cerići, Munara, Trebeda and surrounding area	1. Remaining of Roman settlement, 2. Roman monument-sacrificial altar devoted to Jupiter 3. Byzantium copper coins

Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P451 - P450 P450 - P447 P447 - P435 P435 - P434 P434 - P430	22+500.00 - 21+450.00	cut tunnel cut and embankment viaduct cut and embankment	h=200-600 and more vmin=0.61 (P440-embankment) vmax=43.87 (P448-tunnel)

Environmental impacts

Construction period	Operation period
Excavations and all kinds of earthworks in the rock (soil) weathering layer can cause disturbance or destruction of potential and existing archaeological findings. Particularly endangered and vulnerable zones are the zones of cuttings, viaduct pillar foundations, tunnel entrances and embankments. Therefore the entire section should be paid special attention to. In Munara and Trebeda and in wider area there were found larger Roman settlements-walls and bricks on several places. In the wider zone it was found the sacrificial Altair devoted to Jupiter in secondary use, as well as copper coins from the latte classical period and this zone should be considered potential archaeological site.	

!			
Mitigation measures and recommendations	Construction period	?Detailed archaeological reconnaissance of the wider zone ?Archaeological probing and protective archaeological excavations to the extent and in the zones depending on detailed reconnaissance ?Continuous supervision by an archaeologist during all surface earthworks execution-down to the base rock, in the wider area and in the contact zone and consultative involvement of an archaeologist during work performance along entire section	
	Operation period	In dependence of archaeological exploration	

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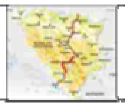
Environmental Study - CULTURAL HERITAGE	**Corridor Vc**	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Gerići	1. S/18 2. S/19	Razice-Moslem tombstone	1. Medieval monument and old Moslem tombstones. 2. The structure of moderate ambient value

Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P420 - P430	20+950.00 - 21+450.00	cut and embankment	h=10-200 vmin=0.05 (P426-cut) vmax=24.34 (P421-cut)

Environmental impacts

Construction period	Operation period
Stronger cutting of the terrain, depending of geological composition, can require aggressive excavation technologies, resulting in negative dynamic effects-potential cause of damage to material of the monument. The most critical section is P421 - P423, while the sections P424 - P426 and P420 are also ones of very high vulnerability. All kinds of earth works for the localities in vicinity of the alignment can be a possibility for a direct physical contact (in sense of digging up, excessive cut profile, machinery impact etc), i.e. possibility of bigger damage of physical-mechanical impact mechanism. In this respect (significant cut height and minimal horizontal distance) the most critical section is P421 - P423 where there are material remaining recorded in the zone of maximum physical-mechanical impact. Excavations and all other earth works in the rock (soil) weathering zone can cause disturbance or destruction of potential archaeological findings. Considering the existing structures, discovery of possible covered tombstones during the excavation works is not impossible .	?damaging dynamic impacts of the traffic-damage to the physical structure ?direct exposure to stronger impacts of polluters ?impact on the ambient, character of micro locations not adjusted with the new function

!

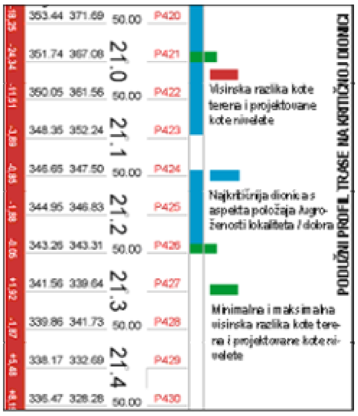
Mitigation measures and recommendations

Construction period

?Excavation technology analyse-adjustment of technology to the value of material remaining, as well as construction of protective structures for vibration neutralization
?Detailed archaeological reconnaissance and assessment of the wider zone,
?Probe sounding archaeological investigation in the extent and at the section that depend on the detailed reconnaissance report.
?Continuous supervision of an archaeologist during all earthworks execution,
?Designing of cuts with structures for anti-vibration protection, considering existence of the recorded material remaining and possible dynamic impact.

Operation period

?Construction of cuts with structures for protection from vibrations from traffic
?Monitoring-monitoring of material modification in sense of movements, decomposition, stone cracking and occurrence of so far unregistered surface anomalies



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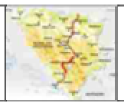
Environmental Study - CULTURAL HERITAGE	**Corridor Vc**	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Pokojište	1. 1/148 (6/124) 2. S/3	1. Grebine 2. Pokojište	1. Medieval necropolis with preserved Moslem tombstone remaining in situ, 2. Rural agglomeration of moderate ambient value

Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P464 - P463 P463 - P462 P462 - P461	23+150.00 - 23+100.00 23+100.00 - 23+050.00 23+050.00 - 23+000.00	viaduct cut tunnel	h=app. 200 vmin=3.3 (P463-viaduct entrance) vmax=48.49 (P461-tunnel)

Environmental impacts

Construction period	Operation period
Damaging impacts on the tombstones and rural agglomerations in the contact zone: communications, organisation and technology of the building site-access road construction, heavy vehicles traffic, uncontrolled disposal of waste and excavated material-possible damage on the physical structure. During construction of cuts, tunnels (entrances!), foundation pit for viaduct pillars and all other earth works treating the soil layer it is possible to discover earth covered tombstones and other findings in the surface layer (above the base rock) and their devastation, disturbance or destruction is possible (potential archaeological finding-wall fragments, movable material, cultural layer etc)	Domination in relation to the entire natural and cultural landscape, permanent ambient devastation. Since the considered localities represent relatively preserved natural ambient in which there are existing the material remaining of the Middle Ages and more recent structure of autochthonous architecture, it is necessity to pay attention to preservation of intact natural and cultural landscape. New-designed structures mustn't be aggressive and visually dominant.

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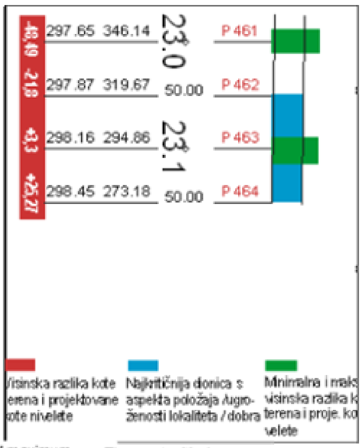
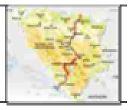
Mitigation measures and recommendations

Construction period	?Detailed archaeological reconnaissance and assessment of the wider zone, ?Archaeological probing in the extent and at the section depending on detailed reconnaissance report or systematic archaeological explorations as needed, depending on the results of detailed reconnaissance (probing). ?Continuous supervision of an archaeologist during all surface earthworks execution-down to the base rock, in a wider area, whose boundaries will be defined after detailed reconnaissance. Special stress should be put on excavations, cuttings, viaduct foundations, ?General mitigation measures for protection against noise and vibrations of all sensitive artificial/built structures in the contact zone ?Crossing over the access roads, waste disposal and stationing of heavy mechanisation can not be done in vicinity of the necropolis	 Minimum and maximum difference between ground and the motorway grade line elevat. The most critical section in respect of the locality/asset endangerment Minimum and maximum difference between ground and the motorway grade line elevat.
Operation period	Structure aggressiveness and visual domination can be avoided by careful structure designing-particularly viaduct and bridge structure shaping (proportions, materials, forms).	

Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Ravna	1. S/8 2. 4/12 (1/10) 3. 4/10 (1/273) 4/11 (1/293)	4 1. Different locations in Ravna village 2. Balića 3. Padulja 4. Ravna	1. Autochthonous rural agglomerations, individual residential objects of ambient value 2. Medieval necropolis 3. Medieval necropolis 4. Medieval necropolis

Spatial relation between the alignment and the cultural heritage

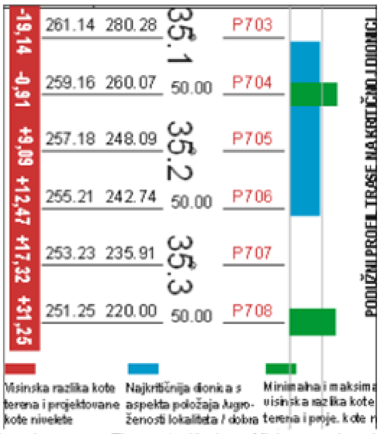
Critical section	Station	Structure	Distance from the alignment (m)
P703 - P705 P705 - P708	35+100.00 - 35+200.00 35+200.00 - 35+350.00	cut and embankment viaduct	h=85-150 and more, vmin=0.91 (P704-cut) vmax=31.25 (P708-viaduct)

Environmental impacts

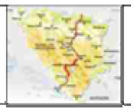
Construction period	Operation period
?Stronger cutting of the terrain, depending of geological composition, can require aggressive excavation technologies, resulting in negative dynamic effects-potential cause of damage to material of the monument. In this respect, relevant is the profile P703 with significant cutting and the tunnel entrance. ? Excavations and all other earth works in the rock (soil) weathering zone can cause disturbance or destruction of the existing and potential archaeological findings. Considering the existing structures, discovery of possible covered tombstones and other findings it is not impossible during the excavation works. ?Ambient devastation due to the works (slope erosion, vegetation destruction, and natural atmosphere of autochthonous architecture, which are inseparable)	?Identification in the wider area - embankment and viaduct ?Ambient devastated by earth works and excavations

Mitigation measures and recommendations

!

Construction period	?Detailed archaeological reconnaissance and assessment in a wider zone ? Archaeological probing in the extent and at the section that depend on the detailed reconnaissance report. ?Supervision by an archaeologist during all earth works in a wider zone in relation to the surface layer -layer of soil with special stress on cuts and viaduct pillars foundations. ?General protection measures related to a dynamic impacts, ?Shaping and designing of structural elements of viaducts and embankments in accordance with character of natural and architectural ambient, observed in the wider zone and particularly at the section P704-P705 (exiting of viaduct and embankment) ?Renaturation of the area after completion of drilling and excavation-dislocation of temporary disposal site, acess roads etc.	 Minimum and maximum difference between ground and the motorway grade line elevat. The most critical section in respect of the locality/asset endangerment Minimum and maximum difference between ground and the motorway grade line elevat.
ation period	?Re-cultivation of the area-recovery of the natural vegetation and general revitalisation of the natural ambient	

Environmental Study - CULTURAL HERITAGE	**Corridor Vc**	



ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Dragan Selo	S/7	Draganska rijeka, Dragan Selo	1. Water mill, 2. Autochthonous rural agglomerations

Spatial relation between the alignment and the cultural heritage

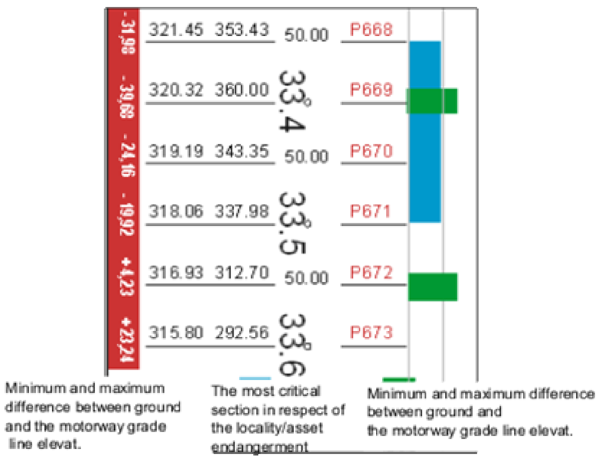
Critical section	Station	Structure	Distance from the alignment (m)
P668 - P671 P671 - P672 P672 - P673	33+350.00 - 33+500.00 33+500.00 - 33+550.00 33+550.00 - 33+600.00	tunnel cut and embankment viaduct	h=135-285 to 500 vmin=4.23 (P672-embankment-viaduct) vmax=39.68 (P669-tunnel)

Environmental impacts

Construction period	Operation period
?Tunnel excavation and bigger cuts in a compact rock masses encompass excavation technologies resulting with dynamic effects-negative impacts. Strong vibrations are potential cause for physical structure damage. Since minimum horizontal distance at the contact zone is 135m and minimum elevation difference between the ground and the grade line is 19.92m, this locality is in the zone of impact but not in range of extremely endangered objects. ?Ambient devastated by earth works	?Identification in the wider area - embankment and viaduct ?Ambient devastated by earth works and excavations

!

