IPSA

INSTITUT

CETEOR

Sarajevo

CENTAR ZA EKONOMSKI, TEHNOLOŠKI I OKOLINSKI RAZVOJ

Study on Environmental Impact Assessment for Motorway

LOT 5, 6: SECTION MOSTAR NORTH - MOSTAR SOUTH – POČITELJ

Mostar South - Buna

13+256,79 – 28+695,00 i 4+389,63 – 15+440,00

-Corrected -

Sarajevo, December 2016.

April 2017

Title:	**Study on Environmental Impact Assessment for Motorway** **LOT 5, 6: SECTION MOSTAR NORTH - MOSTAR SOUTH – POČITELJ** **Mostar South – Buna** **13+256,79 – 28+695,00 I 4+389,63 – 15+440,00** **- Corrected -**
Investor:	**JP Autoceste FBiH d.o.o. Mostar** Head office in Mostar: Braće Fejića bb, 88000 Mostar Tel: + 387 36 512 300 Fax: + 387 36 512 301 Sarajevo operative office: Dubrovačka 6, 71000 Sarajevo Tel: + 387 33 277 900 Fax: + 387 33 277 901 E-mail: info@jpautoceste.ba www.jpautoceste.ba
Contracting authority:	IPSA INSTITUT Put života bb, 71000 Sarajevo
Developer	Centre for economic, technological and environmental development – CETEOR d.o.o. Sarajevo Topal Osman Paše 32 B BA, 71000 Sarajevo Tel: +387 33 563 580 Fax: +387 33 205 725 E-mail: info@ceteor.ba
Time of development:	December 2016. April 2017
Number:	05/P-1793/16

CONTENT

1. INTRODUCTION

In recent years, according to the Pan-European transport initiatives, most recently in Bosnia and Herzegovina is increased activity in the preparation and realization of construction of roads of higher rank, or motorways, to meet the needs of the population and the economy and impact on the overall development. The competent Ministry were undertaken preparatory activities for construction of the motorway on Corridor Vc.

Based on this, the Ministry of Transport and Communications in 2003 issued a "Decision on the existence of public interest for construction of the motorway on Corridor Vc through Bosnia and Herzegovina, based on the award of concessions on the part of the route that will be defined by the contract," launched the production of planning and technical documentation, and today already has built some sections of the corridor.

The Preliminary Design is done for the LOT 4 (Mostar North km 0+000,00 - southern border – km 67+329.00). The "Preliminary Impact Assessment on the Environment" and the final study "Environmental Impact Assessment" (EIA) was made for complete LOT 4.

Basis for preparation the "Preliminary Impact Assessment on the Environment" arising both from assumptions that are embedded in the supporting documentation which is made for the purposes of Technical Studies and Conceptual Design. Within these documents particularly valuable data that are relevant to most of the possible impact arising from dedicated research, relating to relevant traffic studies, geotechnical studies, surveys which are conducted for the purpose of planning documents for urban areas within the study area as well as research which are dedicated to the needs of the analysis carried out in the field.

For the purposes of PEIA and EIA were conducted investigations in various fields of research such as morphological, geological, hydrogeological and engineering geological characteristics; climatic and meteorological characteristics; hydro-geographic and hydrogeological characteristics; soil and land capability; and vegetation; fauna; forest and hunting; landscape; infrastructure; cultural - historical heritage and natural heritage (protected natural areas).

The width of the route in question from the point of impact of the motorway and protection measures is in the zone of 500 m (250 m on both sides of the road axis). However, on cartographic presentation is given broader zone of 1000 m (500 m from the road axis) for access to the wider state of the distribution of certain types of land and related categories of protection, and in relation to that value in use.).

After developing the Technical Study, consultants have created Conceptual Design of more variants of the route, through multi-criteria analysis have chosen the best option, and prepared a draft program of field research works for it. The program was discussed, analysed, revised and approved. Rating of each alternative route has been assessed through evaluation - scoring of variants based on engineering geological and geotechnical

parameters. In this way, studies have made significant contributions when selecting variants for further processing, and also served as a good basis for programming of research work for the next phase of the project documentation.

After a thorough argumentation the final version of the route was adopted and this variant is the subject of the Environmental Impact Study.

Mitigation / prevention of negative impacts on the environment will be implemented in all stages of implementing the construction of the motorway. The Environmental Impact Study recommends the implementation of mitigation measures and protection in the following stages:

- Design,
- Construction,
- Monitoring and maintenance.

Protection measures can be classified into three groups:

- General environmental protection,
- Special measures,
- Technical protection measures.

The Preliminary Design is made for the section "LOT 4" (Mostar North - South border, 67,329 km). This area is now covered with Lot 5, Lot 6 and Lot 7. The "Preliminary Impact Assessment on the Environment" was made for complete LOT 4 and the final study "Environmental Impact Assessment" (EIA) according to the Decision UPI / 03 / 02-23-4-53 / 05.

In 2010, developing of the Main Design was finished for sections Mostar North - Mostar South and Mostar South – Počitelj, a length of about 16 kilometres (Lot 5) and 20 km (Lot 6), as a base to meet the necessary conditions for land acquisition and for issuing construction permit. The ultimate goal of developing the Main Designs is to meet conditions for beginning the construction of these sections in the manner required by international financial institutions (financial and technical feasibility, established through the traffic study, feasibility study, preliminary design and main design) and taking into account all the conditions set by the Study of Environmental Impact Assessment.

The present LOT 5, 6: SECTION MOSTAR NORTH - MOSTAR SOUTH - POČITELJ- Stanojevići - Buna - Mostar South – Suhi Do (km 13+256,79 – 28+695,00 and km 4+389,63 – 15+440,00) with aspects of environmental impact assessment being contemplated in the Environmental Impact Study of CORRIDOR VC MOTORWAY MOSTAR NORTH - SOUTH BORDER LOT 4, km0+000,00 - 67+329,00.

<u>The process of environmental impact assessment</u>

The Decision of the Federal Ministry of Environment and Tourism No: UPI / 03 / 02-23-4-53 / 05 of 01.08.2005, established the content of the Environmental Impact Study, prescribed by the Rules for plants and facilities for which is required environmental impact assessment and plants and facilities allowed to be constructed and commissioned only if they have

environmental permit ("Off. Gazette of FB&H" no. 19/04) - chapter III, which includes the results of the above evaluation of the environmental impact, which are obtained in public discussions and written responses of stakeholders. Acting according to the above Decision, the Ministry of Communications and Transport of Bosnia and Herzegovina, submitted an Environmental Impact Assessment made by the lead consultant: INSTITUT GRAĐEVINARSTVA HRVATSKE dd, Zagreb. In reviewing the Environmental Impact Study, Federal Ministry organized a public debate in accordance with the provisions of Art. 61 and 62, said Act 2006.

In addition to the assessment procedure of the EIA, the Decision of the Ministry established the Commission for the evaluation of the Environmental Impact Study. An expert committee is composed of experts - specialists in evaluation studies, in terms of environmental protection, in the following relevant areas: water, air, land / soil, hydrogeology, waste, noise, biodiversity, fauna, forests, cultural, historical and natural heritage and roads / transport. In addition to these steps in the process, EIS was submitted to the assessment of the competent authorities in the field of environmental protection and interested parties, in accordance with the Law on Environmental Protection. After such a procedure the assessments, comments and suggestions from the public debate, as well as the opinions delivered by the authorities, and the final report and evaluation of the Expert Commission, which are assessed as justified by the Federal Ministry, have become an integral part of supplemented study that is subject to approval.

Since the EIS provided an evaluation of the proposed project on the environment, identified measures to mitigate adverse effects on the environment, and monitoring measures, this Federal Ministry has assessed that the project of construction Corridor Vc Motorway, section LOT 4: Mostar North - South border is environmentally acceptable, and that it will not significantly harm the environment. Based on the above, this Federal Ministry assessed to have met the requirements for the approval of the Environmental Impact Study, acting in the sense of Art. 64, paragraph 1, of the Environmental Protection Act, and has issued a Decision on approval studies for the section LOT 4: Mostar North - South border number UPI / 03 / 02-23-4-53 / 05 dated on 19.09.2007. The environmental impact study for the section LOT 4: Mostar North - Southern Border is available on http://www.jpautoceste.ba/

After the approval of the EIA for the section LOT 4: Mostar North - South border, developing of project documentation has started. In accordance with Article 65 of the Law on Environmental Protection, validity of studies on the environmental impact is five years. Taking into account the above, this Study of the Environmental Impact Assessment processes subsection Stanojevići - Buna - Mostar South – Suhi Do from km 13+256,79 – 28+695,00 and km 4+389,63 – 15+440,00 for the purpose of issuing environmental permit. Therefore, subsection Buna - Počitelj was included in the Environmental Impact Study for the section LOT 4: Mostar North - South border, and the project documentation as part of LOT 6 Mostar jug-Počitelj.

Study on environmental impact assessment includes subsection Stanojevići - Buna - Mostar South – Suhi Do from km 13+256,79 – 28+695,00 and km 4+389,63 – 15+440,00, which

according to the articles 3, 4 and 12 of the " Rules for plants and facilities for which is required environmental impact assessment and plants and facilities allowed to be constructed and commissioned only if they have environmental permit" ("Off. Gazette of the Federation of B&H", no. 19/04) is one of the infrastructure projects that must undergo the procedure of environmental impact assessment before issuing the environmental permit.

Study on Environmental Impact Assessment for Stanojevići - Buna - Mostar South – Suhi Do km 13+256,79 – 28+695,00 and km 4+389,63 – 15+440,00 is updated in relation to the Environmental Impact Assessment of section LOT 4: Mostar North - South border only in the part relating to: changing legislation and obligations of investors, the population and the changes in relation to the Preliminary Design. In this Study on the Environmental Impact Assessment ware used data on the state of the environment that ware available from approved the Environmental Impact Study LOT 4 and other study documents made for the purpose of spatial planning documents in the previous period.

In the specific case Stanojevići - Buna - Mostar South – Suhi Do from km 13+256,79 – 28+695,00 and 4+389,63 – 15+440,00 there were significant changes in location of the route relative to the previously created documents, and environmental impact Assessment LOT 4. The extent of modification to subsection Buna-Počitelj in relation to the Environmental Impact Assessment LOT 4 amounts to 6,41% (4,320 km compared to 67,329 km), which is less than the value of 25%, which is stipulated in the Law on Environmental Protection ("Official Gazette of the Federation of B&H" no. 33/03, 38/09), Article 56.

During 2015, PC Motorways of the Federation of B&H (Client) gives up the route on the final part of Lot 5 and the initial part of Lot 6 (approximately from Oštri rat over junction Mostar South to app. km 13 + 250 on LOT 6 and starts the procedure of finding new possible route on spatial section Stanojevići - Buna - Mostar South – Oštri rat. Client proposes the route that passes very large spatial relief constraints, unfavourable technical elements and a large number of structures (large investment costs, high maintenance costs, management and exploitation).

In the past period were carried out optimization of the alignment on various grounds, but the adopted solution still does not have optimal spatial and technical and exploitative elements.

The Preliminary Design has defined the changed route on the part from Suhi Do, a new proposed location intersection Mostar South (connection to the M17 in the area of the Mostar airport), over the river Buna to areas of Stanojevići where is included in the route of the LOT 6 according the Main Design.

On the part from Oštri rat to Mostar South intersection (northern part of the corridor) chainage is guided further to the LOT 5 chainage route, from km 4+389,63 to km 16+500,00, the length of 12.110,37 m.

On the part from Stanojevići (Lot 6) to Mostar South intersection chainage is guided from the south to the intersection, from km 13+256,70 to km 27+773,51, 14.516,81 m of length. The total length of the route around Mostar is 26.627,18 m.

Based on the Preliminary Design, in December 2016 was developed a Study of the Environmental Impact Assessment for motorway LOT 5, 6: SECTION MOSTAR NORTH - MOSTAR SOUTH - POČITELJ Stanojevići - Buna - Mostar South – Suhi Do, km 13+256,79 – 28+695,00 and km 4+389,63 – 15+440,00 and submitted to the Investor.

In April 2017, the author of the Study received the comments of the Investor in relation to the harmonization of studies on environmental impact assessment for motorway LOT 5, 6: SECTION MOSTAR NORTH - MOSTAR SOUTH - POČITELJ Stanojevići - Buna - Mostar Suhi Do, km 13+256,79 – 28+695,00 and km 4+389,63 – 15+440,00, with modifications of the Preliminary Design related to modifications of the motorway route in the sector Stanojevići- Buna- Mostar South - Suhi Do, km 13+256,79- 28+695,00 and km 4+389,63-15+440,00. This study was coordinated in part relating to the project description. Additional environmental impact assessment was not conducted because the changes are not significant in terms of environmental impact, in accordance with the Environmental Protection Act and the Rules for plants and facilities for which is required environmental impact assessment and plants and facilities that can be built in only if they have environmental permit ("Official Gazette of FB&H", no. 19/04).