Mitigation measures and recommendations

Construction period	?General mitigation measures undertaken under the Project for protection from dynamic effects ?Shaping and designing of structural elements of viaducts and embankments in accordance with natural and architectural ambient, in a wider zone ?Bringing back to the original condition after excavations and drilling is finished-displacement of temporary waste areas, access roads etc.	
Operation period	Area re-cultivation - requalification of natural vegetation and general revitalisation of the natural ambient	

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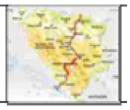
Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

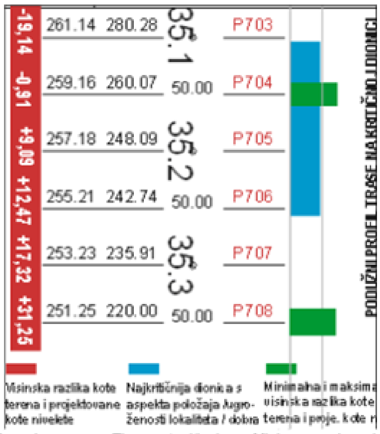
Location	Code	Name of the property	Description
Ravna	1. S/8 2. 4/12 (1/10) 3. 4/10 (1/273) 4/11 (1/293)	4 1. Different locations in Ravna village 2. [illegible] 3. Padića 4. Ravna	1. Autochthonous rural agglomerations, individual residential objects of ambient value 2. Medieval necropolis 3. Medieval necropolis 4. Medieval necropolis

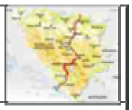
Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P703 - P705 P705 - P708	35+100.00 - 35+200.00 35+200.00 - 35+350.00	cut and embankment viaduct	h=85-150 and more, vmin=0.91 (P704-cut) vmax=31.25 (P708-viaduct)

Environmental impacts

Construction period	Operation period
?Stronger cutting of the terrain, depending of geological composition, can require aggressive excavation technologies, resulting in negative dynamic effects-potential cause of damage to material of the monument. In this respect, relevant is the profile P703 with significant cutting and the tunnel entrance. ? Excavations and all other earth works in the rock (soil) weathering zone can cause disturbance or destruction of the existing and potential archaeological findings. Considering the existing structures, discovery of possible covered tombstones and other findings it is not impossible during the excavation works. ?Ambient devastation due to the works (slope erosion, vegetation destruction, and natural atmosphere of autochthonous architecture, which are inseparable)	?Identification in the wider area - embankment and viaduct ?Ambient devastated by earth works and excavations

!			
Mitigation measures and recommendations	Construction period	?Detailed archaeological reconnaissance and assessment in a wider zone ? Archaeological probing in the extent and at the section that depend on the detailed reconnaissance report. ?Supervision by an archaeologist during all earth works in a wider zone in relation to the surface layer -layer of soil with special stress on cuts and viaduct pillars foundations. ?General protection measures related to a dynamic impacts, ?Shaping and designing of structural elements of viaducts and embankments in accordance with character of natural and architectural ambient, observed in the wider zone and particularly at the section P704-P705 (exiting of viaduct and embankment) ?Renaturation of the area after completion of drilling and excavation-dislocation of temporary disposal site, acess roads etc.	Minimum and maximum difference between ground and the motorway grade line elevat. The most critical section in respect of the locality/asset endangerment Minimum and maximum difference between ground and the motorway grade line elevat.
	ration period	?Re-cultivation of the area-recovery of the natural vegetation and general revitalisation of the natural ambient	

Environmental Study - CULTURAL HERITAGE	Corridor Vc	

ENVIRONMENTAL IMPACTS, MITIGATION MEASURES & RECOMMENDATIONS

Location	Code	Name of the property	Description
Glogošnica	1. 4/15 2. S/9	Glogošnica	1. Recorded medieval monument (there are not in situ remaining. 2. Two old Moslem cemeteries, remaining of autochthonous older cobble pavement, dry stone masonry

Spatial relation between the alignment and the cultural heritage

Critical section	Station	Structure	Distance from the alignment (m)
P752 - P753	37+550.00 - 37+600.00	bridge	h=75-200
P753 - P754	37+600.00 - 37+650.00	embankment and cut	vmin=4.34 (P753-bridge/embankment)
P754 - P756	37+650.00 - 37+750.00	tunnel	vmax=45.09 (P755-tunnel)
P756 - P757	37+750.00 - 37+800.00	tunnel and cut	

Environmental impacts

Construction period	Operation period
?During the tunnel excavations in compact rock masses, applied technologies result with dynamic effects-negative impacts because of potential cause of the monument material. From this point of view critical are profiles P754-P757. ?Excavations and all kinds of earthworks in the rock (soil) weathering layer can cause disturbance or destruction of potential archaeological findings. In respect of the existing site of medieval tombstones it is not impossible to discover tombstones and other structures that are covered up. From this aspect, critical are the profiles P752-P754, due to closeness of tombstones and earthworks in the surface layer. ?Ambient devastation due to the works (vegetation destruction, works in the riverbed and at the riverbanks- construction of pillars)	View disturbance (wider area-the old bridge) Damage to beautiful natural ambient near the river Disharmony of scales (visual domination) and functions (three cemeteries in the narrow zone) on the Morić cemetery and the cemetery close to the chapel there are some old Moslem tombstones)

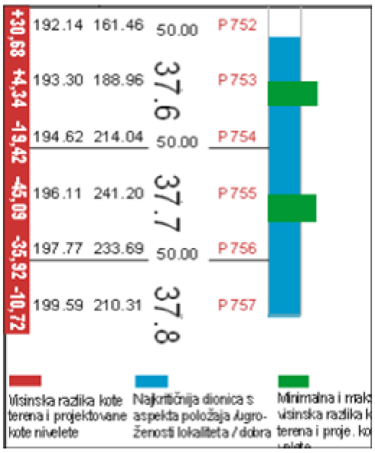
Mitigation measures and recommendations

!

Construction period

Recommendation: dislocation of the alignment to the bigger distance from the said localities-dislocation more away from the settlement, i.e. from the chapel and the active catholic cemetery, since that will be the place of permanent ambient devastation.

?Detailed archaeological reconnaissance and assessment of the wider zone,
?Probe sounding archaeological investigation in the extent and at the section that depend on the detailed reconnaissance report.
?Continuous supervision of an archeologist during all earthworks execution,
?General protection measures related to a dynamic impacts,
?Careful designing of bridge structures, cuts and embankments in accordance with the natural ambient character.
?Bringing the site back to the original condition after excavation and drilling is finished - displacement of temporary waste dis



Minimum and maximum difference between ground and the motorway grade line elevat.

The most critical section in respect of the locality/asset endangerment

Minimum and maximum difference between ground and the motorway grade line elevat.

Operation period

?Recultivation of the area-recovery of the natural vegetation and general revitalisation of the natural ambient

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6.2.11 Game

During preparation, construction and operation period it is necessary to take the following protection measures:

- In order to eliminate negative impacts resulted from isolation of smaller and bigger parts of hunting area, it is necessary to rearrange the hunting area, in order to mitigate cutting the area off on the opposite side of the motorway. It is necessary to provide an adequate connection between the parts of the hunting area in the case of the hunting area divided to larger parts;.
- In order to reduce negative impact on game, it is necessary to provide acceptable condition of game movement along present and future migration directions. Thus, it is recommended to establish the corridors for game's crossing the motorway, in order to mitigate habitat degradation and provide for as good as possible possibility of daily and seasonal game migration. It is, therefore, recommended, for the watercourses cut by the motorway alignment to form the zones in which the game could undisturbedly move. It is necessary to establish good communication along direction east-west and vice versa.
- Base structures for establishment of necessary communication corridors are: culverts for water, underpasses and overpasses for movement of people and vehicles, viaducts and bridges and special structures for enabling movement of animals.

Mentioned structures must be built in a way that they, apart their basic function, enable undisturbed movement of animals and communication between the eastern and western part of the hunting areas.

Being the habitats in the hunting areas of Prenj, Čvrsnica and Čabulja are extraordinary favourable for specific game species, with very distinguished daily and seasonal game migrations it is necessary in the design to foresee crossings for game and other animal species. By insight into the motorway alignment, the following types of game corridors have been analysed:

- Self-contained game passes
- Game passes in the frame of other structures
- Possible passes for game over the structures of different purpose.

Self-contained game passes

A *self-contained game passes* or so called green corridors are the structures bellow or above the motorway, with the main purpose of enabling migration of game and other animals, e.g. crossing from one to another side of the motorway, in order to meet their biological needs.

The chamois will rather cross over the motorway above it's level, than below, and this fact should be taken in account while designing the motorway, if possible in respect of landscape disruption, cost etc. If possible, it would be desirable to predict somewhat wider overpasses and underpasses **(50-75 cm).**

Self-contained game passes are not necessary at the studied motorway alignment, since it is passing mostly through the tunnels and over the viaducts which enable undisturbed game migration.

Game passes in the frame of other structures

At the future motorway predicted are game passes in the frame of other structures, such as viaducts, bridges etc. There are 22 such structures in total and there location can not be influenced. Leaving enough space for undisturbed movement and passing of the game should be taken in account while designing the motorway.

This is to increase the traffic safety on the motorway, avoiding possibility of crash between the cars in motion and the game that can be fathal.

Without passes, the game will instinctively try to overpass the motorway, jumping over the protective fence that does not represent a problem for chamoises. From that reason, on the places of game passes it is necessary to erect the 3m-heigh fence, 500 m length on both sides of the pass. The game should be directed towards the pass under the bridges and viaducts by green strips and high wire protective fence (minimum 3 m high).

Possible passes for game over the structures of different purpose.

Structures of other purpose, but suitable for game crossing the motorway are box culverts, smaller overpasses and others, mostly of smaller dimensions. In any case, it is necessary to use that space to the maximum extent and enable passing the game, reducing the habitat fragmentation.

Again, it is necessary to egrect somewhat higher wire fence around a multipurpose-structures, e.g. passes. Bottom of the fence shoukd be well secured and fixed to the ground in order to prevent passing of smaller game (rabbits, foxes, badgers) but also wild boars.

The game should be directed towards the passes by planting hedges of autochtonous plants and trees. That provides minimum protection from noise and lighting, as well as sence of security. That also provides better insertion of the passage to the landscape.

Tunnel-shaped passes predicted for frogs and amphibie will also be used by small game (badgers, foxes, martens, weasel etc.). Therefore, construction of them is considerably justified and necessary.

6.2.12 Noise

During construction period

The noise protection measures prevent the noise emerging, i.e. the existing noise is reduced to the limiting noise values. In terms of general request related to the mitigation measures, contractors will be required to limit the activities producing excessive noise levels (work in borrow pits and quarries) to the working days and to the daytime. The equipment that normally creates high levels of noise should be suppressed or protected when working within a distance of 200m from any settlement or religious building.

Beside the respect of Bosnian regulations, the following recommendations may be added:

- The itinerary of the transport track must be carefully studied in order to avoid as much as possible noise and vibration disturbances and than strictly respected;
- In particular the dumpers must be operating as far as possible from the existing human settlement;
- Working activities must be developed at distances lower than 200m from populated areas and works should be undertaken only during the day (6 a.m.–10 p.m.) or screened by anti – noise screens;
- The arranging of the activities in the construction site should be studied in the way that noisy activities would be protected;

- The stocking of materials in the construction site should be located in such a way to act as a noise barrier toward the settlements;
- The noise absorption system provided for the machinery should be regularly maintained.

During operation period

One of the main objectives of the noise assessment is to investigate the effect of mitigation measures to avoid adverse impacts of the noise in sensitive areas (residential areas or isolated residential buildings) along the planned road. Noise reduction can be achieved by different approaches:

- Reduction of sound transmission by installation of sound barriers,
- Reduction of noise emissions at the sources (vehicles, road pavement),
- Reduction of noise impact in residential areas by individual installation of noise prevention windows.

The general order for implementation of these measures should be first by sound barrier, second at the sources and third at the receptor. The most important mitigation measures are the construction of sound barriers.
On basis of the theoretical measurements regarding the noise level the following measures could be established:

- Reduction of sound transmission by installations of phono-absorbent panels or creation of green screens with shrubs and threes;
- Reduction the noise emissions at the sources with possible velocity restrictions or use of silent pavement (drainage asphalt).