If the environmental permit is not issued it is possible to apply Art. 48 and Art. 50 of the Act on the motorway corridor.

Social and economic significance of the project

Motorway Budapest - Beli Manastir - Osijek - Svilaj - Zenica - Sarajevo - Mostar - Ploče or its segment LOT 4, Mostar North - South border is a part of the International Pan-European road corridor Vc and one of the most important branches of the TEM / TER Project. The route of the present motorway is part of a European network E73, which connects the north of Europe with the Adriatic Sea and is the backbone of road transport infrastructure in the eastern part of the country.

Traffic infrastructure is one of the key factors which have mutual and multiple influences on economic, social and spatial development of the region and even the country. Transport infrastructure in the process of valuation, allocation and use of space has reflected in the following elements:

- allows the use of natural resources,
- affects the location of economic and population,
- affects the urbanization, the development of settlements and the quality of the human environment,
- influences and encourages the development of less developed areas.

Within the AGR system of main European roads monitored road route has been nominated as E73, and D7 in the Croatian Danube (138 km), M17 in Bosnia and Herzegovina (433 km) and D9 from Metković to Ploče (22 km).

The international importance of the direction emphasizes certain initiatives, associations and projects. Road E73 is within the Pan-European Corridor Vc (Fig. 1) and it is one of the most important branches of the TEM / TER Project and an unavoidable route in future combined transport

The southern part of Bosnia and Herzegovina is a key area in the Federation of Bosnia and Herzegovina with regard to its specific and very good geographical and geopolitical location and socio-economic significance. It is located on the crossroads of important horizontal and vertical backbone of development, and it is nodal space between Central and South-eastern Europe. This part of B&H is also the focus of population in the whole B&H area.

Bosnia and Herzegovina is making great efforts to become part of the European and world economic and transport system. One way to achieve this is to be included in the Pan-European transport integration. The first step on this path has been made by verification of Corridor Vc, which will in the north-south direction links B&H with Croatian and Hungary, and Central Europe. The motorway will leads over Osijek in Croatia and exceed in B&H over the Sava River, north of Odžak. Transportation and improvement of transport infrastructure, in general, have an important role in sustainable socio-economic and economic progress of society.

Road transport in B&H accounts for more than 95% of the movement of goods and passengers within the country. Efficient and cost effective road transport is therefore essential to support local, regional and international trade and economic exchange. It is also an important factor in improving the integration of ethnically divided country. The development of road transport corridors in Bosnia and Herzegovina is very important to improve the standard of living and poverty alleviation. Construction of the motorway on the Corridor Vc can be considered justified from the standpoint of social and economic importance for several reasons. In the zone of Corridor Vc is more than 50% of the population who earn about 60% of the total gross national income, and better conditions of providing transport services mean better living and working conditions of the local population, and improving the social structure.

2. DESCRIPTION OF PROPOSED PROJECT

2.1. Description of the physical characteristics of the entire project and land use requirements during the construction and operation of plants and facilities envisaged by the project

Bosnia and Herzegovina in the context of European transport routes

For Bosnia and Herzegovina realization of construction of the Corridor Vc has multiple meanings. First, because it would be the first international route that would run through its territory and in such a way is involved in the international modern transport network. Also, through this direction Bosnia and Herzegovina will have a high quality exit, via the port of Ploče in Croatia, on the Adriatic Sea and the northern side opens access area of central and north-eastern Europe. For Bosnia and Herzegovina, which at the end of the last century suffered the horrors of war, devastation and great socio-political division, this corridor will be one of the drivers of economic development, but also one of the factors of the integration process of its political space.

Transport corridor Vc through B&H currently includes:

- E-road E-73 Šamac - Doboj - Sarajevo - Mostar - Čapljina - Doljani, which through the port of Ploče has access to the Adriatic Sea, while in the north over Svilaj connects to the Danube corridor of basic trans-European transport network.
- Railway line: Šamac - Doboj - Sarajevo - Mostar - Čapljina - Metković
- Airports Sarajevo and Mostar
- Waterways and ports on the rivers Sava, Bosna and Neretva.

Road network in B&H

Existing national network of road on Corridor Vc does not meet the needs of today's traffic, even with the economic aspect, but also even from an environmental aspect. With the constant increase in traffic in this direction, there is a need for urgent construction of modern roads with greater capacity with higher safety standards. Existing roads were built many years ago and apart from the lack of transport capacity they do not have an adequate system of environmental protection, and become the real threat to the ecological system areas through which they pass.

Intensive Strategic Research in the field of transport and transport infrastructure has been carried out in recent years, through the programs of the European Union (Phare and others), or with the use of funds from international financial institutions or funds B&H. The construction of the highway would reduce the traffic on state roads, this would automatically

reduce the risk of pollution. On the future motorway applying today known principles of environmental protection, environmental hazards would be minimized.

In the zone of Corridor Vc is more than 50% of the population, who account for around 60% of gross national income.

The construction of this motorway will realize a rational connection B&H regions and neighbouring countries and regions and achieve stabilization and development of the country.

Project background

In recent years, according to the Pan-European transport initiatives, most recently in Bosnia and Herzegovina has increased activity in the preparation and realization of construction of roads of higher rank, or motorways, to meet the needs of the population and the economy and impact on the overall development.

The competent Ministry were undertaken preparatory activities for construction of the motorway on Corridor Vc.

Based on this, the Ministry of Transport and Communications in 2003 issued a "Decision on the existence of public interest for construction of the motorway on Corridor Vc through Bosnia and Herzegovina, based on the award of concessions on the part of the route that will be defined by the contract," launched the production of planning and technical documentation, and today already has built some sections of the corridor.

In 2010, developing of the Main Design was finished for sections Mostar North - Mostar South and Mostar South – Počitelj, a length of about 16 kilometres (Lot 5) and 20 km (Lot 6), as a base to meet the necessary conditions for land acquisition and for issuing construction permit. The ultimate goal of developing the Main Designs is to meet conditions for beginning the construction of these sections in the manner required by international financial institutions (financial and technical feasibility, established through the traffic study, feasibility study, preliminary design and main design) and taking into account all the conditions set by the Study of Environmental Impact Assessment

During 2015, PC Motorways of the Federation of B&H (Client) gives up the route on the final part of Lot 5 and the initial part of Lot 6 (approximately from Oštri rat over junction Mostar South to app. km 13 + 250 on LOT 6 and starts the procedure of finding new possible route on spatial section Stanojevići - Buna - Mostar South – Oštri rat. Client proposes the route that passes very large spatial relief constraints, unfavourable technical elements and a large number of structures (large investment costs, high maintenance costs, management and exploitation). In the past period were carried out optimization of the alignment on various grounds, but the adopted solution still does not have optimal spatial and technical and exploitative elements.

The Preliminary Design has defined the changed route on the part from Suhi Do, a new proposed location intersection Mostar South (connection to the M17 in the area of the Mostar

airport), over the river Buna to areas of Stanojevići where is included in the route of the LOT 6 according the Main Design.

Analysis of the route proposal displacement

Through this Preliminary design is included the analysis of the proposed motorway route dislocation in relation to the route defined by the Main Design of Lot 5 and Lot 6, in the wider area of the city of Mostar. The scope of change is in the framework of the corridor, from Suhi Dol (Lot 5) over Gnojnice and Buna to Gubavica or Stanojevići.

The Client has decided to examine the possibility of shifting and keeping the route in the mentioned corridor on the way that the route in the southern part of the city as economically as possible temporarily merges with the existing infrastructure, to be closer to the main road M17 and directly connects to the southern ring road of the city of Mostar.

By analysing the documentation developed, submitted and provided by the Client so far, examined are the possibilities for shifting the route in the concerned zone or its effects on space and the environment. The decision about the possibility of this shift brings Client, based on which, in case of acceptance of this shifting, would initiate the necessary procedures to update planning documents, procedures of development and implementation of the necessary studies and technical documentation for obtaining environmental permits and location requirements, and finally building permits.

Analysis of the proposed alignment defines the point of separation and reclosing of the parts of the previous documentation for the motorway route LOT5 and LOT 6.

Generally, the solution of the new route (shift) is not processed on the same level with the previous documentation (preliminary and final design of the route in the area of lots), but based on all the data available so far and documentation of the Client submitted, it can be done relatively objective assessment of the possibilities for new route proposal in a defined corridor.

Looking from north to south, the relocation of the route has started at about km 4+400 (4+389,63) of the section Mostar North - Mostar South (Lot 5) and the connection on the section Mostar South - Počitelj in km 13+256,70 (LOT 6).

Length of the relocated part of the route is 26.582,38 m, a basic route for lots of the Main Design is 26.444,97 m.

Analysis includes the proposed route (V1) which is further optimized in terms of the plan view, and a height (vertical alignment optimization) to effect the reduction of eng.structures.

The second proposal was a partial shift the route in zone of the Airport (V1a-shift in the "military zone") also with a view to rationalization of facilities and reduction of work. Considered was sub variant - bypass of the airport from the northeast (V2).

Corridor with all variants passes directly through the area of the airport in Mostar. The analysis also considered the proposed location and variants of intersection Mostar South.

An expert assessment in the analysis of the proposed motorway route was based on:

- The data on population (indirect assessment of built and non-built construction areas specified in the Spatial plan of the Municipality of Mostar, as well as the Decision on amendments to the Decision on preparation of the Spatial Plan of the City of Mostar for the period 2011-2020, and the Guidelines for the preparation of the Spatial Plan of the City of Mostar),
- Natural relief features and space - data about the flora, fauna, water, air and land (expert analysis and assessment of the characteristics of each area, from the available documentation from previous documents, from planning documents),
- Climatic characteristics of the area (indirect assessment of the impact of climatic characteristics of the area on the driving conditions, the costs of construction and maintenance),
- The way to use space (existing material goods in the area of influence of the motorway route on the environment were identified based on satellite image areas (ortho-photo maps supplied by the Client), existing spatial planning documents and other sources according to individual characteristics of the area), and include:
    - Developed areas (developed and undeveloped planned plot and wild construction areas recorded by satellite photos),
    - Farmland (quality of agricultural land, and primarily the category),
    - Forests (classification of forest areas),
    - Water Resources (water-Protective Area).
- Transport infrastructure in the Federation of B&H (estimate possibilities of transport connection for the section with the existing system of roads and the planned system of new corridor roads, established by planning documents or already designed),
- Protected and particularly valuable areas (defined by planning documentation).

In all variants adversely is that all passing in area of the airport (via protective planes (clearing), and the planned extension of the runway in case of raising the airport category). The spatial conditions in the area of the airport are extremely complex due to the existing facilities in the area of airport, railways, relief conditions between the railway and the airport, the surrounding villages, springs and the like. With these conditions in the general area of the airport there is high-quality agricultural land (cultivated areas, vineyards, good soil quality areas of the Ist category).

In the proposed basic variant to the north runway was planned intersection which elements directly affect the profile of the access plane of the airport.

Because of the numerous and very complex spatial and relief limitations, shifted route is in plan terms driven by increased number of curves (R min = 930 m), which would imply to increased indirect costs.

In terms of height is not possible to meet the recommended technical requirements for tunnels (the vertical alignment fall to max 3%). In the context of this, proposed route (V1) is

through further work optimized in order to achieve better conditions in plan and height control (V1a). Certain, much better improvement could not be achieved (somewhat smaller amount of the tunnel in the route). Relocation of intersection is proposed in position south of the entrance to the airport, in order to relocate it outside the access plane.

Description of the study corridor route changes and discussed

The proposed route in the variant V1a due height fitting starts separating from the axis alignment in the LOT 5 km 4+389.63 (4+400), directly after leaving the tunnel Debelo brdo Looking at the layout the new route continues around the route of Lot 5 to Virač tunnel, viaducts Suhi Do, tunnel Oštri rat, and viaduct Luka where it is discharged to the right and begins to descend toward Donje Opine. On this segment elevation route is not guided by vertical alignment as in LOT5 (slope increased from 0.78% to 2.60%) in order to shorten the tunnel Oštri rat. But despite this, the length of this tunnel cannot be less than 3320 m.

The route continues to descend to Gnojnice over populated areas with five tunnels and a viaduct and crosses the "Royal vineyards". The descent from the beginning of the route through Gnojnice to the airport takes place from 184.0 meters above sea level at 37.6 meters above sea level.