For exact knowledge of the right position and the height of the panels, more detailed study has to be prepared in the Detailed Design phase. In fact, the panels are the most important and efficient mitigation measures for the noise. Given that the motorway is running most of time on an embankment, slim noise prevention walls are considered more feasible than a broad bank structure with noise preventing quality. A barrier of 2m height could reduce the total affected area by about 56% and a 4 m barrier by 80% of noise.

At this phase of the Project this kind of noise reduction systems could be necessary in correspondence of the settlement systems of:

- Smucka (km 0+900 – km 1+100);
- Hasanovići (km 24+550 – km 24+700);
- km 21+100 – km 22+150 (Konjic interchange).

For the areas with low building density or in case of isolated single buildings out side of closed village areas installation of noise walls can usually not be economically justified as the number of the objects protected is out of proportion compared to the constructive efforts and costs. For such scattered houses in affected areas installation of noise reducing windows (passive noise protection) is then recommended. At this phase of the Project this kind of noise reduction systems could be necessary in correspondence the isolated buildings in correspondence of:

- km 1+425; km 2+050;

- km 2+400;
- km 7+950 – km 8+250;

Construction of a special pavement i.e. so called drain asphalt which provides a smooth surface and thus reduce noise emissions from rolling, is significantly more expansive than the standard asphalt concrete pavement and it also more costly than the installation of sound barriers. The spatial noise reducing smooth road surface can reduce the noise emissions for about 2 to 3 dB(A) compared to the standard pavement.

6.2.13 Vibrations

No mitigation measures are foreseen at this level of the project.

6.2.14 Infrastructure

In the *phase of the motorway preparation and construction* it is necessary to undertake certain measures for protection of infrastructure which the motorway in intersecting with.

Electrical power network

Protection measures related to the existing and planed electrical power network are contained in specific regulations on the construction of electric power network. These measures are related to a prescribed protection of people, property and environment.

Protection measures treat also cable lines in the places of the motorway crossings and interchanges.

Important protection measure is lighting installation at all boarder crossings and motorway interchanges, what significantly increase traffic safety, e.g. decrease possibility of traffic accidents and damaging environmental impacts.

Telecommunication network

Protection measures for protection of immovable telecommunication network cables encompass reconstruction of the same in accordance with specific regulations.

Transportation network

Planned motorway alignment is crossing the existing of the different category in several places. In order to mitigate the impacts of the motorway, the mitigation measures are undertaken during preparation, construction and operation period.

A Traffic management plan is prepared: planning of sign location, bumpers to be constructed/placed etc. This is undertaken in the phase of the project preparation and construction.

- Identification of critical areas and construction of speed bumps and passage points;
- Informing neighbouring population in advance on the detour roads alignment and preparation of time schedule of the planned works;
- Timely installation of traffic signs and warnings on the construction site;
- Detour roads repair after construction works;
- Functional maintenance of the local roads;

- Silent pavements (extremely smooth asphalt).

Apart the above mentioned the main measure for providing of undisturbed every day life is construction and utilisation of underpasses in the body of the motorway, in the required places.

Measures during operation period

Protection measures of other infrastructure objects during the motorway operation consist of a regular technical status control and regular maintenance, in order avoid that possible defects cause negative consequences on the environment, human health and property.

6.3 Technical mitigation measures for negative impacts on environment

Landscape

The planning of an ensemble of environmental landscape insertions to be connected with the realization of a motorway project, is considered as a fundamental phase to proceed to the re-qualification of the environmental landscape characteristics in the context in which there is estimation of intervention and of improvement of the peculiar elements.

The environmental arrangements are based on the individuation of restoration works that allow the recovery of the areas touched by the realization of the project and the improvement of the elements crated by it. The purpose is to recreate the continuity of the existing signs and views in the realization of the work and to confer a landscape value to the project elements.

The use of green plants doesn't have the purpose of offering only an aesthetic re-qualification but also should operate a reconstruction of natural elements that, as observed before, represent sporadic events.

This type of intervention belongs to environmental recovery system that includes all the interventions finalized to the spontaneous recovery of the autochthonous vegetations. A purpose is to support the trigger of the development processes to improve the capacity of the natural system through interventions with the existing vegetation. The purpose is to reassemble the landscape and perceptive unit but especially the structure of the natural system. In fact the vegetation holds a fundamental role in the qualification of landscape peculiarities in the intervention area.

The first phase of environmental-landscape interventions planning considers a preliminary analysis with the purpose of studying current characteristics of the natural elements not derived from human activities and the general potentials of transforming and developing of the territory examined.

Reaching this purpose it will have to be analysed the bioclimatic and geomorphic characteristics of the area and also the main vegetation types available.

This aspect is really important in the planning of an intervention that would respect the characteristic natural insertion in order to restore or to requalification, in the most appropriate way, the land portions directly touched by the work and by the operations needed to realize it (construction site works, running roads created to realize the construction of the infrastructure, etc.).

Concerning the animal communities, they react particularly sensitivelly to the structure of the vegetal consortiums because the presence of arboreal and shrubbery elements and their specific location provides the opportunity of alimentation and hiding for different faunal areas.

The vegetal aspect assumes a relevant role in the success of all the insertions. The result of the "artificial" plant it belongs to a reconstituted dynamic structure in which its balance should be holding in particular consideration.

The planning of the green interventions has been realized with the purpose of improve the starting of developing spontaneous processes that in the future could become independent and able to develop and emphasize the capacity of the natural system.

Following this aim, it is necessary to organize specific interventions to exceed with success the critic phase of initial recovery that it is usually the longer and more difficult one.

These actions should keep, where possible, the recovery of the autochthonous vegetation and fauna in order to evolve the system to a more natural state. In this context the realization of an infrastructure that estimates green interventions constitutes a chance of obtaining a re-qualification of the territory of the work.

In the territory crossed, with reference to the gricultural ecosystem, an improving intervention with the introduction of elements able to diversify and increase the heterogenity (fences, rows, thickets, wet land etc) should be estimated.

In regards to the structure configuration (grass areas, arboreal or shrubbery) it has been taken into consideration the following aspects:

- Extension of the available area
- Structure and shape of the area
- Limitation involved in the infrastructure under construction
- Connection of the site with the neighbouring areas

The project and the distribution of the plant have been planned trying to copy the natural shapes, supporting mostly the landscape insertion with the around area and assuring the perfect connection between the new and the existing. Concerning the linear aspect, having not enough space, the shrubbery is preferred, for obvious space limitation of the arboreal elements; also in this case respecting as much as possible the naturalistic distribution of the ensemble. For this reason the hypothesis suggested are characterized with inhomogeneous rows to swerve as much as possible from a too regular disposition that would reveal obviously the artificiality of the plant.

It is clear that this plant in the phase of taking root and of first growing will be in any case artificial, because caused by the man, and will result loosen and so recognizable from the rest of the existing communities; however the system will be able to evolve independently in the time, offering at the end a situation as much natural as possible.

Choice of the vegetation species

The choice of the vegetation species to be utilized was mainly suggested by studying the bibliography relating to the area of the motorway (Annex 5) and analysing the residual strip of land of vegetation. In choosing the vegetation species it will be keep under consideration the following guidelines:

- Climatic characteristics of the area
- Coherence with local flora and vegetation
- Development of bio-diversity
- Facility of rooting

- Facility of finding in the market
- Lowest maintenance
- Aesthetic and naturalistic value
- Structure functionality
- Characteristic of stationer condition

The climatic knowledge and potentiality of the area must be kept under the due consideration, in fact they allow to design in the direction of a natural approach, minimising the influence of the impact. In order to respect the local vegetation it is necessary to identify the different specific flora with the characteristics of stability and in equilibrium with the geomorphologic and climatic conditions of the area. This flora represents definitely the vegetation that would live in the whole territory if the men with their activity wouldn't interfere repeatedly and continually on the natural development of the area.

The study of the variety and the development serial stages that we find in the residual natural areas with the same geomorphologic and climatic characteristics permitted to have an indirect evaluation on the suitability of single variety and on the vegetation. The vegetal species existing, since growing up spontaneous, revel the best capability of rooting, environmental adaptation, resistance against external attacks (for example: sudden frost, aridity, plant pests…etc.), competitively.

Therefore, to include these varieties means, generally, to have a minor charge of care and maintenance and in addition to reduce the amount of chemical substances, like fertilizer and parasiticidal, in the implantation phase.

The utilization of selected species on the basis of these principles will revel suitable to increment the local biodiversity: in fact the start of natural dynamic will promote the vegetal biocoenosis evolution, also throw the spontaneous insert of new species. In choosing the variety inside the local flora it will be operate a selection, keeping attention on different typological areas such as exposition, inclination, water abundance etc.

In the situation in which the designed structures will require a further intervention in respect of the standard rehabilitation of the local environment, for example works of shielding or camouflage, the vegetal variety must be selected to respond at the specific goal pursued (crown dimension, growth quickness, etc.).

Interventions of bioengineering (see paragraph 13.6 of Annexes)

In landscape and environmental designing a role of primary importance may be carry out by the bioengineering interventions and planning. Bioengineering is a technology that projects with vegetation and particular materials (for example geotextile, biomat, wire mesh, stones, wood, straw, etc.) to solve the erosion and washout phenomenon.

The main goals of bioengineering interventions are:

- Techno-functional (consolidation against washout and erosion)
- Naturalistic (the project has to design not only the green but also the reconstruction of the para-natural ecosystem through the utilization of autochthon species)
- Landscape
- Economic (the structures desiged by natural engineering are economicaly competitive and alternative with respect to the traditional one.

The bioengineering interventions are implemented in the following categories:

- Covering of washout (sowing, sowing mattress and mat)
- Stabilizer (shrubs planting, taleas, fascines, herbs, etc.)
- Consolidation (live palisade, live grating, gabionade, green mattress, etc.)
- Particular (anti-rockfall, wind-break works, etc.)

Bioengineering is divided into three different branches of intervention, summarised in:

- Realization of bio-type and para-natural eco-system
- Realization of consolidation against washout and erosion
- Intervention on the local fauna, with regard to guarantee the habitat continuity

The proposed interventions, according to the flora mitigation measures and showed in the annexed maps 13.4, are:

- Arrangement of arboreal and shrubby community near the rivers
- Green arrangement of interchange and residual area
- Shrubby stripe arrangement
- Renaturation systems

This type can be predicted in a way to be convenient for tunnel entrances.

Green interventions alongside the body (see paragraph 13.6 of Annexes)

The width of the areas under or over the slope embankments depends to their height. This ambit will be faced by the simple grassing or by the realization of shrubs constituted exclusively by shrubby elements or by more articulate vegetal formations, that will include whether low and high shrubby.

The shrubs and the meadows with bushes used in the ripristination on cliff in middle height embankments will be planted in irregular strips and variable size. These typologies of greening present a dynamic process more developed with respect to the simple meadowing with the local vegetation.

The shrubs and the meadows with bushes have an aesthetic function of landscape design and produce a consolidation of the ground. Furthermore, they are in the direction of an environmental retraining because the presence of local species placed in a wide area constitute the favourite way for the fauna to connect areas of different environment value.

With particular reference to rural areas, quicksets and shrubby formation represent a kind of ecological corridor for vegetal species that don't like the open space and a refuge for those who grow up in lands under cultivation.

This mitigation measure is showed in the annexed maps (13.4) with the voice *Shrubby stripe arrangement.*

Noise

(see paragraph 13.6 of Annexes)

For mitigation of noise impacts, at this level of the project, it is proposed an opaque barrier to be installed along the motorway.

The barrier is 3m high with reinforced concrete plank on base. Drawing of noise barrier is given in the Annex 13.6.

6.4 Breakdown of estimated costs

In the following table, the breakdown of mitigation measures costs is proposed by section. Obviously, the values shown are indicative because at present is possible only a cost forecast that will be verified in the following phases of the study, when the characteristics of the project will be detailed.

Tarčin – Konjic		
	estimated cost breakdown	
	euro	KM
Noise barriers	450,000	877,500
Re-vegetation around the tunnel entrance	1,440,000	2,808,000
Shrubby stripe	1,440 000	2,808,000
Stabilisation and re-vegetation (slopes and erosion)	4,320,000	8,424,000
Re-vegetation of construction camps and borrow pits	2,160,000	4,212,000
Re-vegetation of interchanges	720,000	1,404,000
TOTAL	***10,080,000***	***19,656,000***

Konjic – Jablanica		
	estimated cost breakdown	
	euro	KM
Noise barriers	263,077	513,000
Re-vegetation around the tunnel entrance	720,000	1,404,000
Shrubby stripe	1,584,000	3,088,800
Stabilisation and re-vegetation (slopes and erosion)	2,160,000	4,212,000
Re-vegetation of construction camps and borrow pits	2,160,000	4,212,000
Re-vegetation of interchanges	720,000	1,404,000
TOTAL	***7,344,000***	***14,320,800***

Jablanica – Mostar		
	estimated cost breakdown	
	euro	KM
Noise barriers	-	-
Re-vegetation around the tunnel entrance	1,080,000	2,106,000
Shrubby stripe	1,440,000	2,808,000
Stabilisation and re-vegetation (slopes and erosion)	4,320,000	8,424,000
Re-vegetation of construction camps and borrow pits	2,160,000	4,212,000
Re-vegetation of interchanges	-	-

TOTAL	***9,000,000***	***17,550,000***
GRAND TOTAL LOT 3	***26,424,000***	***51,526,800***

7.0 ALTERNATIVES CONSIDERED AND ENVIRONMENTAL REASONS FOR SELECTION OF THE SOLUTION OFFERED

7.1 Introduction

The project of the motorway section encompassed by Lot 3, considering limitation and stimulating factors, has taken into account the 7 motorway alternatives (including the Base Corridor conceptualised by the Spatial Plan of B&H).

Evaluating advantages and disadvantages of each alternative, final choice respected not only technical elements of the road alignment but also an impact of the alignment on development of wider area of the Corridor, as well as an impact on spatial development on the settlement structures, demographic flows, environmental, esthetical and other conditions.

In the process of the final alignment selection, the impacts of the motorway on the area within the Corridor, from the aspect of natural features, development possibilities and limitations, spatial limitations for the settlement development, establishment of collision points, impact to agriculture development, water management, as well as to all utility infrastructure systems, natural values and cultural-historical heritage have been considered.

In this sense, during the study, the Consultant has developed two Multi-Criteria Analysis between 6 possible alternatives, in order to select the most favourable alignment alternatives.

The main structures (viaduct, bridges and tunnels) are listed for all the alternatives. The main data of the alternatives studied are presented in the following table:

Table 68

Corridor	Alternative	Description	Length (km)	Interchanges	Bridges	Tunnels
0	0	No Intervention	-	-	-	-
1	1	Upgrading of existing Road to Highway Standards	about 70	to be evaluated	to be evaluated	to be evaluated
2	2A	Follows the River Neretva after Jablanica	63+800	Tarčin, Konjic, and Jablanica	34	39 (max. 3,800m)
	2B	Similar to 2A, but more far from Neretva	62+900	Tarčin, Konjic, and Jablanica	32	32 (max 4,250m)
3	3	After Jablanica passes far from the River Neretva	60+400	Konjic and Jablanica	22	35 (max 6,400m)
4	4	Not passing by Jablanica	56+050	Tarčin and Konjic	31	27 (max 9,150m)
5	5	Arrive to Mostar trough a long Tunnel	45+350	Tarčin and Konjic	8	12 (max 12070m)

All the alternatives start from the same point, near Tarčin, and have the same ending point, in North Mostar.

The starting point was individuated trying to understand how roads will serve the Sarajevo zone in the future; therefore two different connections are possible by this starting point:

- direct connection to Sarajevo following the existing road, or maybe a new road that will be built conforming the existing to motorways standard;
- direct connection to Visoko making shorter the Corridor Vc.

The end of Lot 3 is situated in the North of Mostar, and after this point it is possible to by-pass the town on the left or on the right side of the Neretva River.

Generally the design speed along the whole length is 120km/h as per TEM recommendations.

The other parameters, as horizontal/vertical minimum radius and maximum slope were adopted on the basis of recommendations for Motorway Construction in Europe (in accordance to TEM) for all the studied alternatives, in order to obtain comparative costs based on the same inputs. Once the most favourable route will be chosen, analysis on possible standard reduction will be made in order to evaluate the possibility of decreasing the cost of the Project.

Taking into consideration the above, it was decided at this first stage to have Minimum Radius (R) of 1,000m in the usual sections, and R=1,250m in the tunnel section, in order to guarantee enough visibility, without widening the cross section. As far as tunnels concern, each tube should be 12.75m wide at the base.

In the first part of all the alternatives (section 0-26 km station) the length of the main structures (bridges, viaduct and tunnels) is not dependant of the value of the radius. This fact is evident because the difficult morphology of that zone demands following of incisions and all the variants cross the mountains and the valleys perpendicularly.

All the design criteria should follow the TEM Standards.

7.2 Definition of the alternatives

7.2.1 General

The analysed alternatives are:

- The Base Corridor, conceptualised by the Spatial Plan of SRB&H was also analysed. This alternative is following the existing road leading towards Konjic. It is crossing Jablanica Lake, passing through the tunnel in Prenj Mountain, towards south, enters Bjelopoljska valley.
- Alternative 0 or do nothing, that considers no intervention of the existing main road M17
- Alternative 1 is showing possibility of motorway construction by following the existing alignment of the main road M17.
- Alternative 2A; By this alignment, from Tarčin to Konjic intersection, for approximately 21 km, the alignment is lying along the left - east side of the existing road. Avoiding unfavourable geo-technical terrain conditions with one tunnel and the bridges, the alignment leads to Konjic. After this, the alignment is crossing Jablanica Lake by viaduct. In order to avoid very unfavourable geotechnical conditions near Ostrožac, the alignment is, with 3,800m-long tunnel, overcoming the space to Jablanica intersection, After this intersection, the alignment is following the existing main

road and crossing the Neretva river with two bridges. After that, the mountainous part is surmounted by the tunnel, and exits to Bjelopoljska valley near Mostar.

- With the Alternative 2B, the numerous particularities, characteristics and contents have been explored, concerning the space from Tarčin to Bjelopoljska valley. From Tarčin to Konjic intersection, the alignment section of 21 km is lying along the left, east side of the existing road, using tunnel and bridges. Over the viaduct, the alignment is crossing over the Jablanica Lake and using the longer tunnel, due to the unfavourable geological conditions, forms Jablanica intersection. After this, the alignment does not follow the Neretva River, but leads towards the mountainous area and, through the tunnel, to the Bjelopoljska valley.
- Alternative 3; from Tarčin to Konjic intersection, for approximately 21 km, the alignment is lying along the left - east side of the existing road. It is overcoming geo-mechanically disadvantageous terrains by the tunnel and the bridges. Like with the previous alignment, after Konjic intersection, the alignment is crossing Jablanica Lake via viaduct, and that, through the longer tunnel, it surmounts the terrain up to Jablanica intersection.
- Alternative 4; by this alternative, from Tarčin the alignment is connecting to the existing road system, and than surmounts the terrain up to Konjic intersection through the tunnels and over the bridges. At last, after the Konjic intersection it is crossing Jablanica Lake via higher viaduct. The alignment does not serve Jablanica, since the alignment enters Bjelopoljska valley through long tunnel.
- Alternative 5; From Tarčin, the alignment is easily connected to the system of existing roads, and than, through the 12km-long tunnel in the mountain Prenj, changes its direction, leading over bridges along the west-right side of the Neretva river, finishing in the Bjelopljska valley.

The basic data on the structures for each of analysed alternatives are given in the following table.

Table 69

ALTERNATIVE	STRUCTURES (NUMBER)		TOTAL LENGTH (m)		MAXIMUM LENGTH (m)	
	TUNNELS	BRIDGES	TUNNELS	BRIDGES	TUNNELS	BRIDGES
Alternative 2A	39	34	36,170	8,200	3,800	1,160
Alternative 2B	32	32	41,710	6,700	4,240	1,040
Alternative 3	**35**	**22**	**38,500**	**3,800**	**6,400**	**850**
Alternative 4	27	31	26,980	6,600	9,150	720
Alternative 5	12	8	29,800	2,600	12,070	960

Alternative 0
Do-nothing alternative, e.g. which will be the situation in the project life duration “without project”.

Alternative 1
The existing road upgraded to the highway standards.

Alternative 2A
The total length of that alignment is almost 63,800m. It starts near the town of Tarčin (ground elevation of 657.50 m) and it is easily connected with the existing road system. It ends in the North of the town of Mostar (ground elevation of 160.00 m) with a total difference of ground elevation of 497.50 m. The

maximum ground elevation is 793.70, at the station 6+100. The longitudinal gradient is always less than 4%, and the maximum is 3.73%.

From Tarčin (km 0) to the interchange of Konjic (km 21) the alignment passes mainly on the left side (East) of the existing road with a sequence of tunnel (not longer than 2km) and bridges (not longer than 400m) since the morphology of the area is difficult. After the interchange of Konjic this alternative crosses Jablanica Lake by an important viaduct, located near the existing railway bridge.

Between Jablanica Lake and the interchange of Jablanica (km 37), this alternative presents an important tunnel of almost 3,800m to avoid the difficult geological site of Ostrožac, where it is possible to notice some actives landslides.

After the interchange of Jablanica the alternative follows in its first section the River Neretva, crossed in two different places (in particular the second one presents same difficulties). After the last river cross, this solution crosses the mountains by a sequence of tunnels (not longer than 3,800 m) and bridges (not longer than 1,160 m).

Alternative 2B

The total length of that alignment is almost 62,900m. It starts near the town of Tarčin (ground elevation of 657.50 m) and it is easily connected with the existing road system. It ends in the North of the town of Mostar (ground elevation of 160.00 m) with a total difference of ground elevation above sea level of 497.50 m. The maximum ground elevation is 793.70 above sea level, at the station 6+100. The longitudinal gradients are always less than 4%, and the maximum is 3.73 %.

From Tarčin (km 0) to the interchange of Konjic (km 21) the alignment passes mainly on the left side (East) of the existing road with a sequence of tunnel (not longer than 2km) and bridges (not longer than 400m) since the morphology of the area is difficult.

After the interchange of Konjic this alternatives crosses Jablanica Lake by an important viaduct, located near the existing railway bridge.

Between Jablanica Lake and the interchange of Jablanica (km 37), this alternative have an important tunnel of almost 4,240 m to avoid the difficult geological site of Ostrožac, where it is possible to notice some actives landslides.

After the interchange of Jablanica the alternative does not follow the River Neretva because this solution is an evolution of the solution 2A. Therefore this alternative tries to avoid River Neretva crossing, entering the mountains area. This alignment crosses the mountains by a sequence of tunnels (not longer than 3,800 m) and bridges (not longer than 800 m).

Alternative 3

The total length of that alignment is 60,400 m. It starts near the town of Tarčin (ground elevation above sea level of 657.50 m) and it is easily connected with the existing road system. It ends in the North of the town of Mostar (ground elevation of 160.00 m) with a total difference of ground elevation of 497.50 m. The maximum ground elevation is 793.70, at the station 6+100. The longitudinal gradients are mainly less than 4%, with a maximum of 5% in a short section.

From Tarčin (km 0) to the interchange of Konjic (km 21) the alignment passes mainly on the left side (East) of the existing road with a sequence of tunnel (not longer than 2km) and bridges (not longer than 400m) since the morphology of the area is difficult. After the interchange of Konjic this alternatives crosses Jablanica Lake by an important viaduct, located near the existing railway bridge.

Between Jablanica Lake and the interchange of Jablanica (km 37), this alternative have an important tunnel of almost 3,800 m to avoid the difficult geological site of Ostrožac, where it is possible to notice some actives landslides.

After the interchange of Jablanica the alternative does not follow the River Neretva but it goes directly into the mountains with a long tunnel of 6,400m. After this long tunnel the alignment crosses the mountains by a sequence of tunnels (not longer than 3,800 m) and bridges (not longer than 800m).