Upon crossing the road M 6.1. enters the protected zone of the airport and the approach runway-landing planes, and a tunnel of 250 meters runs along the northern threshold of runway (take into account the future expansion of the runway), "tries" between the railway Mostar-Čapljina and airport's edge (distance from railway and the entrance to the airport is approximately 32 m). The route continues through Ortiješ space and follows the runway corridor side, at distance of approximately 35-45 m (according to claims MZLAM) and descends towards the Buna. On the stretch from the airport to the Buna passes in the vicinity of several sources.

Because of the terrain between the railway line and the airport and avoiding the tunnel around the airport (approximately 3300 m), the alignment shift is proposed in the protection zone of the airport ("military area") to avoid the tunnel. But it requires entry into a military zone in length of just over 1,000 m, demolition of a number of buildings in this zone.

Further the route crossing over river Buna and Bunica by bridges L = 1140 and L = 1147 m (optional with the steep grade line that requires slow vehicles lane, the length of these facilities would be 460 m and 820 m), and continues to climb towards Rotimlja overcoming peaks Hum and Kvanj by tunnel Kvanj length of 2,680 m.

Rotimski stream crosses by the bridge L = 221 m. Comes to the plateau Gubavice and in region of Stanojević in km 26 + 582.38 is included in the route of Lot 6 (= 13+256.70).In this position fits in the LOT 6 (height). The longitudinal inclination of the southern part of the corridor (from Buna to the LOT 6 connection) in this variant is 3.40%.

The analysis of the proposed junction position, indicates that the junction Mostar south and links of the motorway to the M 17 and the City of Mostar is possible only in a position Ortiješ (outside the corridor approach planes). Direct connection to the southern bypass of Mostar is

not possible from the spatial and technical reasons (closeness to M17, M6.1. and the railway does not provide space for the development of junction and installation of toll collection block).

It was noted that in the corridor of 50 meters (direct impact of motorway) demolition of 26 buildings (mainly homes) is necessary, but if you take into account the full scope of the motorway body (the slopes), on completion of main designs, can be expected even further demolitions.

With further analysis and optimization of design ware not possible to improve elements of the northern part of the corridor (from the junction of Mostar South to junction Mostar North), although the longitudinal slope erected on the critical 4.0%. Large tunnels are not reduced, and smaller are slightly increased.

Based on the requirements of the Client we further optimized the route (Revision of vertical alignment) of the sector Stanojevići - Buna - Mostar South - Mostar North.

In the part around beginning (cca 1+250,00 LOT 5) the route moved slightly lower (in layout) on the slopes of Oštri rat and Samac, in order to shorten the tunnel Oštri rat (between km 0+ 000 and 5+500).

In this context it is done analysis with increasing slope of the motorway in the area of the tunnel to 3.0% (max in long tunnels) or descending tangents to the airport at 4.00% (maximum to avoid the necessity of slow vehicle's lanes and expansion of the tunnel at – three lane). Small shifts in layout or height on such complex relief conditions cause significant changes in the lengths of road facilities. The analysis shows that it is not possible to achieve shortening of tunnel Oštri rat that the length of some of the smaller tunnels on the descent toward the airport partly even increased.

In a previous variant to the sector Mostar North - Mostar South (V1), the total length of the tunnels (to the front of runway) amounted to 6.307m and 925 m of viaducts. In solution with required corrections (V1a) the length of the tunnels increased at 6,889 m, and viaducts at 941 m.

In the zone of the tunnel "Pista" is necessary to perform mutual supporting walls on the approaching side in the tunnel in length of 516 x 2 = 1.132 m + 615 x 2 = 1.230 m, i.e. a total of 2.362 m, a height of 6.50 to 7.0 m in average. In detailed designing through the main design (when geotechnical data are known), we can expect an extension of the tunnel due to the very small space between the tracks and airport.

In addition to increasing the length of road structures, disadvantage is the increase of longitudinal slope which causes long-term increase in user costs and maintenance costs, greater environmental impact, and further demolition 3 more residential buildings in the area of Gnojnice. On the part of the airport to Stanojevići settlement, by shifting the route in the military area we avoided the tunnel length of approximately 3300 m around the airport.

Also at the sector Stanojevići - Mostar south from km 13+256,70 to km 28+750 were analysed shifts of alignment as lowering and increasing the slope (to the max value of 5.0%) in the area from crossing the Buna to the tunnel Kvanj).

On the part of approx. km 15+500 - 19+000 the alignment has been optimized and further lowered by approximately 10-12 m and inclination is increased to 3.52%. Next, the alignment is steeper in tunnel Kvanj, (L= 2,706 m, to 2.67%) in order that fitting in the existing part of the route could be done in the context of previously defined points. A further increase in the inclination (max 3%) does not lead to a further reduction of viaducts, and increases the length of tunnel Kvanj approximately 314 m.

Such a correction of alignment caused that bridges Buna and Bunica are slightly shortened (Buna to 95 m, 1140 m now, and Bunica by 83 m, and now 1147 m). Before the tunnel viaduct Kvanj decreased from 600 to 275 m.

In this sector the alignment is set so as to be within the limits when it is not necessary to design slow vehicle's lane, because it would further expand facilities, or create additional investment and maintenance costs.

The proposal for further adjustment of alignment requested by the Client after these solutions, lies in the fact that it was proposed that the vertical alignment fall from Buna to the tunnel Kvanj be 5.00%.

The analysis of this proposal stipulates that bridges over the Buna and Bunica shortened to 680 m (Buna, now 460 m) and 327 m (Bunica, now 820 m).

Such vertical alignment however, by shortening the two facilities, requires:

- The construction of a new tunnel L=410 meters;
- The construction of a new viaduct L=145 m;
- The construction of three overpasses with road crossings for regional and local network;
- The construction of three travel pass for the local network;
- The construction of lane for slow vehicle's driving in length of 2.465 m.

Additional analysis in this segment (km13+256,70 – 28+750) was done at the request of the Client and consequently was made an additional correction of alignment in the sense that once again attempts to avoid the need for the slow vehicle's lane. Correction of vertical alignment, within the analysis was performed in a manner that the slope of the tunnel Kvanj increased up to max 3.0% acceptable. In this way the fall of the alignment from the tunnel Kvanj to the bridge Buna reduced from the previous 5.0% to 4.0%. This solution now caused the extension of tunnel Kvanj for 54 m, and its length is now 2760 m.

Due to the configuration of the terrain and relief with great restrictions, this shift of level requires the following additional activities:

- Viaduct behind the tunnel Kvanj decreases from 275 m to 140 m,
- The construction of additional tunnel Kičin 1 (500 m) and Kičin 2 (400 m),

- Bridge Bunica with 513 m reduces to 140 m,
- Tunnel Goica decreases from 410 m to 350 m,
- Buna Bridge remains unchanged (460 m),
- Three overpasses for local and regional infrastructure.

This geometry is favourable as far as talking about the user costs and investment costs (decrease compared to the previous solution for approximately 7.2 million euros), but in the long run will be increased maintenance costs and management (three new tunnels).

After conducted the analysis of capabilities, it can be concluded that the solution is more acceptable than the previous one with the slow traffic lane and expanded facilities.

Therefore, the route with the proposed correction may be considered acceptable because the elements are within the permissible range, although it will cause increased costs of users, maintenance and management. Consequently, the route with the corrections in this segment is adopted as an acceptable solution for further analysis and detailed design.

While making definition of project solutions in all variants within the corridor, elements for defining the beginning and end of structures (height of abutment, height of approach cutting) were taken across the border and engineering practice and some optimum (abutments 6-8 m, approach cuttings to 15 m) to obtain min length of road structures (here with abutments 12-15 m, and approach cuttings up to 25 m), in order that variants could be realistically compared.

Generally, the entire route in the proposed corridor is forced and does not follow the natural flow of relief, so that a sudden leap from the slopes in the valley and sharp climb again to the slopes, certainly require a greater number of larger road structures.

The entire section is limited in setting the route by the route elements of previous section and on beginning of the LOT 5, and connection to the road route at LOT6, protective airport area, the existing main infrastructure (railway line, roads M 17, M6.1.), and by corridors of HV transmission lines. Given that this is a motorway, the route has prescribed min and max elements, and their sequence and connection, also that in these very difficult conditions of the relief acts as a limiting factor in setting the route.

Data for design

Changed road section in this Preliminary Design is part of the LOT5 and LOT6, according to previous documentation (Main Designs Lot 5 and Lot 6). The change is made in most of Lot 5 and the initial part of LOT 6.

Basis of preparation of the Preliminary Design with modifications of sections was order and proposal of route by the Client, and data from the Main Design of lots which was produced in the previous period.

Information on the documentation which has been used for preliminary design:

- Basic Terms of reference of the Client;

- Valid technical regulations for specific areas, listed in the parts of the design;
- Data from previous special conditions of some relevant institutions;
- Environmental Impact Study for the sections from the previous documentation and procedures;
- All available documentation from local sources, which in any way dealt this corridor (articles, books, and the results of various research works, studio works, official data obtained from professional services BH DCA and MZLAM);
- Geodetic ortho-photo images received from the Client.

Data from physical planning documents

The investigated corridor of modified route is not regulated by planning documents (Spatial and Urban Plan of the Municipality of Mostar, Spatial Plan of the special features of Corridor Vc in Bosnia and Herzegovina, 2009). For the purposes of the Preliminary Design we conducted a field tour route and overview of the zoning within the scope of the corridor, and some consultation with relevant professional services of airport and BH DCA, and the Office for Urbanism.

To create a basis for design we obtained the following documentation:

- The Main Design of the motorway in the scale of 1: 1000;
- Air photo image of the corridor zone changes;
- Map 1: 25000.

2.2. Description of the main characteristics of the production process, the nature and quantity of materials used

In the technical section of design, the motorway route is modified and in the final solution guided in two parts: On the part from Oštri rat to junction Mostar south (northern part of corridor) chainage is guided further continuing the LOT5 chainage, from km 4+389,63 to km 16+500,00, the length of 12.110,37 m.

On the part from Stanojevići (Lot 6) to junction Mostar south chainage is guided from the south to the junction, from km 13+256,70 to 27+773,51, length of 14.516,81 m. Total route changes length in the wider zone around Mostar is 26.627,18 m.

From north to junction Mostar the route is separated from the alignment in LOT5 in the area of Gostino brdo, abruptly descends through the D.Opina and Gnojnica in the valley of Neretva river or the airport. Passes over populated areas, the royal vineyards, some industrial facilities, road M6.1., passes below the threshold and the access plane of airports Mostar (Tunnel "Pista" approximately 250 m), wriggle at Kadijevići through the narrow space (about 32 m) between the railway and the airport building. In this part the route is in the deep ravine and ends in the zone of the future junction Mostar south. From these positions, continuing to south the route passes over a length of approximately 1000 m through a military area where demolishes part of the facilities in the military zone. Such a shift of the route in the military area, avoided the tunnel length of approximately 3300 m (continued

tunnel "Pista"). Below the Buna motorway route follows the auxiliary runway at a distance 35-45 meters under the conditions of MZLM and BHDCA, passes through built or rural areas, passes over the Buna and starts climbing over the Bunica toward Kvanj, and after leaving the tunnel, Kvanj on the flat area around Stanojevići fits in the route of LOT 6 at km 13+256,70.

By adopting solutions with smaller longitudinal slope and increasing road structures we avoid the need for the construction of slow lanes and wider road structures. However, this solution requires the construction of two additional tunnels (Kičin 1, L=500 m and Kičin 2, L=400 m), and three overpasses for transition of local and regional road infrastructure across the motorway.

North of Ortiješ at km 27+308.00 provided is the final solution junction Mostar south (type trumpet with toll-block), and at km15+440 (northern part of the corridor, at km 28+695 of southern part) a temporary connection of the motorway to trunk road M17 (M17 intersection and road for airport). Connecting intersection is provided as a roundabout. Connecting road to the motorway M17 is in a deep cut and the junction was at an incline of 4.68%. In the context of temporary connection envisages the construction of the temporary frontal collection at km 16+180 (km 27+854 of the southern part) with 6-7 passages (in final phase eventually by a traffic analysis would be 11 vehicle passages). In km 20+200 in phase construction is planned temporary junction to Hodbina, on existing road Buna - Stolac. At the time of construction of the continuation corridor to the north, will need to remove the temporary junction and temporary frontal toll station, and construct an overpass over motorway for the access road to the airport.