Alternative 4
The total length of that alignment is 56,050 m. It starts near the town of Tarčin (ground elevation of 657.50 m) and it is easily connected with the existing road system. It ends in the North of the town of Mostar (ground elevation of 160.00 m) with a total difference of ground elevation of 497.50 m. The maximum ground elevation above sea level is 793.70, at the station 6+100. The longitudinal gradients are always less than 4%, with a maximum of 4.95% in a short section.

From Tarčin (km 0) to the interchange of Konjic (km 21) the alignment passes mainly on the left side (East) of the existing road with a sequence of tunnel (not longer than 2km) and bridges (not longer than 400m) since the morphology of the area is difficult. After the interchange of Konjic, this alternatives crosses Jablanica Lake by an important viaduct, located near the existing railway bridge.

This alternative is shorter than 2A, 2B and 3 but does not serve the town of Jablanica and presents a very long tunnel of 9,150m since this solution passes more directly across the mountains. This alternative ends in North Mostar by a succession of tunnels and bridges (not longer than 720 m).

Alternative 5
The total length of that alignment is almost 45,350 m. It starts near the town of Tarčin (ground elevation of 657.50 m) and it is easily connected with the existing road system. It ends in the North of the town of Mostar (ground elevation of 160.00 m) with a total difference of ground elevation of 497.50 m. The maximum ground elevation is 797.47, at the station 6+192. The longitudinal gradients are always less than 4%; expect a maximum of 4.10% in a short section.

This alternative follows the same alignment of the others solutions just approximately for the first 8 km, and than, after the existing tunnel Ivan, changes its way to go on the right side of the existing road (West).

In the zone of Ovčari, well know for the presence of landslides, this solution abandons the existing road to avoid these geological problems.

This alignment crosses the River Neretva (km 21) and than enter in a valley following the ground and has an extremely long tunnel (more than 12km) to cross the mountains. This alignment ends in the same point of the others alternatives. This solution is the shorter but does not serve the town of Jablanica, and the long tunnel of 12 km is very hard to build and maintain, because of the safety problems that long tunnels present.

7.2.2 Selection of the compliant alternative

The overall objective of the studies and project documentation for the motorway is to consider the necessity of improvement of the transport quality, traffic capacity and safety in the corridor through construction of a full profile motorway. For this reason the Consultant prepared a Multi-Criteria Analysis, which is described here below. Sustainability of motorway investment includes different objectives: “offering the adequate level of service to transport demand”, “preserve the natural and historical resources of the country”, “ensure the social acceptability of the community living in the influence area of the infrastructure”.

Each criterion is then expressed through the value of few parameters that best represent the impact of each alternative on the specific criteria. The parameters are represented by measurable variables. They should be not redundant but could be alternative (the achievement of a bit more of one objective could partly preclude the achievement of the other).

The application of the MCA III to the Sarajevo - Mostar considers:

- *According to MCA I and II the selected project alternatives: Alt2B and Alt3)*
- *The Base Corridor (Alt4*) as Corridor proposed in the B&H Spatial Plan

The policy objectives of the project, assumed from the stated overall objective of the Sarajevo - Mostar motorway, constitute the CRITERIA of the MCA:

1. The new infrastructure should respond to the increased needs of transport demand in terms volume of vehicles and level of service. In other terms, the proposed alternative should be effective offering increased transport capacity at higher level of service. This objective of technical effectiveness (*respondence to transport demand requirements*) is translated into the *TRANSPORT criteria* (increased traffic volumes, capacity offered, decreased transport time, transport connection), here nominated as *TECHNICAL and OPERATION CHARACTERISTICS*.
2. The new infrastructure should be designed optimising the economic resources, in terms of economic efficiency (*respondence to market requests*). The *ECONOMY criteria* include the investment costs, recurrent costs over the project life and transport cost savings. Here nominated as *INVESTMENT COST* criteria.

   The construction of the new infrastructure will bring disturbance to present traffic conditions and to surrounding population for the duration of the construction period, for this reason a fourth criteria has been added: *TIME and CONDITION of CONSTRUCTION*.
3. The new infrastructure should bring substantial benefits to the population in the area traversed and ensure the social acceptance of the investment. In other words the *SPATIAL PLANNING criterion tries* to minimize disturbance in *urban areas, protected areas*. The new infrastructure should preserve the natural and cultural endowments of the territory. The *ENVIRONMENT criteria* look after the conservation of the landscape, water, air, and protected areas resources and after the minimization of territory severance and erosion. The factors are summarised under the *SPATIAL PLANNING and ENVIRONMENTAL CHARACTERISTICS* criteria.

The weighs to be given to each criterion of the MCA are naturally a public choice in accordance with the objectives set for the transport development strategy of the country. Here the Consultant is presenting a basic proposal using usual international assumptions:

A)	TECHNICAL AND OPERATIONAL criteria	40%
B)	INVESTMENT COST criteria	30%
	CONSTRUCTION TIME AND CONDITION criteria	10 %
C)	SPATIAL criteria	20%

Sensitivities are then operated with different weighing distribution.

The results of the MCA II show that Corridors 2 and 3 are the preferred solutions to carry on for the following phases of the Project. In fact, options 4 and 5 with very long tunnels, present several problems in the management and high risk in case of accidents. We have also to notice that the management cost of long tunnels is very high, therefore, even if the construction cost could be lower, the overall investment becomes more expensive. The Consultant wishes also to add that corridors 2 and 3 have the advantage, serving the existing towns along the route and being closer to the actual road, to be opened also in sections, while the direct route does not have this advantage.

Since option 2B is the evolution of option 2A, the Consultant proposes to carry on the Study with options 2B and 3, in order to establish by MCA 2nd phase, which is the preferred option.

Accordingly, the variants 2B and 3 including alternative 4 as Base Corridor constituted the object of the *Multi-criteria Analysis III.*

The results obtained through MCA III are reported in the following table:

Table 70

	Base case		**Sensitivity**		**Sensitivity**		
ROUTE ALTERNATIVE	A) Technical Operability B) Investment costs Construction time/condition C) Spatial Planning& Env.	40 % 30 % 10 % 20 %	A) Technical Operability B) Investment costs Construction time/condition C) Spatial Planning& Env.	35 % 35 % 15 % 15 %	A) Technical Operability B) Investment costs Construction time/condition C) Spatial Planning& Env.	40 % 40 % 10 % 10 %	**Ranking**
Alt 2B	38.2		37.1		35.9		3
Alt 3	**56.6**		**58.8**		**62.0**		**1**
Alt 4	51.1		47.3		46.2		2

Alt 3 represents the preferred alternative.

8.0 POTENTIAL DIFFICULTIES DURING REALIZATION OF EIS

The lack of air quality and noise level data, both along the current M17 alignment and proposal motorway alignment is a particular shortcoming of the existing Environmental Baseline Data.

In particular the air quality data had been asked for the Federal Meteorological Institute of Bosnia and Herzegovina* (FMI B&H), and the obtained results concerned air quality observation at Meteorological Station Mostar and Ivan Sedlo. These two meteorological stations are located in the extensive project area, but for now, only the Meteorological Station Mostar is in function, while station Ivan Sedlo is out of function since the war beginning and so the data is not updated.

- Station Mostar

Results of the air pollution observations in the project, obtained at Meteorological Station Mostar encompass statistical processing of sulphur dioxide and smoke concentration in period:

- 1975/76 to 1991/92
- 1999/00 to 2001/02

- Station Ivan Sedlo

Results of pollution observation at Station Ivan Sedlo refer to period January-December 1991. In this period the average monthly concentration measurements of sulphur dioxide, nitrogen dioxide and monthly average rainfall pH values are encompassed.

There aren't other data on the air quality measurement in the project area. The author of this part of the EIS is aware of the fact that these data are strictly local, apart form being out-of-date; they can not be applied on the entire intervention location. Thus, due to the low quantity of the measured data, it is difficult to talk about the present pollution level of this Corridor Vc section area.

9.0 CROSS-BORDER ENVIRONMENTAL IMPACTS

The focus of this paragraph is the harmonisation of the construction with the international obligations of FB&H on reduction of cross border environmental impacts.

About the harmonisation of the construction with the international obligations of FB&H on reduction of cross border environmental impacts, the Espoo convention was proposed.

The UN Convention on Environmental Impact Assessment in a Trans-boundary Context, the so-called Espoo Convention, was signed in 1992. It requires that assessment be extended across border between Parties of the Convention when a planned activity may cause significant adverse trans-boundary impacts.

The Convention was a response to a growing concern about trans-boundary emissions and the emergence of environmental impact assessment as a tool to reduce the negative environmental effects of new activities.

In the case of the Project under study (Lot3, Section Sarajevo South (Tarčin) – Mostar North), the cross-border environmental impacts are not significant for the long distance to Croatia border.

10.0 MONITORING SYSTEM AND METHODOLOGY

Monitoring is carried out to assess any disturbance to the environment and to protect both MCTBH and the affected parties from false charge. An environmental inspector could be proposed to this project by MCTBH. The inspector should have a number of short-term inputs from the commencement of the construction through to its completion and until cleanup has been finalised.

Monitoring a project or a program and its surrounding is a tool for decision-making, not an end product. The environmental team and Environmental protection agencies will conduct the monitoring. The monitoring will involve maximum use of information collected in existing regular channels for reasons of resources efficiency and to avoid adding to the workload of the organisation compiling data.

10.1 Environmental implementation measures

Monitoring the environmental protection measures during construction mainly concern the impact mitigation and enhancement and the construction activities that are required of the contractors, that include rehabilitation or protections of borrow pits, re-vegetation of barren areas, and bush clearance with minimal ancillary damage to the landscape, proper waste management and other obligations. An aim is for the environmental team to help the contractors maintain sensitivity towards environmental concerns, meet their contractual responsibilities and have flexibility in response to environment-related issue.

The effects of the project road upon surrounding environment has both short-range and long-term dimension. The short-range effects mainly involve construction-related activities.

Monitoring these events requires attention to the following:

- Appropriate data collected by government agencies;
- Suitable institutional arrangements and communications;
- Necessary staff to get tasks done;
- Adequate financial and technical resources;
- Capacities to compile process and analyse information in a timely fashion.

The kinds of effects to be monitored:

- Population displacement;
- Resettlements and compensation;
- Construction-related pollution;
- Land and water uses;
- City infrastructure.

In addition to construction-related concerns, the environmental management team will establish systems to monitor long-range, mainly development-related effects.

It will be necessary to assess the capacities of organizations to collect the required data and perform appropriate analyses.

10.2 Environmental management team

The aim of a group that monitors its own program is to determine the adequacy of past and present tasks, so as to plan for the future. On the project road these evaluations will address the subjects of staff, finance support, resources, progress of program activities and change to work plans.

The monitoring will include quarterly work-plans that are update as necessary and quarterly meetings or as necessary, to anticipate problems, suggest solutions and help implement the work program.

10.3 Work program

The environmental protection work program has the following goals:

- The implementation of environmental protection measures both during the construction of the project and afterwards;
- The addressing of environmental issues by appropriate organisations and officials, within the context of long-term planning and management of the project;
- The organizational strengthening of MCTBH

10.4 Work activities

Work activities for environmental protection associated with the project are in four areas:

- Establishment of liaison, communications and working arrangements;
- Implementation of measures for avoiding or mitigating problems and enhancing benefits and opportunities associated with the roads project;
- Monitoring activities;
- MCTBH staff training.

Much of the work involves monitoring contractor activities and coordination of the impact mitigation and enhancement measures. The Environmental Coordinator will arrange specific work activities and organizations responsible for their implementation.

10.5 Schedule

Early activities of the environmental team include the following:

- Preparation of the training materials for the workshops, followed by the start of the training itself;
- Dissemination of information about the project;

Many of the activities involve coordination, encouragement, and impetus provided by the environmental staff, rather than their extensive participation.

Some tasks will begin with the construction of the line. These include the following activities:

- Establishing working relationships and monitoring arrangements with the contractors;
- Facilitation of planning for lay-byes and service centers;
- Feedback from the advisory group on organisation, initial efforts and future program priorities.

10.6 Monitoring plan on physical and biological environment

- *Soil and Erosion*

Monitoring during construction shall be done by MCTBH (Environmental Inspector) as per the mitigation measures recommended in Chapter 6 During operation the district maintenance office should conduct the surveillance of erosion.

- *Vegetation and Fauna*

The purpose of this programme is to monitor effects of the project during the construction and after the completion of the project. The monitoring of components associated with vegetation and fauna will be contracted to the interested Ministry and the Environmental protection agencies.

- *Nuisance Noise and Dust*

It will be the responsibility of MCTBH (Environmental Inspector) or Site Engineer to ensure that appropriate control measures are taken.

- *Clean up*

Following the completion of the road project, it will be necessary to cleanup and rehabilitate the construction site.

This monitoring will be maintained for only a short duration during the cleanup of the construction site to ensure that environmental precautions are implemented.

Table 71 List of environmental quality monitoring requirements

Project Phase	Category	Indicators	Location	Method	Duration	Frequency	Purpose	Expertise Required	Responsibility	Estimated Cost
Pre-construction	*Soil erosion*	Soil nature, slopes inclination, vegetation coverage, cllimatic condition	All areas affected by construction	Visual and descriptive, soil sampling and analysis	(Not applicable)	1 time prior to construction	To define any necessary protection measures	Engineering Geologist with experince of field monitoring	M.C.T.B.H.	
	Vegetation	Epiphytic Lichens	Natural area adjacent to the facilities	Approved standards of sampling and analysis	2-3 days	1 time prior to construction	To define background biological conditions of forest areas which will be affected by project impacts	Botanists with experience of field monitoring	M.C.T.B.H.	Purchase of the main pieces of equipment
	Fauna	Aquatic macroinvertebrates	All watercourses associated with the construction	Approved standards of sampling and analysis	1-2 days	Twice a year (once in spring, once in fall) prior to the construction	To define background biological conditions of forest areas which will be affected by project impacts	Zoologists with experience of field monitoring	M.C.T.B.H.	Purchase of the main pieces of equipment
	Baseline Air Quality And Noise Conditions	SO_2, Pb, TSP, NOx, CO Ambient noise	The sites are listed in the text after the table	Portable air quality and noise measurement equipment of approved manufacture	Over 1 hour, with AM peak traffic flows	1 time prior to construction	To define background conditions against which to assess project impacts	Resourced Environmentalist with experience of field monitoring	M.C.T.B.H.	(mainly Equipment purchase)
	Baseline Water Quality Conditions	PH, Colour, Smell, Dry residuum of filtrated water in mg/l,	Vulnerable wells adjacent to off-site facilities	Approved standards of sampling and analysis	(Not applicable)	1 time prior to construction	To define background conditions against which to assess project impacts	Resourced Environmentalist with experience of field monitoring and analysis		
		Faecal Coliforms (E.coli), Total Coliforms, Visible waste materials	Vulnerable wells adjacent to off-site facilities							
		Total Suspended Solids, Dissolved Oxygen								

Project Phase	Category	Indicators	Location	Method	Duration	Frequency	Purpose	Expertise Required	Responsibility	Estimated Cost
Construction	*Soil erosion*	Construction of slopes , cut configuration, soil nature	All areas affected by construction	Visual and descriptive	(Not applicable)	3 times	To define any necessary protection measures	Engineering Geologist with experince of field monitoring	M.C.T.B.H.	
	Vegetation	Epiphytic Lichens	Natural area adjacent to the facilities	Approved standards of sampling and analysis	2-3 days	1 time prior to construction	To define environmental stress of forest areas	Botanists with experience of field monitoring	M.C.T.B.H.	Purchase of the main pieces of equipment
	Fauna	Aquatic macroinvertebrates	All watercourses associated with the construction	Approved standards of sampling and analysis	1-2 days	Twice a year (once in spring, once in fall) prior to the construction	To define pollution and alteration effects on watercourses	Zoologists with experience of field monitoring	M.C.T.B.H.	Purchase of the main pieces of equipment
	Site Inspection	Site clearance	All areas, both on and off site, to be cleared as part of construction area	Visual and descriptive, against a check list	(Not applicable)	12 times each year	To ensure compliance with B&H laws, general standards of "Good practice" and that health and safety are adequately provided for	Environmentalist with experience of site construction and inspection and awareness of health and safety requirements	M.C.T.B.H.	…
		General Construction Activity	All sites associated with the construction	Visual and descriptive, against a check list	(Not applicable)	6 times each year				
		Batching and Asphalt Plants, etc.	All batching, asphalt and other processing plants	Visual and descriptive, against a check list	(Not applicable)	12 times each year				
		Camp and Maintenance Facilities	All construction camp and maintenance facilities	Visual and descriptive, against a check list	(Not applicable)	4 times each year				
	Air quality and noise conditions	SO_2, Pb, TSP, NOx, CO Ambient noise	The sites are listed in the text after the table	Portable air quality and noise equipment of approved manufacture	Over 1 hour, with AM peak traffic flow	Every 3 months	To assess the magnitude of any project impact	Resourced Environmentalist with experience of field monitoring	M.C.T.B.H.	…
	Water quality conditions	PH, Colour, Smell, Dry residuum of filtrated water in mg/l,	Vulnerable wells adjacent to off-site facilities	Approved standards of sampling and analysis	(Not Applicable)	Every 3 months	To assess the magnitude of any project impact	Resourced Environmentalist with experience of field monitoring and analysis		
		Faecal Coliforms (E.coli), Total Coliforms, Visible waste materials	Vulnerable wells adjacent to off-site facilities							
		Total Suspended Solids, Dissolved Oxygen								

Project Phase	Category	Indicators	Location	Method	Duration	Frequency	Purpose	Expertise Required	Responsibility	Estimated Cost
	Contract supervision	Contractor's compliance with Standards, Low numbers of injuries to workers	All sites of construction and project related activity	Primarily visual and descriptive against a check list	On going	Daily	To ensure Contractors comply with Standards requirements	Experienced site supervisor with awareness of environmental and health and safety issues	Contract Supervision consultants	…
	Cultural heritage	The lack of disturbance of known site	All vulnerable sites adjacent to the road	Visual and descriptive	(not applicable)	…	To ensure all new. findings are recorded in accordance with requirements	Inspector	M.C.T.B.H.	…
		Documentation gathered	All previously unknown remains unearthed during construction	Standards procedures	As necessary	…				
	Land acquisition	The early identification of acquisition problems	All lands to be acquired under the project	Internal monitoring	(not applicable)	Continuous	To provide early warning of difficulties	Community liaison office and representatives of the local community	M.C.T.B.H.	…
		The effectiveness of acquisition procedure and of compensation disbursement	All lands to be acquired under the project	Independent monitoring	(not applicable)	Over 200 days spread throughout the duration of acquisition	To review the acquisition procedures and ensure their efficiency and transparency	Person of "High standing " within the communityFunding agency missioners	M.C.T.B.H.	…
		The overall efficiency of acquisition and resettlement	All lands to be acquired under the project	External monitoring	During Funding agency mission	As required by the Funding agencies	To ensure the adopted procedures conform to Funding agency requirements	Funding agency missioners	Funding agencies	Included within Funding agency costs
Post-Construction	*Soil erosion*	Land surface evolution	All areas affected by construction	Visual and descriptive	(not applicable)	Every six months for two years period	To verifie effectiveness of provided mesures	Engineering Geologist with experince of field monitoring	M.C.T.B.H.	
	Vegetation	Epiphytic Lichens	Natural area adjacent to the facilities	Approved standards of sampling and analysis	2-3 days	Once a year	To define environmental stress	Botanists with experience of field monitoring	M.C.T.B.H.	Purchase of the main pieces of equipment
	Fauna	Aquatic macroinvertebrates	All watercourses associated with the construction	Approved standards of sampling and analysis	1-2 days	Twice a year (once in spring, once in fall)	To assess pollution and alteration effects on watercourses	Zoologists with experience of field monitoring	M.C.T.B.H.	Purchase of the main pieces of equipment
	Air Quality and noise conditions	SO_2, Pb, TSP, NOx, CO Ambient noise	The sites are listed in the text following the table	Portable air quality and noise measurement equipment of approved manufacture	Over 1 hour, to coincide with peak traffic flows	Every 3 months	To assess operation impacts, including improvements to the urban environment resulting from the project	Resourced environmentalist with experience of field monitoring	M.C.T.B.H.	…
	Water Quality conditions	PH, Colour, Smell, Dry residuum of filtreted water in mg/l, up to	The nearest wells downstream of road drainage outfalls	Approved standards of sampling and analysis	(not applicable)	Every 6 months	To assess any long term project impacts	Resourced environmentalist with experience of field monitoring and analysis		

Project Phase	Category	Indicators	Location	Method	Duration	Frequency	Purpose	Expertise Required	Responsibility	Estimated Cost
		Faecal Coliforms (E.coli), Total Coliforms, Visible waste materials	The nearest wells downstream of road drainage outfalls							
		Total Suspended Solids, Dissolved Oxygen								
	Landscape	The sustainability of landscape planting	All sites subject to landscape planting under the project, including the planting to mitigate noise	Visual inspection	1 day	3 times each year, dictated by climatic conditions and the growing seasons	To ensure the planted areas are maintained and that any die-back is replaced	Landscaper with experience in the planting and maintenance of public areas	M.C.T.B.H.	

Impact on air quality

There are only few buildings in the neighbourhood of the project. They are present mainly in tree points:

- In proximity to Smucka (from km 0+950 to km 1+150);
- In proximity to Jablaničko Jezero lake (from km 21+150 to km 22+150);
- In proximity to km 24+700

Noise impact

Therefore, some settlements and isolated buildings along the planned alignment will be effected and in particularly:

- The isolated buildings in correspondence of km 1+425; km 2+050; km 2+400; km 7+950 – km 8+250;
- The settlement systems of Smucka (km 0+900 – km 1+100); Hasanovići (km 24+550 – km 24+700) and in correspondence of km 21+100 – km 22+150 (Konjic interchange).

11.0 EXTRAORDINARY CONDITIONS

11.1 Links between environmental management and disaster reduction

The environment and disasters are inherently linked. Environmental degradation affects natural processes, alters humanity's resource base and increases vulnerability.

It exacerbates the impact of natural hazards, lessens overall resilience and challenges traditional coping strategies.

Furthermore, effective and economical solutions to reduce risk can be overlooked.

Practices that protect the integrity of nature and ensure a wise use of natural resources can provide solutions to reduce vulnerability from which both the environmental and disaster effected communities will benefit.

Although the links between disaster reduction and environmental management are recognized, little research and policy work has been undertaken on the subject. The concept of using environmental tools for disaster reduction has not yet been widely applied by practitioners.

Environmental management can become a cost-effective tool for disaster reduction while serving many other objectives including conservation of biodiversity, mitigation of adverse global environmental changes and poverty alleviation.

A closer analysis of what transforms a natural event into a human and economic disaster reveals that usually the fundamental problems of development that the area faces are the very same problems that contribute to its vulnerability to the catastrophic effects of natural hazards.

The principal causes of vulnerability can be summarized in:

- Rapid urbanization;
- Persistence of widespread urbanisation;
- Mismanagement of natural resources;
- Public policies;
- Lack of investment in infrastructure.

Development and disaster-related policies have largely focused on emergency response, leaving a serious underinvestment in natural hazard prevention and mitigation.

In order to reduce the toll of disasters in the area requires a more comprehensive approach that encompasses both pre-disaster risk reduction and post-disaster recovery.

It is framed by new policies and institutional arrangements that support effective action. Such an approach involves the following set of activities:

- Risk analysis to identify the kinds of risks faced by people and development investments as well as their magnitude;
- Prevention and mitigation to address the structural sources of vulnerability;
- Risk transfer to spread financial risks over time and among different actors;

- Emergency preparedness and response to enhance a country's readiness to cope quickly and effectively with an emergency;
- Post-disaster rehabilitation and reconstruction to support effective recovery and to safeguard against future disaster.

11.2 Environmental legislation

In its chapter on integrating environment and development in decision making, Agenda 21 notes,"laws and regulation suited to country specific conditions are among the most important instruments for transforming environment and development into action".

Framework environmental legislation mostly deals with cross-sectoral issues. This includes establishment of environmental standards, the use of economic instruments for environmental management, environmental impact assessment procedures, public participation, education and institutional coordination.

National environmental laws provide some direction for the implementation of environmentally sound disaster reduction planning. Ways should be explored to ensure that environmental laws and disaster reduction strategies are mutually supportive.