The route and location of junctions are set so that they met safety distances and conditions of access plane according to conditions of MZLM and BHDCA. The position of vertical alignment in a normal cross-section is also defined by the Terms of reference, as well as cross-slope of emergency stop lane. Cut gradients and embankment slopes were determined on the basis of the assessment of geological situations, since geotechnical investigations were not carried out.

On the basis of the relevant parameters, traffic load, climatic, topographical and geotechnical characteristics of the soil and the material in the road foundation, available resources (natural and artificial materials), as well as appropriate technology of works defined in the preceding main design, adopted pavement structure. Applicable axle load of 115 kN provided by the ToR was reviewed and aligned with the standards.

Load of structures (bridges, viaducts and overpasses) should be coordinated with the new European regulations (EUROCODE), or to the proposed Regulations on technical standards for determining the size of bridge load Off gazette SFRJ no. 1/1991, DIN 1.072.

Other details of the project are defined in accordance with the terms of reference or the current legislation.

Technical elements of the motorway

All technical elements of the motorway route modifications are in line with the motorway route of LOT 5 and LOT 6, which are at the stage of preliminary and main design. All intersections with the existing transport network are resolved as grade-separated junctions, and connections to the motorway are only possible in the junctions. Types of intersections are selected as appropriate to traffic-technical criteria for their formation. At this section, there is a junction Mostar south (in phase construction as a temporary connection to the M17).

All technical elements of the motorway are defined according to the Regulations on the basic conditions of the road, its elements and facilities on them have to meet in terms of traffic safety ("Official Gazette", 2007), the Terms of reference and rules of procedure for the category and the meaning of the present motorway, and for the design speed of Vp = 120 km / h. Twisting pavement made for the speed of 130 km/h, which allows in the future possible increase in the speed limit driving at 130 km/h (as other geometric elements meet this criterion).

Permitted limit elements of motorway:

- radius of curvature of the ground plan..... R_{min} = 750 m
- the length of the transition curve ..... L_{min} = 120 m
- longitudinal fall ..... s_{max} = 4 %
- the radius of the convex curve ..... $R^{\frown}_{min}$ = 19000 m
- the radius of the concave curvature ..... $R^{\smile}_{min}$ = 13000 m

Applying the limit elements on the modified route:

- radius of curvature of the ground plan..... R_{min} = 960 m
- the length of the transition curve ..... L_{min} = 150 m
- longitudinal fall ..... s_{max} = 5,00 %
- the radius of the convex curve ..... $R^{\frown}_{min}$ = 20000 m
- the radius of the concave curvature ..... $R^{\smile}_{min}$ = 13000 m

The motorway was designed with two carriageways separated by a central reservation. Each carriageway has two lanes and an emergency stop lane. Slow lane on this section is designed.

The elements of the motorway cross-section:

- width of the lane..... 3.75 m
- Width of emergency stop lane..... 2.50 m
- Width of edge lane ..... 0.50 m
- Central reservation..... 4.00 m
- Lane for deceleration (acceleration)..... 3.50 m
- Edge lane along the lane for deceleration (acceleration)..... 0.50 m
- Width of embankment (berm) ..... 2.00 (2.50) m

Planned cross section is not aligned with sectional elements according to the Guidelines (GPP A-1), but it also would not be able to ensure the introduction of motorway speed of 130 km/h. Tunnels are presented with two tunnel tubes, of which the distance between the axis is

at least 25 meters. The spacing and width of the lanes is same as in open route, but the edge lanes are 25 cm wide and the stop lane is not running in the tunnel. The adopted route has 12 tunnels.

For the purpose of diverting traffic during the planned ordinary and extraordinary maintenance and accident situations, as well as for the needs of the passage of emergency vehicles (ambulance, fire brigade, police, service maintenance) are planned demountable passes into the central reservation of the motorway on the following locations: in front of the tunnels, facilities and approximately 3.0 kilometres on an open route. Minimum length of paved zone is 135 m. Should choose a location in the straight line or with minimal difference in height between the edges of the pavement. The cross slope of pavement in the straight line is 2.5%, the maximum cross slope of 6.2% is applied in curve radius of 960 m. The cross slope of emergency lane is designed in the same slope as the traffic lane.

Overview of elements of the motorway route and a list of structures on the changed part of the route

The route follows the relief, so layout elements are relatively extended, except to the extent of running into and around the airport where two sharper curves are.

The minimum value of the horizontal radius is 960 m, and the min length of transition curve is 300 m. The route alignment laid the most part in the ups with large vertical curves, the exchange of embankments and cuttings and a large number of facilities. Great relief barriers overcome with several bigger bridges and viaducts and tunnels. Part of the route, after the bridge Rotimski potok, was laid on the terrain surface.

Sequence of horizontal alignment elements on modified axis (in the direction from north to south):

*	Right curve	R=3900.00	L=300 (continuation of the previous section LOT 5)
*	Transition curve	A=1081,665	L=300
*	Transition curve	A=846,759	L=300
*	Left curve	**R=2390.00**	L=4.206,46
*	Transition curve	A=846,759	L=300
*	Transition curve	A=1095,445	L=425.00
*	Right curve	**R=4000.00**	L=125,20
*	Transition curve	A=1095,445	L=425.00
*	Straight line		L=1.574,28
*	Transition curve	A=600.00	L=300.00
*	Right curve	**R=1200.00**	L=1.285,28
*	Transition curve	A=600	L=300.00
*	Transition curve	A=536.656	L=300.00
*	Left curve	**R=960.00**	L=836,63
*	Transition curve	A=536.356	L=300.00
*	Transition curve	A=900	L=300.00
*	Straight line		L=494,21
*	Transition curve	A=692.82	L=300.00

*	Left curve	**R=1600.00**	L=278,75
*	Transition curve	A=692.82	L=300.00
*	Left curve	**R=1600.00**	L=48,67
*	Transition curve	A=1.161,895	L=255,00
*	Right curve	**R=4500.00**	L=1.483.59
*	Transition curve	A=1.161,89	L=255.00
*	Transition curve	A=932.738	L=300.00
*	Left curve	**R=2900.00**	L=614,91
*	Transition curve	A=932.738	L=300.00
*	Transition curve	A=670.82	L=300.00
*	Right curve	**R=1500.00**	L=654.85
*	Transition curve	A=670.82	L=300.00
*	Transition curve	A=648.07	L=300.00
*	Left curve	**R=1400.00**	L=627,31
*	Transition curve	A=648.07	L=300.00
*	Transition curve	A=916.515	L=300.00
*	Right curve	**R=2800.00**	L=5.576,14
*	Transition curve	A=916.515	L=300.00
*	Transition curve	A=948.683	L=300.00
*	Left curve	**R=3000.00**	L=1.839,37 (continue to the next section LOT 6)

Sequence of vertical alignment elements in this section (in the direction from north to south):

*	rise	**0,78 %** / 306,02 m	Continued from the previous sections LOT 5)
			R$^{\cup}$= 20 000 m
*	rise	3**,00 %** / 3245,58 m	
			R$^{\cap}$= -20 000 m
*	fall	**4,00 %** / 6127,39 m	
			R$^{\cup}$= 22 000 m
*	fall	**0,13 %** / 1067,43 m	north / south part
			R$^{\cup}$= 25 000 m
*	rise	0,3**1 %** / 4588,46 m	
			R$^{\cap}$= -20 000 m
*	fall	1,24 **%** / 582,71 m	
			R$^{\cap}$= -20 000 m
*	rise	**0,61%** / 1526,73 m	
			R$^{\cup}$= 13 000 m
*	rise	**5,00 %** / 2310,49 m	
			R$^{\cap}$= -30 816 m
*	rise	2,48 **%** / 4225,19 m	
			R$^{\cap}$= -23 065 m
*	fall	**1,93 %** / 1203,10 m	

		R⌒= -22 100 m
* fall	**3,84 %** / 872,67 m	
		R⌣= 23 000 m
***** rise	**1,05 %** / 532,41 m	continue to section LOT 6)

Elements of motorway axis - MC are presented with data for staking (calculation of axis elements), in the framework of this project, MC00 axis is the axis of the central reservation.

Geotechnical characteristics of the material along the route

For the purposes of making a preliminary design of the motorway to the changed part of the route is not made geotechnical design of the route, facilities and tunnels, in line with previously annotated conditions.

Pavement structure

At this stage of conceptual design, considering that geotechnical investigations are not carried out, the pavement structure is approximately assumed according to the experience of the main design of the basic route.

Drainage system

Drainage of road is based on the needs to drain pavement and get driving conditions, on conservation and regulation of the existing water regime of the wider catchment and environmental protection from the negative effects.

Internal drainage is considered to be a drainage system that precipitation fell on the road catchment surface, freely, and / or by buried waterproof channels drains outside the roads basin, if necessary, cleaned to the required degree of efficiency in a variety of protective structures, and then concentrated or dispersed released into the environment.

Engineering-geological, hydrological and hydrogeological investigations on this part of the route are not performed, and no knowledge of underground and surface water, water protection zones.

For the purpose of dimensioning drainage and water protection facilities are required ITP curve for higher return periods (10-100 years).

For the considered area there are no adequate ITP-curves and for the further course of the design of pavement drainage facilities and facilities of external drainage and water protection, it is recommended to prepare them.

Engineering structures

On the motorway route, given the high categorization of road, on relief complexity of the terrain and the importance of space in which the route passes, appears a series of facilities in the route and over the route and tunnels.

The route from design (part of Lot 5 + part of Lot 6) on modification section (start the changes on LOT 5 at km 4+389.63 (4+ 400.00), the end of changes on LOT 6 at km 13+256.70)

	BASIC motorway route V1a	MODIFIED ROUTE V1b (fall 5,0%)	CORRECTED ROUTE 18.01.2017 adopted
ROUTE	26.588,18 m	26.588,18 m	26.588,18 m
TUNNEL	285 m	285 m	285 m
VIADUCT	365 m	365 m	365 m
TUNNEL	3.320 m	3.320 m	3.320 m
TUNNEL	632 m	632 m	632 m
TUNNEL	400 m	400 m	400 m
TUNNEL	345 m	345 m	345 m
VIADUCT	576 m	576 m	576 m
TUNNEL	800 m	800 m	800 m
TUNNEL	857 m	857 m	857 m
OVERPASS	1	1	1
TUNNEL Pista	250 m	250 m	250 m
OVERPASS	--	1	1
BRIDGE Buna	1.140 m	460 m	460 m
TUNNEL Gorica	--	410 m	350 m
BRIDGE Bunica	1.147 m	820 m	140 m
TUNNEL Kičin 2	-	-	400 m
TUNNEL Kičin 1	-	-	500 m
VIADUCT	--	145 m	140 m
OVERPASS	--	1	1
OVERPASS	--	1	1
VIADUCT	275 m	275 m	140 m
TUNNEL	2.706 m	2.706 m	2760 m
VIADUCT	221 m	221 m	221 m
JUNCTION	1	1	1
$L_{\text{route netto}}$	13.269,18 m	13.721,18 m	13.647,18
$L_{\text{facilities}}$	13.319,00 m	12.867,00 m	12.941,00
OVERPASSES	1	4	4
Lane for slow vehicles	--	2.465 m	-
max fall of alignment	4,00 %	5,00 %	4,00%
max fall in tunnel	3,00 %	3,00 %	3,00%
No. tunnel L > 500 m	5	5	5
Tunnel length > 500 m	8.315 m	8.315 m	8.369 m
No. of tunnels with length > 500 m and fall	3 / 2.289 m	3 / 2.289	3 / 2.289

>3,0 %			
demolition of structures	29 (in zone 25+25 m) Estimation 60 in zone of 50+50	29 (in zone 25+25 m) Estimation 60 in zone 50+50	29 (in zone 25+25 m) Estimation 60 in zone 50+50
Noise protection (m^1)	= 4.473 m	= 4.473 m	= 4.473 m

Proposed variant V1a (L = 26.588,18 m):

- Total length L = 26.588,18 m
- Length of bridges and viaducts = 3.148 m
- Proportion of bridges and viaducts in the route: 11.84 %
- Tunnels length = 10.171 m
- Proportion of tunnels in the route: 38,25 %
- Length of facilities in total= 13.319 m
- Proportion of all facilities in the route: 50,09 %
- Route length Lnetto = 13.269,18 m
- Proportion of netto route: 49,91 %
- Overpasses 1
- Junction 1
- Slow lane --
- Three – lane facilities--

Corrected alignment in V1a - = variant V1b (5,0%)

- Total length L = 26.588,18 m
- Length of bridges and viaducts = 2.452 m
- Proportion of bridges and viaducts in the route: 9,22 %
- Tunnels length = 10.581 m
- Proportion of tunnels in the route: 39,80 %
- Length of facilities in total = 13.033 m
- Proportion of all facilities in the route: 49,02 %
- Route length L_{netto} = 13.555,18 m
- Proportion of netto route: 50,99 %
- Overpasses 4
- Junction 1
- Slow lane 2.465 m
- Three – lane facilities 3 / 1240 m

Adopted variant V1 (L = 26.588,18 m) – corrected alignment on the part Buna-Stanojevići:

- Total length L = 26.588,18 m
- Length of bridges and viaducts = 2.042 m
- Proportion of bridges and viaducts in the route: 7,68 %
- Tunnels length = 10.899 m
- Proportion of tunnels in the route: 47,99 %
- Length of facilities in total = 12.941 m
- Proportion of all facilities in the route: 47,67 %
- Route length Lnetto = 13.647,18 m
- Proportion of netto route: 51,33 %
- Overpasses 4
- Junction 1
- Slow lane --
- Three – lane facilities--

All variants considered passing in restricted areas (additional charges):

- agricultural land category I (vineyards, fields) L = 5778 m
  (cca 230.000 m2)
- required area of noise protection L = 4473 m (cca 18.000 m2)

Passage construction area *GP existing- L= 1287 m*

GP1 planned - L= 873 m

special purpose (airport) N - L= 634 m

area of significant landscape - L= 1289 m

tourism purposes T1 - L= 1204 m

drainage area (possibly high groundwater)- 6048 m

Cross section, for a pavement is: 1,00 + 2 x 3,75 + 2,50 + 0,5 = 11,50 m.

Gauge: 4.70 m, and the applicable load for static analysis is activity of typical heavy vehicles SLW 600 + 300kN.

In addition to technical and cost components, the route to the new corridor requires:

- Modify urban planning documentation
- Resolving property rights (private and public)
- Resolving property relations and permit with BHDCA and MZLAM and Armed Forces of B&H
- Preparation of the new study and technical documentation
- Obtaining environmental and construction permits.

Crossing roads and other infrastructure

All intersections with the existing transport network are resolved as grade-separated.

Plots to which will be disabled former approach by the construction of motorway will ensure the construction of access roads or parallel with the motorway body - processed in designs of parallel roads.

Estimated crossings, passages and road deviations in this section are the following types and characteristics:

TYPE 1 V_r = 60 - 80 km/h (trunk roads)
Width: 1,50 + 2 x 3,50 + 2 x 0,50 + 1,50 = 11.00 m
Fall: s_{max} = 8 % (hilly to mountainous terrain)

TYPE 2 V_r = 50-60 km/h (regional roads)
Width 1,25 + 2 x 3,25 + 2 x 0,30 + 1,25 = 9,60 m
Fall : s_{max} = 11 %:

TYPE 3 V_r = 40-50 km/h (local roads)
Width 1,00 + 2 x 2,75 + 2 x 0,20 + 1, 00 = 7,90 m
Fall : s_{max} = 11 %:

TYPE 4 V_r = 30-40 km/h (unclassified roads)
Width 0,75 + 2 x (2,50) + 0,75 = 6,50 m
Fall : s_{max} = 11 %:
Cross fall 4% - macadam or asphalt

TYPE 5 V_r = -- km/h (field roads)
Width 0,25 + 2 x (1,50) + 0,25 = 3,50 m
Fall : s_{max} = 11 (15) %:
Cross fall 4% - macadam

All intersections of installation of utility infrastructure will be appropriately protected or exceeded under special conditions of competent distributers and solutions in specific project designs of installations relocation (a group of documents I). Each installation is addressed in his special project design in detail.

Intersections

On the modified route is designed intersection Mostar south located at km 27+311.00 of motorway axis, and connects the motorway to the trunk road M17. The intersection is located near the village Ortiješ. Since the intersection is in the collection system, the shape of the trumpet is chosen as an optimal solution for the setup of toll collection. After descending /

ascending ramps the toll station is located with 10 toll booths and 11 passes, and further is placed connecting intersection on the trunk road M17.

Cross-sections of the ramp at the intersection:

One-lane ramp:

- Traffic lanes: 1.50 + 3.50 = 5.00 m
- Edge lanes: 2 x 0.50 = 1.00 m
- A shoulder: 2 x 1.50 = 3, 00 m

Two-lane ramp:

- Traffic lanes: 2 x 3,50 = 7,00 m
- Edge lanes: 2 x 0,30 = 0,60 m
- A shoulder: 2 x 1,50 = 3,00 m

In phase implementation is done as a temporary connection to the M17 at approximately km 15+440 with temporary frontal toll.

Toll facilities and rest service facilities

Toll is a design unit which consists of three basic elements, namely a tollbooth, and a canopy above and the collection control facility. Individually each of these three elements is the functional entity for itself, and therefore design task.

Toll booth must provide comfortable working in shifts of eight hours and at the same time be in the function of toll collection and traffic development.

Canopy has the purpose of covering the space with simultaneous provision of providing visual information for easier and faster passage of vehicles, highlighting the passage below, protection from the sun and weather.

The collection control facility must provide space for traffic control at the toll station at the same time providing comfort and working conditions for employees, supply toll with conditioned air and heating, electricity supply of canopy and everything that is necessary for the functioning of collection.

Frontal toll "Mostar South" in the final stage consists of 10 toll booths and 11 traffic lanes. Frontal toll has storey building control of toll collection with the passageway for oversized vehicles in front of the building, parking for vehicles of employees, and an energy facility.

At the stage of the temporary solution frontal toll would have reduced the number of toll crossings (according to calculations in a traffic study), and given the temporary nature, facilities can be made of prefabricated structures.

On the relocated part of the route are not designed service facilities.

Road furniture

This Preliminary Design did not process in detail traffic signs and equipment. Traffic signs, vertical and horizontal must match the Rules on Traffic Signs and Signals on Roads of the Federation of Bosnia and Herzegovina and the Guidelines for the design, construction, maintenance and monitoring on roads, Chapter 5: Traffic signalization and equipment issued by the Federal Roads Directorate and the Public Enterprise "Roads of the Republic of Serbian".

Horizontal road markings under this project are in accordance with the adopted standards JUS U.S4. 221-230 and in accordance with the Rules of signalling and traffic signs on the road by which it is performed.

Vertical signalling is designed in such a way that on the main route corresponds to the level of the road. In relation to that the forms and colours of traffic signs are determined.

Arranging these roads by which it is possible to realize high speed driving with a high traffic load, requires adequate traffic equipment:

- the introduction of signalling variables notice as a medium of communication with drivers,
- installation of measuring devices for control of traffic flow and the environment, which allows at any time professional and operational services overview situations on the road.

Requirements on traffic signs and signals are related to the clear, precise and unambiguous notify the driver. This applies to:

- systematic management by objectives on signs notice,
- identical sequence of traffic signs by type and subject to that found,
- identical display on signs of changing notification,
- identical display temporary restrictions due to changes in driving conditions,
- clear and uniform retro reflective properties of horizontal signage,
- identical markings for other notices (outside the area of traffic signs).

The equipment often includes a protective guard rail, reflective markings, retro reflective elements of the vertical safety barriers and directional posts.

Safety barrier is a technical structure that is placed on all parts of the road where there is a possibility of uncontrolled and undesirable turning of the vehicle from the road that would jeopardize the safety of drivers and passengers and other participants in traffic.

Retro reflecting, vertical retro reflective elements on safety barriers and direction posts are provided in accordance with the Rules of the traffic signs, signalling, markings of works on road and barriers and signs that provides to road users an authorized person (Official Bulletin, No.16 / 07) and are set in accordance with it.

2.3. Assessment per type and quantity of expected waste and emissions (pollution of water, soil and air, noise, vibration, light, radiation, etc.) as a result of the scheduled production process

Basic amount of work in this stage can be obtained based on the geometry of the project. The calculation of earthworks is performed as information for determining the scope of works, on geodetic maps on which the solution is done in the absence of geotechnical investigation works.

The total amount of earthworks in the section Stanojevići - Buna - Mostar South is (without tunnels):

- Excavation 1.599.886 m3
- Embankment 600.285 m^3

The total amount of earthworks in the section Suhi do – Mostar jug is (without tunnels):

- Excavation 1.708.800 m^3
- Embankment 528.720 m^3

Overall, in the changed part of the route:

- Excavation 3.308.680 m^3
- Embankment 1.129.000 m^3
- (Excavation in tunnels on modified route cca 1.692.860 m^3)

Asphalt pavement on the changed part of the route cca 642.100 m^2/layer)

Noise protection

For the purposes of the section is expected to perform barrier for noise protection (one part of the route passes through settlements).

In accordance with conventions of the profession, for modelling the barrier height is determined that the barrier height cannot be more than 5.0 m on terrain and 3.0 m on the structures (viaducts).

Due to the visual impression at the beginning and end of the barrier height of 5.0 m perform the additional barrier segments to form a stepped end (beginning) of such high barriers.

In accordance with HRN EN 1793 the barriers divide into groups, depending on the acoustic properties:

- A 0 to A 3 - in terms of sound absorption;
- B 0 to B 4 - in terms of sound insulation.

Soundproofing barriers are subject to the necessary reduction of noise at protected facilities. Sets the criteria for sound insulation barrier that must be a minimum of Rw> 24 dB for all types of barriers (category B3 in accordance with EN 1793-2: 1997).

Sound absorption for barriers depends on the need to limit the noise on the other side of the protected one, if there are also buildings which should be protected from noise. Absorbing properties for barriers must fall into the category A3 (according to EN 1793-1: 1997).

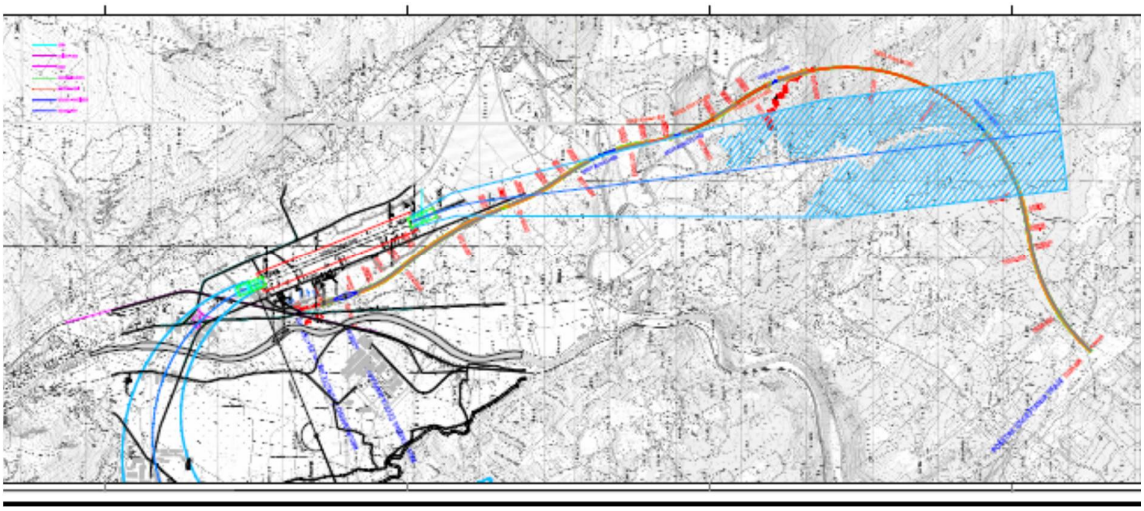
In order to protect existing facilities that have been exposed to excessive noise levels envisaged are the barriers for protection against noise to ensure noise levels lower than the law allowed and defined certain geometric parameters of barriers for noise protection.

In optimizing acoustic barriers should consider the potential increase in traffic for the next 20 years from commissioning roads in traffic. Barriers for protection against noise accompanying the terrain, and are placed along the road on the outer edge of the shoulder.

Landscaping

Landscaping design will determine the primary objectives of planning with an emphasis on protecting and improving the ecological and visual quality of space. Basic concept of landscaping motorway and content of RSF (rest service facility) are based on the need to design create a townscape high levels of landscape-arrangement attractiveness, specifics of expression and development of identity. Arrangement is in the category of landscape-park architecture, a theme should guarantee experiential impact and recognition of the location and preservation of vistas.

The vegetable material should be fully compliant to climate, and selected according to the necessary characteristics of resistance to the specific conditions of pollution.



3. DESCRIPTION OF ENVIRONMENT WHICH IS AFFECTED BY THE PROJECT

The environmental impact study examines the section of motorway subsection LOT 5, 6: SECTION MOSTAR NORTH - MOSTAR SOUTH – POČITELJ, Mostar south – Buna 13+256,79 – 28+695,00 and 4+389,63 – 15+440,00.