The objective of environmental laws also could address the requirements of disaster reduction explicitly by reinforcing the protection of those natural ecosystems that have a protective function.

Existing legal instruments and ongoing work with sustainable development are also pertinent to disaster reduction. For example, the alpine convention of 1989 places some emphasis on natural hazards and addresses land-use planning, soil and landscape conservation, water management, forest and farming. Specific obligations to reduce the impacts of natural and human-induced disaster, including land-use planning, watershed management and early warning, are foreseen in future regional mountain ecosystem agreements.

11.3 Environmental policies and planning

As in the case of environmental legislation, environmental and disaster reduction policies need to be mutually supportive as part of the sustainable development agenda.

Designing a national environmental action plan is a standardized process that is widely used. Some of the features of integrated environmental and disaster reduction policies include:

- Assessment of environmental causes of hazards occurrence and vulnerability;
- Assessment of environmental actions that can reduce vulnerability;
- Assessment of the environmental consequences of disaster reduction actions;
- Consideration of environmental services in decision-making process;
- Interdisciplinary approaches that will ensure the use of natural and sciences in disaster reduction planning and decision-making;
- Partnerships and regional approaches to land use and nature conservation;
- Reasonable alternatives to conflicts concerning alternative uses of resources;
- Advice and information to involve actors in enhancing the quality of the environment.

Water policies such as water pricing and hydropower regulation offer examples of environmental policies with beneficial impacts on disaster reduction. They can be designed to promote the sustainable use of water and allow adjustments depending on seasonal forecasts, in order to avoid floods.

Policies promoting sustainable management of fire wood and the development of alternative sources of energy can reduce deforestation and contribute to controlling flood, avalanche and landslide.

11.4 Disaster preparedness prevention in Bosnia Herzegovina

The profile of disasters

According to the Law on the protection and rescue of people and material assets from natural and other disasters (Official Journal FB&H, 39/03), natural, technical-technological and other disasters encompass: earthquakes, floods, snow drifts, avalanches, ice accumulation on big water-flows, landslides, soil settling, droughts, storms, hail, frost, conflagrations, gas expansions, traffic accidents, destruction of dams at accumulations, epidemics, epizootics, contagious diseases, calamities of plant diseases and pests, radioactive and other pollution of air, water, land and food, mining accidents, settling of land due to the exploitation of mines and other minerals, as well as other similar events which may endanger the health and lives of a large number of people and which may cause considerable material harms.

Earthquakes

Location/Affected area

The territory of Bosnia and Herzegovina represents one of the most active seismological areas of the Balkans Peninsula, which is a part of the Mediterranean-Trans-Asian seismological area.

The most frequent and the strongest earthquakes occured in the areas of Dinara Mountain, the lower Neretva River, Boka Kotorska, Dubrovnik, Podrinje, Šumadija, Metohija and Skopje, which have been very destructive.

The areas of the IX degree are located in the area near the west border with the Republic of Croatia, i.e.: From Sinj – Makarska – Hvar Island – Pelješac Peninsula – Mljet Island to Boka Kotorska, Ulcinj – Skadar – Podgorica – Gacko – Mostar as well as in the area of Banja Luka.

Other parts of the territory of Bosnia and Herzegovina are characterised mainly by the maximum intensity of earthquakes ranging from VII to VIII degrees of the MCS.

There is a possibility of occurrence of destructive earthquakes in the next one hundred years, especially in the areas of Banja Luka, Livno and southeast Herzegovina.

The Banja Luka earthquake zone is seismically one of the most active areas in BiH and beyond.

Specific preparedness measures

Due to the accidental character of earthquakes, it is necessary to constantly observe seismological activities of the whole earthquake zone and beyond, through the network of seismological stations. For that purpose, after the catastrophic earthquake in 1969, a modern seismological station for the research of earthquakes in the region was built in Banja Luka.

During the war, the local seismological stations which were operational in a larger area were destroyed. Similarly, the instruments which were installed in the seismological center in Banja Luka cannot be used appropriately anymore due to the lack of maintenance, shortage of spare parts and outdated equipment (30 years).

Landslides and soil settling

Location/Affected area
Bosnia and Herzegovina is characterized by striking diversity of the litho-stratographic structure of the terrain, the high degree of tectonic and seismological activity, complex geological features, diverse characteristics of the relief, diverse characteristics of the climate, water-flows of different inclination and considerable influence of human activities to the terrain. Everything aforementioned, to some extent, affects the geological characteristics of the terrain.

Landslides represent particularly important danger for material goods and human lives in Bosnia and Herzegovina. Having in mind the fact that 80% of the territory of BiH falls within the category of highland, mountainous or mountainous-Mediterranean areas, the occurrence of landslides in the mountainous parts of Bosnia and Herzegovina is very frequent. Due to underground streams and underground waters their frequency is increased.

The activating of landslides in Bosnia and Herzegovina frequently occurs due to increase of the quantity of underground waters during springtime. However, sometimes it is caused by illegal and unplanned construction. Reconstruction works are very small and sporadic and preventing activities or activities related to alleviation of potential disasters are very rare. The number of landslides considerably increased during the war and in its aftermath due to uncontrolled exploitation of forests and exploitation of minerals, which affects the change of the water and land regimes, as well as due to increased illegal and unplanned construction.

Soil settling in Bosnia and Herzegovina is most frequently caused by the underground exploitation of minerals. The most endangered area in the FBiH is Tuzla – as the consequence of salt exploitation. Taking into account a long presence and specificity of that problem, special methods of planning have been developed in Tuzla, aiming at the alleviation of the consequences of soil settling.

Factors contributing to vulnerability
Long and heavy rains and floods.

Specific preparedness measures
The task of geology is to observe, research and forecast the development of modern geological processes, landslides, etc., and in case of their appearance to give appropriate warnings and take appropriate steps for alleviating it. Monitoring and research of risk from soil settling and landslides, informing the public in order to be able to undertake efficient and organized actions in case of soil settling and landslides. Technically trained and equipped rescue units have to be established.

Assessment tools: Continuous monitoring.

Floods

Location/Affected area

The relief of BiH is characterized by relatively steep slopes, which result in unequal draining along with unequal precipitations. Particularly critical are mountain streams from lower mountains, which are shaping the Sava river valley, as well as upper course of direct tributaries of the Sava river.

Floods in the great Karst valleys are the result of discrepancy of water inflow and outflow through evacuating capacities of seeping of water underground, surface flows and tunnels.

In the last ten years, however, trends of decreasing value of average yearly water-flows have been noticed. These trends have been developed on the basis of Black Sea basin, and particularly the Adriatic basin.

Taking into account the outdated water regime in Bosnia and Herzegovina, about 2,500 km^2 (about 60% of all plains and lowlands) have been endangered.

According to the information from the Urban Plan of the Republic of Bosnia and Herzegovina, 450km of embankment, about 210km of drainage, about 450km of partial regulation of water-flows and 23 pumping stations with the capacity of $120m^3/sec$, have been constructed. During the war, most of the systems created for the purpose of flood protection have been damaged.

Generally speaking, according to the total yearly precipitation and outflow (surface and underground waters), Bosnia and Herzegovina belongs to water-rich areas. The climate, geographic and other relevant factors unfavourably affect the hydrological regime in all aspects and in most water-flows, thus classifying it as very unequal, not only in space but in time as well. Due to unequal precipitation distribution and unfavourable hydrological characteristics, in the past in Bosnia and Herzegovina 2,617 km^2 or 5.12% of the territory were exposed to floods. These precipitations covered the areas where the water spill out from the river bed and floods wide areas of its surroundings, and where the duration of the floods is more important (one day or more) as well as their frequency (once or several times a year). High waters endanger around 250,000 ha of the land, which is around 4% of the total territory of BiH, or 60% of the plains.

Only in the year 1976, 43 municipalities were flooded (out of 109 according to the Census). During a five-year period (1976-1980) three catastrophic floods occurred in different periods of the year, which means one every second year. Neither were floods which occurred in other years negligible just as the damage caused by them.

Factors contributing to vulnerability

Long and heavy rains and snow thawing.

Specific preparedness measures

Monitoring and research of flood risk, informing the public for the purpose of taking efficient and organized measures in case of floods. The planning has to be undertaken at both the local and state level.

Assessment tools

The type, intensity, length, frequency of floods (floods occurring every 5 years, 10-20 years, catastrophic floods which occur once in 50 years).

Snow drifts and avalanches

Location/Affected area

The number of snowy days in a year, with a snowfall of more than 1 cm (only registered occurrences), ranges from the smallest number in Herzegovina, in the Neretva valley, only 4, whereas at the mountain peaks of Herzegovina the number is 60. The maximum of 80 days occurs at the mountain peaks of central Bosnia. The lowest value in the mountainous areas of central Bosnia is about 30 snowy days a year. Less then 20 snowy days a year are values for the region of Banja Luka, Doboj, Ugljevik until the river Sava. The average maximum value of snow cover in south Herzegovina is 5-10cm. In the part of Herzegovina which is to the north of Mostar, the highest value of snow on the ground is ranging from 40cm in the lower parts to above 200cm on the mountain peaks. The same values are also in the region of central Bosnia, until the plains near the river Sava, where those values fall to the range between 30-40cm. The similar situation is also in the valleys of the rivers Vrbas, Bosna and Drina. In big towns of the Federation of Bosnia and Herzegovina, during November 1999 the following values of snowfalls have been registered: Bihać 105cm, Bugojno 85, Sarajevo 83, Tuzla 65, Livno 64, Zenica 51 and Mostar 37cm.

We can surely predict that 50cm of new snow would cause problems in the traffic functioning. In the Sarajevo Canton, according to the estimation of danger from natural disasters, that limit is 30cm. The experience shows that 5cm of new snow in 12 hours (in some countries it is 2cm per hour) is sufficient for issuing public warnings - declaring natural disasters. In the mountainous areas of the Federation of Bosnia and Herzegovina (Bjelašnica, Igman, Ivan, Karaula, Čvrsnica, Podvelež) the snow cover may be from one to 2.5 meters.

Specific preparedness measures

Monitoring and researching the risk of snow drifts and avalanches, informing the public in order to be able to undertake efficient and organized actions in case of snow drifts and avalanches. Technically trained and equipped rescue units have to be established.

Destruction of dams at accumulations

Location/Affected area

Having in mind that several dams are constructed at the Neretva river, with regard to the seriousness of the problem, the appropriate regulations are applied:

- technical regulations for designing and construction of dams,
- manual for technical monitoring of high dams,
- book of regulations on technical standards for seismological monitoring of high dams.

Program of activities

Aiming at the protection of population and material goods, especially downriver parts of high dams and accumulations for which a potential danger exists, it is necessary to consistently apply the following: “Technical Regulations”, “Instructions” and “Books of Regulations” which define:

- physical observations,
- geodetic observations, and
- seismological observations.

For the accumulation area and the space immediately around the future dams, prior to designing and construction, the following situations and trends which are related to all types of dams should be defined: climate trends, hydrological trends, seismological trends, continuous physical, geodetic, seismological, climate, and hydrological observations and measures should be organized. Permanent analysis and interpretation of results should be performed and it should be compared with the project parameters, all in the aim of timely prevention from possible dam and accumulation incidents.

Two registered cases are related to the damage which occurred at the Hydro-Power Plant Mostar (1995) and Hydro-Power Plant Jajce II (1996).

National policies, plans and projects

National policy of acting in the case of catastrophes
At the state level in Bosnia and Herzegovina there is no established and unified policy of action in the case of catastrophes, neither there are unified institutions charged with acting in such events. At present, plans and projects of civil defense systems are drawn up at the entity level.

Basic aims of civil defence systems are: prevention, readiness (for action in the case of catastrophes), alleviation of suffering (reducing the negative impact of catastrophes), aid and rescue, provision of basic necessities for living, recovery and revitalization. Plans for civil defense and rescue are made on the level of competent entity authorities, local communities, commercial companies, and other organizations.

Federation of Bosnia and Herzegovina
In the Federation of Bosnia and Herzegovina there is no adopted project for reducing the negative impact of catastrophes, but in the municipalities in which partially organized civil defense structures exist there are plans for civil defense and rescue from the impact of natural disasters, in accordance with provisions of the Law on Natural Disasters. At the Federal level, legal and executive regulations concerning activities in the case of catastrophes are being prepared at present.