It is expected that construction of the motorway is a key driver of economic activities and to enable the inclusion of B&H in the main European traffic flows and the global European economic system. The construction of the motorway will allow a rational connection between B&H regions and neighbouring countries and regions and achieved stabilization and development of the country. Improvement of transport conditions will improve quality of life that will be manifested through:

- reducing the length of time and travel time of goods and passengers,
- reducing the cost of transporting goods and passengers,
- increasing employment,
- evaluation of the geographical-traffic position of B&H,
- increase the competitiveness of economy in the gravity area of corridor.
- the launch of new projects and increase private investment in the regional economy.

Since the Environmental Impact Study for the relevant area is made in 2007, in this Supplement are presented data from this study and available documentation, which is made in the previous period.

3.1. Population and settlements - demography

For the purposes of the EIA-March 2007th, a sociological analysis of the impact assessment of the corridor of the future motorway (Corridor Vc, LOT 4) is based on an analysis of existing documents (statistical and related data, data from existing spatial plans), as well as on the analysis that is with the use of several techniques of research performed in the field (observation, survey, focus group analysis).

In the first phase, the analysis was considered 12 potential variants of the corridor of the future motorway, and examined their potential impacts, including an earlier version of Corridor no. 7, which are the closest definitely adopted variants.

For the purposes of the EIA- March 2007 (previously mentioned) have been analysed the data of "the Institute for Statistics of the Federation of B&H".

In the period of 1948-1991 has recorded steady population growth. As is well known in B&H there is no official census after 1991, after which happened political and social change and turbulent demographic movements that are caused by war events.

According to available data and documentation that is made for the purpose of the Spatial Plan of the City of Mostar was stated that the City of Mostar live 113,169 people, which represents 48% of the Herzegovina-Neretva Canton / County.

The city of Mostar with its population density (96.3 inhabitants / km2) is slightly more than the average density of the Federation of Bosnia and Herzegovina (92 inhabitants / km2), a significant average of the entire B&H (75 inhabitants / km2).

The City of Mostar includes 60 settlements in total, among which the town of Mostar is most populated with 65,286 inhabitants.

The official census in B&H was carried six times from 1948 to 1991. Prior to 1961 censuses were carried out at irregular intervals, but after 1961 are made at intervals of ten years. Table 1 shows the official numbers of the population of Municipality of Mostar at that time.

Table 1 -Basic data of the census in period from 1948 to 1991.

Year	Municipality Mostar
1948	51.823
1953	58.471
1961	72.452
1971	89.588
1981	110.377
1991	127.368

Table 2 shows the number of inhabitants on an annual basis according to the reports of the Federal Bureau of Statistics.

Table 2. City of Mostar - Population and density according to the report of the Federal Bureau of Statistics

Surface cca km^2	Population in 2008.	Population / km^2 2008.	Population in 2007.	Population /km^2 2007.
1.175,00	111.116	95%	111.198	95%

Types of settlement (rural, urban), according to estimates (source: study "Demographic trends and settlements system HNŽ/K", September 2009.) Mostar - group of rural settlements of 1-99, 100-399, 400-999 inhabitants makes 39 settlements or 69.6% with 16,314 inhabitants or 13.53% and 10 settlements so-called transition groups or 17.9% (1000 to 1999) with a population of 14,109, or 11.6%. Total rural population is 30,413 inhabitants or 25.13%. The urban population located in 7 urban settlements or 12.5% of which is six in the group with 2000-4999 with 18,221 inhabitants, or 14.97% of the population of the municipality and municipal centres of 72,381 populations or 59.9% of the population of municipality. Thus, the total urban population is 90,602 inhabitants or 74.87%. This is an extremely large concentration of urban population, but its disadvantage is reflected in a high concentration in the municipal centre, and emphasized disposition group settlements of 2000-4999 inhabitants. The absence of settlements from two groups of urban settlements (5000-9999 and 10000-19999) does not allow real distribution of function of centrality and their availability to the population of the municipality. The concentration in the centre of the municipality threatens to "swallow" the surrounding small settlements creating eligibility for a total urbanization and draining the surrounding area of the municipality. Urban settlements of the group 2000 - 4999 are Rodoč with 4.320 inhabitants, Cim with 2.949 inhabitants, Gnojnice with 2.116 inhabitants, Ilići with 2.743 inhabitants, Potoci with 2.762 inhabitants and Vrapčići with 3.331 inhabitant. From the group of so called. transitional settlements (1000-1999) are Blagaj 1.734, Buna 1.044, Drežnica 1.038, Hodbina 1109, Humilišani 1.701, Jasenica 1.977, Kutilivač 1.308, Polog 1.120, Raštani 1.383 and Vihovići 1.695. What should be noted for the City of Mostar is that there is the extremely small number of settlements from groups with a smaller population of 100, only 3 settlements and only 168 inhabitants. Also advantageous is the fact a large number of so-called large settlements, settlements from the group 400 to 999 inhabitants, 15 villages with 10,116 inhabitants and 10 settlements from the interim group from 1000 to 1999 inhabitants.

Demographic projections for the period until 2020

According to the study "Demographic trends and settlements system HNŽ/K", September 2009, potential demographic and urban development of Mostar would look like this: "In the total population of the municipality shows a slight increase from 116.117 in 2007 to 117.710 inhabitants in 2020. What is characteristic for this municipality is a slight reduction in the total urban population in the planning year, from 105.682 (90.9%) in 2007 to 101.200 inhabitants (84.3%) in 2020. This reduction of the urban population in its distribution to centre of municipality and settlements in wider urban zone (environment) experienced a different redistribution rather increasing concentration of the population in centre for the account of the environment." Accordingly over 100,000 inhabitants gravitate to planned subsection of motorway in corridor Vc.

3.2 Geographical features

The City of Mostar through which run LOT 5, 6: section Mostar North– Mostar South – Počitelj; Stanojevići - Buna - Mostar South – Suhi Do (km13+256,79 – 28+695,00 and km 4+389,63 – 15+440,00) is located in the central part of HNŽ/Canton. It covers an area of

1.165,00 km^2. The metropolitan area is geographically described as a node of northern, western and eastern Herzegovina. Closely urban area located in three basins and makes 18.8% of the territory of the City, and 88.2% is hilly and mountainous terrain of which over 60% of the altitude of 1,000 meters.

3.3 Geomorphological characteristics

Area of the City of Mostar belongs to Dinaridic system and the part where the characteristic is occurrence of the fault zones and abnormal sort of geological layers. It is characterized by a much diversified relief, between the creeks are deep and long river valleys, which often have the form of a canyon. Geomorphological formation of the territory of the City of Mostar gives the possibility to separate a few orographic units. The highest part of the terrain belongs to the high mountains of Herzegovina: Čvrsnica, Prenj, Čabulja and Plasa with peaks: Pločno (2.228 m) on Čvrsnica, Zelena Glava (2.150 m) and Lupoglav (2.102 m) on Prenj, Ošljar (1.882 m) on Čabulja, Brasina (1.897 m) and Botin (1.969 m) on Velež. To the southeast high mountain of Herzegovina passes in specific karst orographic or morphological area, karst surfaces. These are surfaces: Raska Gora and Goranaci, from the right, and the planes Jasenjani and Podvelezje, on the left side of the Neretva. Their average height is around 600 to 1000 m. Lowering the terrain in the direction of the Adriatic coast, on the surfaces south of Mostar continues even lower surfaces Gubavica and Slipčići that otherwise are only small parts of spacious karst surfaces Dubrava and Brotnja in area of Čitluk and Domanovići. Levels of these surfaces have ranges of 200-300 m. In the bed of the river Neretva, whose canyon characteristics together with its tributaries represent a specific orographic whole, on the site Kručevići is the lowest point of the territory of the City, at about 20-30 m above sea level.

Within the mentioned orographic units, special morphological whole region represent karst fields, which due to the height positions can be divided into fields of upper, lower and lowest horizons.

Field of the upper horizons (600 - 800 m) consists of Gornje Hansko and Donje Zijemaljsko and Goranačko field, lower horizons is Mostarsko blato (cca 230 m), and field of lowest horizons are Mostarsko, Bijelo and Bišće polje and Malo polje near Blagaj (30 – 80 m). The fields of upper horizons are formed by lowering terrain along the dislocation lines are substantially are dry. Mostarsko blato as a typical karst periodically flooded field is formed in the same way, while Mostarsko polje and Bišće polje, representing depressions. As morphological unit, a depression is clearly differentiated in relief, plastic self-expressed independently and represents the type of open karst field. Morphologically, because of narrow areas above and below the town, Mostar basin is divided into three natural zones:

- The northern part - Bijelo polje (field)
- The middle section - the area of Mostar with Cim and Ilići
- The southern part - Bišće polje (Mostarsko polje- field).

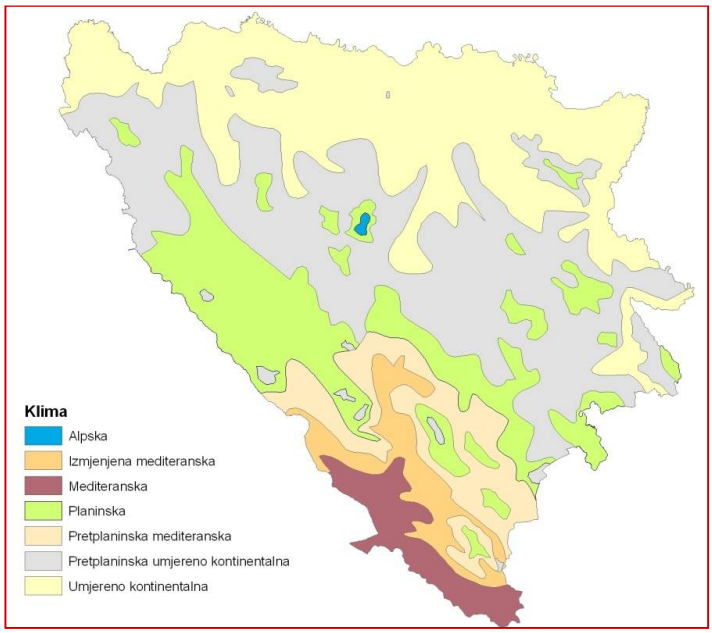
The longitudinal axis of the basin is clearly expressed by the North - South (Salakovac - Buna) and is approximately 30 km. The maximum width of moving up to 6 km.

3.4. Climate characteristics - general

In Bosnia and Herzegovina, incorporating three separate areas with more or less clear boundaries, as follows:

- in the north - temperate continental, or central European climate;
- in the central part - the continental mountain or alpine climate; and
- the southwest - Mediterranean, i.e. maritime climate.

In the north of the country is moderate continental climate, with fairly cold winters and hot summers, but in relation to the alpine zone, with smaller ranges between winter and summer temperatures. In the central part of B&H is continental mountain climate, alpine type. The main characteristic of this climate are cold winters (absolute minimum temperatures are very low), while the summers are warm. In the southern parts of the country, due to the proximity of the Adriatic Sea, mean January temperatures are high (from 3,0 to 5,0 ^{o}C). Depending on the altitude, between the abovementioned basic zones, there are also transient climatic zones. So, going from south to the north, with increasing altitude, we are talking about the transitional areas, i.e. on the modified Mediterranean climate, Mediterranean climate of pre-mountain type, respectively, further to the north, the moderate continental climate of pre-mountain type (Figure 1).



. Figure 1. Climatic zones in B&H[1]

Climate characteristics – the City of Mostar

The City of Mostar is located on the southern part of Bosnia and Herzegovina. Through the valley of the Neretva River to the city reaches the Mediterranean (Mediterranean) climate. Due to the position of the city could be said to have a modified Mediterranean climate (Figure 1).

Due to the proximity of the Adriatic Sea temperatures even in winter are not much lower. The average winter temperature in Mostar in January is about 4˚C.

[1]Study climate characteristics of Bosnia and Herzegovina with special emphasis on extreme weather situations, FHMZ, 2007.

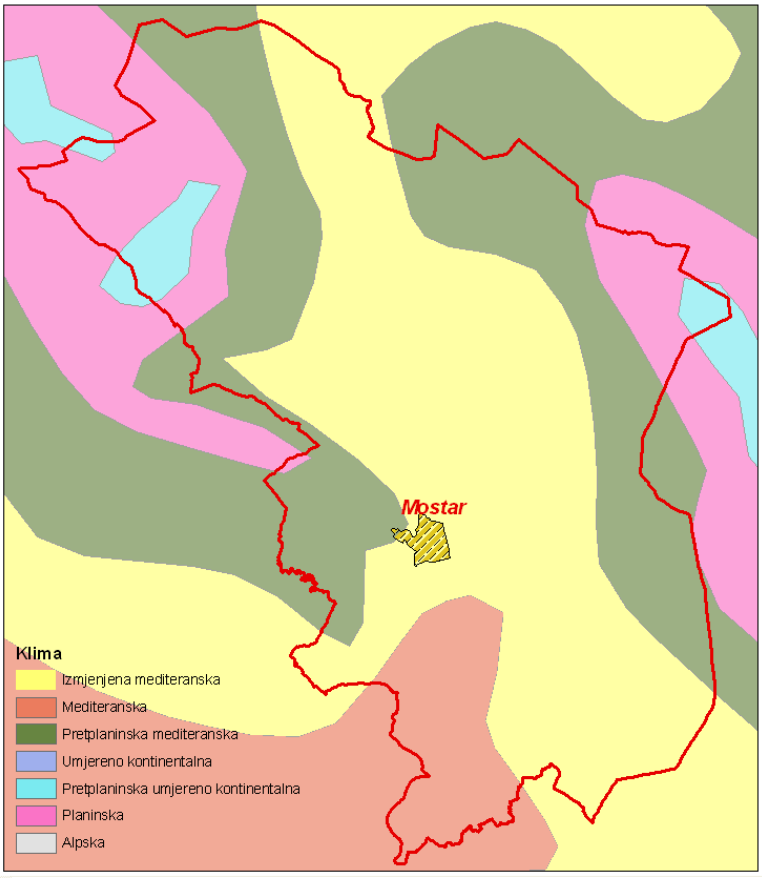


Figure 2. Climatic zones in Mostar

Mostar weather station is located at 43°21'N and 17°48'E at an altitude of 99 m in climate zone characterized as Mediterranean climate.

Mostar is the warmest city in Bosnia and Herzegovina. It has the largest number of sunny days per year (2.285 hours). In spring and autumn period Mostar is rich with plenty of rainfall. Snowfalls are rare in Mostar. Table 3 shows the climatological series for the month of August in the period from 1961 to 1990.

Table 3. Climatological series for the month of August in the period from 1961 to 1990.

Parameter	Value
Mean temperature	24,2
Absolute max.	40,8
Absolute min.	10,2
Pressure	1001,2
Rainfall	73,7

Humidity	54
Insolation	296,2
No. of cloudy days	2,5
No. of sunny days	13,1
No. days with rainfall greater than 1mm	5,5

Temperature

Temperatures in the summer time in Mostar are very high. In the hottest days reach up to 45˚C in the shade. Due to the extreme heat in the summer time there is a big drought when declared even natural disasters. High temperatures reach their peak in July and August. In winter, the temperature range of 3 - 5 ° C. The temperatures in winter additionally lower the strong wind "bura", which knows to drop the temperature by a further 1-2˚C. The average annual temperature in Mostar is around 14˚C. In spring and autumn period temperature ranges from about 10-13˚C. Autumn is warmer than spring, because of the warm air currents from the Adriatic Sea through the Neretva valley. However, temperature fluctuations are much higher in the fall than in the spring period.

Table 4 shows the temperature indicators for the meteorological station in Mostar for 2014.

Table 4. The temperature indicators of the City of Mostar for 2014 (°C)

	Par	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
Mostar	T_{sr}	8,5	10,3	12,4	14,6	17,8	22,6	23,4	24,1	19,3	16,6	12,8	7,8	15,8
	T_{min}	6,0	6,7	7,8	10,5	12,5	17,1	18,2	18,5	15,4	12,6	9,8	5,7	11,7
	T_{max}	11,7	14,7	18,0	19,7	23,3	28,7	29,4	31,2	25,0	22,3	16,9	10,8	21,0

wherein in the above table:

T_{sr} - monthly mean temperature (°C)

T_{min} - minimum temperature (°C)

T_{max} – maximal temperature (°C)

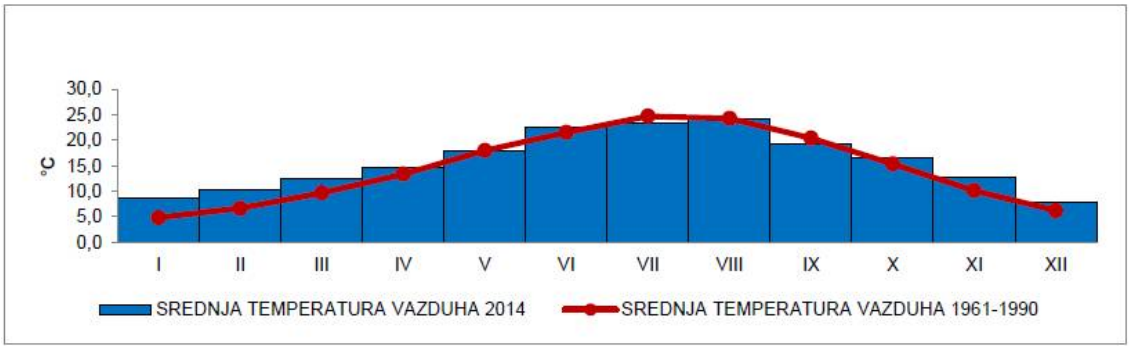


Figure 3. Monthly mean temperatures in 2014.

Precipitation, humidity and fog

Maximum rainfall in Mostar is in the fall, but is quite strongly felt in the spring. The greatest amount of precipitation falls in November and December. Annual precipitation of Mostar is about 150 l/m^2 for the first 3 months of the year. In the central part of year the rainfall sharply reduced and is around 60 l / m2. Towards the end of the year rainfall is again growing and moving around 150 – 180 l/m^2. November is usually the month with the highest precipitation amount in Mostar, where it can be even 210 l/m^2. Table 5 presents data for rainfall, humidity, and fog in Mostar 1961-1990. years

Table 5. Rainfall in Mostar

Month / Parameter	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Central air humidity	81	76	60	68	64	68	75	73	82	77	84	76	**74**
Minimum humidity	14	30	13	26	25	33	39	37	42	35	40	28	**13**
Central cloudiness	6/8	6/8	4/8	5/8	4/8	4/8	4/8	2/8	4/8	4/8	5/8	4/8	**4/8**
Insolation (h)	67	88	197	163	237	253	276	324	193	185	106	121	**2.209**

Wind and pressure

Modified Mediterranean climate prevails in Mostar with mild winters and warm summers, pronounced rainfall and cooler seasons. Adriatic Sea during winter radiates the heat accumulated during the summer period, increasing the air temperature in winter. The most winds are north and northeast. People these winds call the north or bura. Bura is a phenomenon, which occurs on the eastern Adriatic coast and its hinterland and along the Neretva valley comes to Mostar. This wind mostly blows in the winter period when, every other day wind is blowing (bura). Characteristics of bura are that it is very dry and cold wind, which took place in the winter and additionally lower the temperature of the air to 1-2˚C. In addition to the wind bura for city of Mostar is a characteristic also a second wind – south wind called jugo. It blows from the Adriatic Sea and is typical for the fall and spring. South wind -jugo is saturated with moisture and autumn brings rain precipitation in large quantities. The wind is of high intensity. Blows for several days and stops only after rain.

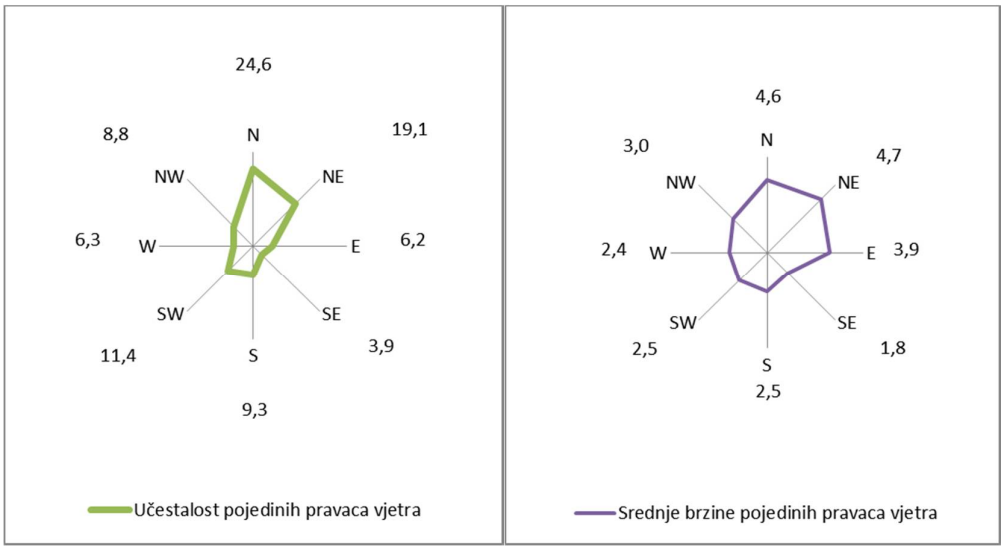


Figure 4. Wind rose for Mostar for the period 1961.-1990.

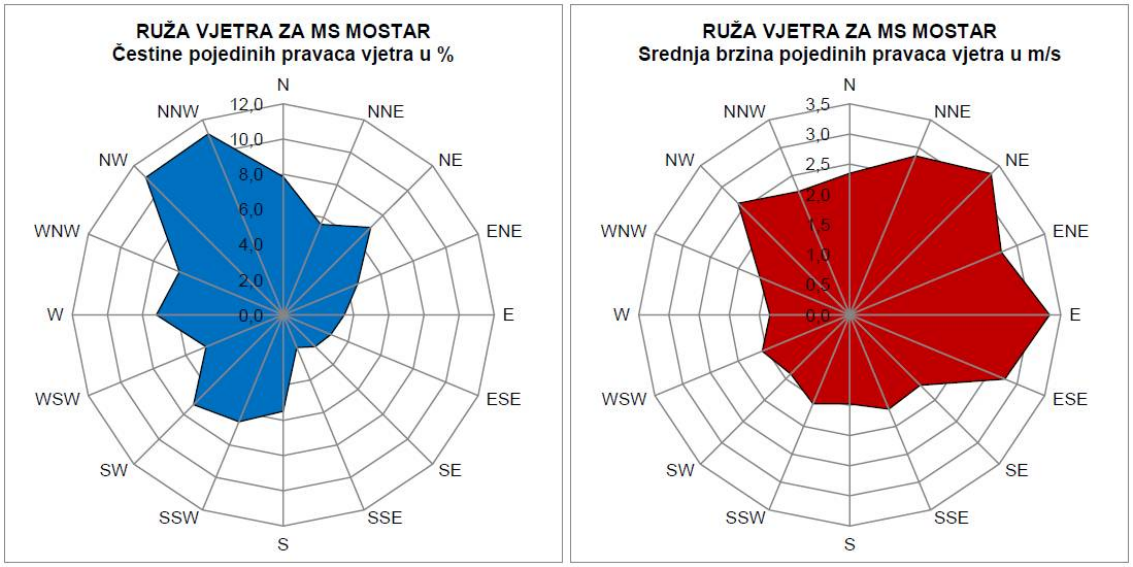


Figure 5. Wind rose for Mostar for 2014.

3.5. Air pollution

Tropospheric air pollution is related to pollution at local and regional level. For pollutants as well as for other substances in nature characteristic is the cyclical movement. This movement is characterized by continuous emission of material from the lithosphere and hydrosphere in the atmosphere and also by their continuous returning from the atmosphere to the ground and hydrosphere. The causes of these exchanges of substances are natural and anthropogenic.

Anthropogenic flow of substances has two basic components:

- transformation of the energy emissions from combustion of fossil fuels,
- gas emissions, taking part in the technological process.

To facilitate the study, we differ following phases of problems of air quality management:

- emission of pollutants, production and emission of pollutants,
- distribution of hazardous substances (transmission),
- conditioning of the atmosphere - the removal of polluting substances (deposition) and their departure to the ground and the hydrosphere,
- occurrence of polluted air in a given area and the entry of contaminants in receptors.

Production and emissions of pollutants

The emission is ejection from the source into the atmosphere substances in certain concentrations that can be harmful to humans, plants and animals, and goods created naturally and the work of man. These materials are, therefore, called pollutants. Emissions can be divided into natural and emissions of anthropogenic origin. Natural emissions occur when spreading material by living beings (breathing), decay, and other natural processes (wind erosion, forest fires). Anthropogenic emissions are due to the transformation of energy as a result of technological processes. The emission of anthropogenic origin is the result of a process which seeks to improve the quality of life. Pollutants emitted may be solid, liquid or gaseous. There are several thousand, but monitored are only the most important or representative.