Legislation

Program for minimizing the danger from atmospheric, hydrologic and seismological catastrophes was drawn up in Bosnia and Herzegovina during 1998-1999 in accordance with corresponding program and recommendations of the World Meteorology Organization and the Program of UN International Decade for reducing the impact of natural disasters. However, due to the lack of funding, the realization of this program has not yet started.

In the Federation of Bosnia and Herzegovina, besides already existing Law on Defense (“Official Journal FB&H”, 15/96) which regulates the field of Civil Defense, the Government of the Federation of Bosnia and Herzegovina prepared and passed the Regulation on Organization, Content, and Carrying out of Measures for Protection and Rescue of People and Material Goods (“Official Journal of FB&H”, 27/98).

Besides, the Federation of Bosnia and Herzegovina applies the Law on Protection from Natural Disasters (“Official Gazette of SR B&H”, 40/90), and Law on Water Resources (“Official Journal of FB&H”, No. 18/98).

Informing the public and the awareness of the possibility of catastrophes

Public awareness of potential dangers is relatively high. The education and instruction of population on the actions to be taken in particular cases of danger is done through the means of mass media and work in the field. Also, there is awareness (among the public and authorities as well) about the necessity of constructing and equipping some parts of the system for prevention and readiness in the case of catastrophes, but the practical realization of such projects is limited by insufficient material and financial means.

Monitoring, informing and public informing and warning system

System for observation and information in the Federation of Bosnia and Herzegovina (system for warning citizens and other legal entities) is organized as an integral part of the Federal Ministry of Defense in its headquarters and cantonal and municipal branches and departments.

Its duties in future (following changes and amendments of the Law on Defense) will become part of the Federal Civil Defense Directorate, cantonal civil defense directorates, and civil defense branches in municipalities.

Such organization will create right conditions for competent civil defense authorities, enabling timely warning of population about the advent of natural disasters through departments of the Ministry of Information.

12.0 RESULTS OF ENVIRONMENTAL IMPACT STUDY

The first phase of the Environment Impact Study has been carried out according to the alignment defined on Conceptual Design Report, delivered on June 2005.
On the basis of alignment environmental analysis the main critical subjects were:

1. Agricultural system;
2. Landscape;
3. Natural and Protected areas;
4. Water resources and hydrogeology.

In particularly:

1. Agricultural system

In the interested area, the agriculture zones are the second important land use after the forestry. In fact in correspondence of the valleys, the hills and the much part of mountain slopes, the farm activities are the most important economic sectors and landscape characteristic. The motorway input could induce some temporary and permanent impacts as loss of farmland, loss of production, income and livelihood, severance of existing communication links, severance of rural communities, and severance of individual properties.

The agricultural system critical areas are:

km 0+000 - km 1+800 (Tarčin)

km 3+100 - km 4+630

km 7+660 – km 8+360 (near Rosulje)

km 10+450 – km 11+490 (near Šunji)

km 20+130 – km 23+150 (Jablanica lake)

km 23+400 – km 25+460 (Čelebići)

km 27+550 – km 29+350 (above Ćosići village)

2. Landscape

The impacts on the landscape are important for this area that has a very sensitive value. The crossing of areas with special quality, also without directly touching the single quality resources, it increases the accessibility of it, but it risks provoking negative impacts as the interruption of the continuity of the landscape entities, interference with visual continuity, alteration or loss of value, development of residual areas. Then the proposal alignment will have to be evaluated on base of the general impacts on the landscape (structural - on its ecological efficiency – visual and cultural, on the social communities).

The landscape critical areas are:

km 0+000 - km 3+250 (Tarčin)

km 7+700 – km 8+350 (near Rosulje)

km 20+150 – km 22+300 (Jablanica lake)

km 23+150 – km 23+550 (Jablanica lake bridge)

km 24+600 – km 25+450 (Čelebici)

km 27+550 – km 29+350 (above Ćosići village)

km 36+050 - km 37+650 (Draganka valley)

km 33+500 – 34+550 (near Dragan Selo)

km 38+650 – km 40+000 (Potok valley)

km 46+600 – km 48+700 (Bijela valley)

3. Natural and Protected areas

A high percentage of the examined area (Konjic-Mostar) will form part of proposed National Park. So they should be considered as natural sensitive areas. In fact, the motorway input could induce, on the natural components and systems, some temporary and permanent impacts as removal of vegetation, removal/alteration of border cenosis, removal/alteration of faunistic habitat, interruption/modification of ecological territory.

The critical areas on this subject are:

- the river systems of Neretva river and its tributaries
- the area of the Park of Nature Prenj, Čvrsnica and Čabulja in the Konjic and Jablanica municipality territory.

4. Water resources and hydrogeology

In terms of geology and hydrogeology critic areas, the majority of the Corridor Lot 3 passes through mountain area with local earth instability, rockfalls and landslide. (Drežnica and Aleksin Han, as well as to the active landslide "Kukovi", 2 km far from Ostrozac). Risks of sloping have been detected in the area that goes from Jasike, Ostrožac to Vrtlišta, (Neretva Valley, North-West from Jablanica). In particular, from km 18+500 to km 25+000, the alignment is laying in sediment complex of Middle to Upper Miocene age, represented by substrate breccia and conglomerate, cemented with clayey and ferruginous mass. Beside that, there is occurrence of sandstone rocks and marlstone rocks. Covers are very thick, the soil is wet, slopes are conditionally stabile and there are some small landslides (landslide "Jezerine"-north from the road alignment).

The biggest problems in land management are erosion processes caused by water impacts. In the southern areas, erosion is under a strong wind impact. Currently, about 2/3 of the examined ecosystem is endangered by the high level of erosion, caused by human activity and degradation. In particular the existing road from Sarajevo to Mostar located in the Neretva Valley, has the highest percentage of underground and surface water flow and springs crossed. This situation is being reduced to the East side.

From km 25+000, near Čelebići, to km 30+500, Middle to Upper Miocene sediments are thinning out, i.e. the drawn road alignment superficially touches Campil sediments (from km 26+500). From km 26+500 to km 27+500, there is a volcanogenic-sedimentary series, represented by spilite rocks, tuffs, red weathered cherts, and there are subordinated siltstone and claystone rocks. Previously described contact borderlines are very unfavourable in respect of the road construction. At the section from km 25+500 to 27+800 km, the long tunnel of 2,350 m has been predicted, with the over-layer of 130-260 m. The tunnel will be built in the rocks of volcanogenic-sedimentary formation.

The straining waters are expected in Werfenian, and bigger quantities of water are predominantly expected in limestone rocks. At the section km 29+200- km 32+750, i.e. at the length of 3.650 m, in Jablanica complex, construction of the tunnel with the over-layer of 550 m, has been predicted.

In certain areas in syncline structures, depending on the position of the alignment to the syncline axis, as for example, at the section around Stajski Gvozd, larger pressures from the ceiling can be expected. That can be generally noticed for some other locations and will be more detail researched in the future phases.

According to those preliminary results of the Environmental Impact Study and to the requests of the Public Consultation about the Prior Environmental Impact Assessment carried out in June 2005 in the Municipality of Hadžici, Konjic, Jablanica, and Mostar, during the last phase of this report, the project designers have proposed some alignment improvements (layout changes, downsizing of the tunnels and bridge, etc.) in order to minimise the main impacts pointed out.

Those alignment improvements specifically defined in the Preliminary Design Report, can be summarized in:

- km 0+000 – km 1+800 the foreseen interchange (Tarčin) is deleted with improvements of the different impacts on agricultural system and landscape;
- km 3+696 – km 4+414 the alignment is moved to west in order to avoid geological impacts;
- km 7+686 – km 7+950 the alignment is moved to south in order to avoid hydrogeologycal system impacts;
- km 9+238 – km 9+456 the open–air alignment part is reduced in order to avoid geological impacts;
- km 11+050 – km 11+500 the tunnel no.5 is improved with an artificial tunnel with improvements of the different impacts on agricultural system and landscape;
- km 14+612 – km 14+878 the embankment is change into bridge in order to avoid on hydrogeologycal system impacts;
- km 19+850 – km 21+000 is foreseen a new part of the tunnel no. 12 in order to avoid hydrogeologycal system impacts with improvements of the different impacts on agricultural system and landscape along the Jablaničko lake;
- km 22 + 200 – km 24+000 the alignment is moved to south and some works (tunnels, bridge) are changed in order to avoid and minimize different impacts (agricultural system, landscape, hydrogeologycal system);
- km 24+550 – km 25+459 some works (tunnels, bridge) are changed in order to avoid and minimize different impacts (natural system, landscape, hydrogeologycal system); it's foreseen a new tunnel from km 24+800 to km 25+250;

- km 27+851 – km 29+150 some works (tunnels, bridge) are changed in order to avoid and minimize different impacts (natural system, landscape, hydrogeologycal system); are foreseen two new tunnels (no. 17 from km 28+150 - km 28+236, no. 18 km 28+507 – km 28+785);
- km 35+200 – km 37+950 in correspondence of Draganka valley the alignment is moved to southeast and some works (tunnels, bridge) are changed in order to avoid and minimize different impacts (agricultural system near Glogošnica, natural system, landscape, hydrogeologycal and geological system);
- km 39+500- km 40+500 a new tunnel is foreseen in order to avoid hydrogeologycal system and landscape impacts;
- in correspondence of Bijela Valley (km 46+595 – km 48+695) the alignment is moved to east and some works (tunnels, bridge) are changed in order to avoid and minimize different impacts (natural system, landscape, hydrogeologycal system);
- from km 54+300 the alignment is moved to east and it finish at km 60+400 near Podgorani.

The present Enviroment Impact Study Report concerns this environmentaly improved and unpgraded final alignment in order to mitigate the specific environmental impacts along the motorway.

13.0 ANNEXES

13.1 Results of the Preliminary Environmental Impact Assessment and Decision on realization of EIS
13.2 Report from Site visits (photos and Data Core Sheets on cultural-historical heritage)
13.3 Photo documentations (Attachment to the Chapter 4.9 – Landscape)

13.4 Maps
- 13.4.1 Layout map of the adopted Variant 3 of the Corridor Vc Motorway, scale 1:25,000
- 13.4.2 Geological map, scale 1:25,000 (2 sections)
- 13.4.3 Hydro-geological map, scale 1:25,000 (2 sections)
- 13.4.4 Engineering-geological map, scale 1:25,000 (2 sections)
- 13.4.5 Synthesis map of the existing environmental status and potential Project impacts, scale 1:5,000 (18 sections)
- 13.4.6 Map of mitigation measures proposed, scale 1:5,000, (18 sections)
- 13.4.7 Map of infrastructure/transportation network and mine fields, scale 1:50,000

13.5 Synthesis table of potential impacts and mitigation measures
13.6 Technical mitigation measures (attachment to the Chapter 6.3- Technical mitigation measures for negative impacts on environment)

Project "Corridor Vc Motorway"

LOT No.3 – Section Sarajevo South (Tarčin) - Mostar North

ENVIRONMENTAL IMPACT STUDY (EIS)

LIST OF EXPERTS FOR EIS

SPT :

NAME OF EXPERT	DESCRIPTION OF TASK
Aldo Coltellacci	Mitigation Measures, Env. Management and Monitoring Plan
Serena D'Ambrogi	Landscape, Critical areas, Noise and Air

Energoinvest d.d.:

NAME OF EXPERT	DESCRIPTION OF TASK
Ph.D.Izet Čengić	Soil, Agricultural Areas
Ph.D. Nijaz Musabegović	Population and Settlements
M.S. Arifa Fetahagić	Law Regulation, Methodology of EIS
Belma Čongo	Protected Parts of the Nature, Game and Hunting
M.S. Ermedin Halilbegović	Geomorphology, Geology and Hydrogeology
Amela Vražalica	Spatial planning, Infrastructures
Tomislav Goić	Climate, Meteorology, Hydrology
M.S. Nermina Mujezinović	Cultural-Historical Heritage
Ivan Buntić	Flora, Fauna

TZI-Inženjering:

NAME OF EXPERT	DESCRIPTION OF TASK
Zoran Trobok with his team	Alignment, Description of the Project, Drainage System and Water Treatment, Waste Materials and Emissions, Waste Management