The most important pollutants are particulates, sulphur dioxide (SO_2), Nitric oxide (NO_x) and carbon monoxide (CO). Sulphur oxides are formed by oxidation of the sulphur from the fuel in its combustion. Part of the sulphur is related to ash and slag, and part goes into the atmosphere in the form of SO_2. Soot, non-combusted hydrocarbons and carbon monoxide, are products of incomplete fuel combustion in the combustion chamber (the lack of the combustion area, shortness of air, rapid cooling of the flame, etc.). Nitrogen oxides formed by oxidation of nitrogen from air and nitrogen in the fuel at high temperatures.

With the improvement of economic activities, the country is again facing the challenge of air pollution. In general, a negative impact on air quality in Bosnia and Herzegovina performs emissions from industrial sources, energy production, traffic, transport, agriculture and

heating. As a result of poor maintenance system for waste management, waste is normally incinerated in the open air and at low temperatures. Because of the negative impact on the quality of air the traffic is one of the major problems in B&H. The reason is that Bosnia and Herzegovina imported old cars. They emit significantly higher emissions of new cars. In addition to traffic, the old industrial plants are significant sources of air pollution in Bosnia and Herzegovina. New industrial facilities, in accordance with the environmental legislation in B&H, do not constitute significant sources of air pollution.

The main causes of air pollution in B&H are:

- nature of the industry (basic industry)
- high energy intensity in industry,
- high heat losses in the housing sector,
- inadequate constructions of furnaces (furnaces and boilers of low power are made mostly by west-European licenses) designed for other types of coal which does not allow efficient and little polluting combustion of domestic coals),
- lack of routing coal consumption depending on the coal quality and local environmental conditions,
- lack of refining the coal for small furnaces,
- not well maintain power and industrial plants, particularly those equipment which influences the emissions of pollutants,
- inappropriate treatment of the problem of air pollution by making regional plans.

Overview state of air quality monitoring

Measurements of air quality in the City of Mostar have been made by the Cantonal Institute of Public Health until 2007, and the available data of air quality cover a period from 2000 to 2007.

Measurements were stopped in 2007 because of equipment failure, and since 2007 there is no data on air quality. Compared to the existing equipment, the following pollutants are measured:

1. Sulphur dioxide (SO2) - as measured from 2000 to 2007

2. The solid particles (LC10) - measured from 2000 to 2005,

3. Nitrogen Oxides (NOx) - measured in 2000 and 2001

Measurements were noted following:

- *Sulphur dioxide (SO2) in the spring-summer transitions and summer-autumn in a number of days does not occur. During the summer maximum values of SO2 have almost constant value and are in the range of 38-68* µg/m^3. During the winter, the

SO2 maximum values fluctuate within the limits of 54-146 µg/m^3. For sulphur dioxide (SO2), we can conclude that during the year does not exceed the limit values.

- *Solid particles (LČ10) appear in the extreme maximum values only in the first three months of 2004 (from 209 to 414 µg/m^3). In the rest of the measurement, value of the largest peak in the winter can also occur, i.e. in the months of January and February (18-148 µg/m^3). Given that this are the maximum values can be concluded that the concentration of solid particles in the air during the year does not exceed the limit values.*
- *Nitrogen oxides (NOx) were measured just over two years (2000 and 2001). In summer, a maximum value of nitrogen oxide (NO2) is constant and within the limits of* 28-46 µg/m^3. In the winter period the values fluctuate from 32-62 µg/m^3.

Air Quality in the City of Mostar is not currently monitored. The latest available data on air quality in the city of Mostar were from 2007 when it was in function the local stations for monitoring the air quality. In Table 6 are shown the results of measurements SO2 concentration in the air in the 1998-1999 seasons.

Table 6. Air pollution with SO2 in the City of Mostar 1998/99..

C_{sr}	C_{50}	C_{98}	C_{max}
12	5	66	107

Key to the table:

c_{sr} – the average annual value,

c_{50} – values below 50%,

c_{98} – values below 98%

c_{max} – maximum value during the year

The concentrations of pollutants 1998/99 ware less than the limit values of air quality. Given that there have been no significant changes in the sources of emission of pollutants in relation to the situation of 1998/99, it can be estimated that the current concentrations of pollutants are similar to values in Table 6, i.e. still are below the air quality threshold value for the quality of air.

3.6 Hydrogeological characteristics

The area builds high mountains in Dinaric direction. To the east is Velež, to the north is Prenj, in the northwest is Čabulja, which gradually slopes as stairs towards the south to Mostarsko Blato and Čvrsnica. From the south side of Mostarsko Blato is lower mountain Trtla exceeding the karst plateau and Humine toward Ljubuški and Metković, and extend across the south-east over Dubrava and Stolac to Ljubinje.

The highest mountain parts (above 1500 meters) have sharp mountain climate with long cold winters and short warm summers. Maximum rainfall occur from April to May and from September to November and the minimum from July to September. It is very noticeable influence of the Mediterranean climate, while precipitation significantly increased at altitudes of 1.600-2.100 m. The Mediterranean climate has an influence and deep inland along the river Neretva, and on karst fields whose altitude does not exceed 900 m. There are great variations in rainfall and frequent are prolonged droughts. Great influence on the regime of surface and groundwater has snow cover on the mountains.

A special feature of the relief of the city of Mostar provides a canyon and valley of the Neretva River. The Neretva River is canyon type in the upper course, but in Bijelo Polje enters the spacious valley which narrows in Mostar, in the Mostar's field extends from the mouth of the Buna again narrows in shallow canyon, until Capljina where again expanding.

The lower reaches of the river Neretva ends the vast delta with occasionally and / or permanently flooded fields Hutovo Blato, Metković and Opuzen's field, with the impact of sea-salted water up to Gabela on the border of Dalmatia and Herzegovina.

The area of Mostar belongs to the Adriatic basin where it developed a weak hydrographical network. The main water course is the Neretva with its tributaries Drežnica, Bijela, Radobolja, Buna and Bunica.

In the morphological and structural terms, this is a karst area of the Outer Dinarides. In addition to carbonate rocks that make up the mountainous relief, alluvial deposits of river valleys have been developed too. A special role in the development of recent hydrogeological relations has sediments of the river Neretva. In the wider area dominate structures of Dinaric direction (NW-SE), wherein the carbonate rocks in reverse relation to the impermeable flysch. Flysch layers are in the form of relatively narrow elongated zones in fault contact with permeable carbonates.

This material terrain caused the occurrence of abundant karst springs where groundwater from karst aquifers encountering a barrier built of flysch or on impermeable Neogene in zone of Bijelo and Mostar fields. It should also be noted that in the Neretva River valley, especially in Bijelo Polje, there are alluvial deposits which may contain significant amounts of water for water supply.

The Neretva is the longest and richest in water river of the Adriatic basin in the Dinaric karst. To Mostar the river has a total drop of 380 meters, and on section from Jablanica to

Mostar, 40 m. The most of the water Neretva receives in the middle and lower reaches. In the town of Konjic intermediate flow is 58 m3/s, and at the mouth of the river flow is 380 m3/s. Besides its tributary, the Neretva River receives large amounts of water from springs Salakovačka vrela, Bošnjaci and Livčina in Bijelo polje and a lot of permanent and temporary springs, from Buna and Bunica to Kuta and intermittent streams.

Hydrogeological characteristics of rocks

In the area of Mostar are represented mainly carbonate rocks (limestone prevail) with hydrogeological function transmissive area, and karst aquifers. Dolomite rocks are mediocre water permeability and local barriers to the relative movement of groundwater.

Eocene flysch (its properties - watertight) have the function of complete or "hanging" hydrogeological barriers. In the Neretva River valley were selected alluvial deposits which may have hydrogeological function of alluvial aquifers. Also the isolated quaternary clastic sedimentary rocks with low permeability were selected.

According **hydrogeological categories** or **water permeability**, all the rocks of this area can be divided into three groups:

- well permeable rocks,
- medium to low permeability carbonate rocks,
- poorly permeable rocks and
- watertight.

These deposits have a characteristic maximum infiltration of surface water, which means that all water that fall or are poured into this environment, practically no retention infiltrate into the soil and get into the zone of groundwater circulation. Because of the fracture, and often cavernous porosity this environment has minimal or practically no ability for purification of polluted wastewater.

In the medium and less permeable rocks are included dolomites, dolomitic limestone and marl limestone. In wider area, the oldest is dolomite of Triassic period (**T_3**), and dolomitic limestone of Malma (**J_3**), and the layers from period of Lower Cretaceous (**K_1**).

Further follow dolomites and limestones of the lower part of the Upper Cretaceous (Cenoman) (**K_2**). There are also included liburnian plate and marl limestone of Palaeocene and Eocene **(Pc,E).** Rocks with these hydrogeological characteristics represent a narrow and/or a broader zones within the impermeable layers. Their hydrogeological function is a such that they act as relative barriers to movement of groundwater**.**

In hydrogeological terms impermeable rocks are represented by clastic of Lower Triassic (**T_1**), marl, marl limestone of Eocene flysch (**$E_{2,3}$**) and marls of Neogene (**$M_{2,3}$**).

Triassic and Neogene sediments on the surface are represented locally in the Bijelo field and the Mostar field. They have an important function as hydrogeological barriers to movement of groundwater. Surface deposits of Eocene flysch are much more widespread. Such complexes of rocks are in a whole-impermeable, since the tightness is ensured by thickness of marl sequences. Locally can be expected weak filtering within the limestone parts in flysch complex.

Described impermeable rocks found in the area as narrower or extended elongated zone. In principle, the said zones are the hydrogeological barriers to the karst groundwater movement. Past experiences show that the said zones which are made of impermeable flysch layers do not necessarily have the function of complete hydrogeological barrier for the movement of groundwater.

Function of complete hydrogeological barriers in this area has Neogene and Triassic sediments ($\mathbf{T_1}$) in the area of Bijelo and Mostar fields. Function of hydrogeological barrier in the broad sense has actually Neretva River, which is the erosion base for all karst groundwater, since the entire porous area of the left and right waterside is "opened" to the Neretva River, so function of hydrogeological barrier to groundwater from large carbonate hinterland take quaternary river sediments.

Special importance is given to very widespread alluvial, fluvioglacial, tufa deposits, talus, and proluvial in the Neretva River valley. Hydrogeological characteristics of these layers are determined to a large extent by grain size composition and the position in space relative to the carbonate basis and seasonal changes in the water table. These deposits are covered by permeable calcareous paleorelief or in some parts by impermeable clastic Neogene sediments. In the valley of the Neretva river separated the two groups of Quaternary sediments:

1) Alluvial deposits and fluvioglacial. These sediments are made of unsorted debris, fragments and boulders surrounding carbonate rocks. They can contain a variable amount of fine clastic materials. Mostly are heterogeneous bulk materials. Mainly are permeable, so in the Neretva valley represent important aquifers.

2) Talus and proluvial deposits. They are due to the content of clay component predominantly poorly permeable to impermeable. In the Neretva River valley these deposits represent a complete hydrogeological barrier to surrounding karst groundwater in areas where their impermeable layers are in the substrate.

Hydrogeological zones

On the basis of structural-tectonic, geomorphological and hydrogeological characteristics, the town of Mostar, in hydrogeological terms can be divided into the following hydrogeological units (Slišković 1986):

- 1. Catchment area hydropower HE Grabovica
- 2. The Neretva river basin between hydropower HE Salakovac and HE Grabovica

- 3. Catchment area of Bijelo field
- 4. Basin of springs Studenac
- 5. Basin of springs Radobolje
- 6. Catchment area of Mostarsko Blato
- 7. Catchment area of Buna and Bunica

Table 7 The water body by a significant amount of ground water

No.	Title	Surface km^2
1	Mostarsko blato	233,76
2	Radobolja-Studenci	449,81
3	Prenj	453,24
4	Drežnica	71,24
5	Čvrsnica	251,50
6	Velež	294,79

3.7. Cultural-historical heritage

According to the "Cultural-historical and natural heritage for the City of Mostar, STUDY / BOOK 1 EDO PLAN, 2010," it can be said that in the area of the City of Mostar 416 sites were identified totally and documented and have been the subject of work, namely:

- National monuments 41
- Provisional list of national monuments 25
- List of petitions to designate properties as national monuments 37
- List of the institute for heritage protection 219
- Other sources 36

Preparation of the Main Design takes into account cultural-mentioned features, as well as the requirements laid down in the decisions to designate properties as national monuments, Provisional List, Threatened monuments, national monuments - the world heritage in B&H.

3.8. Biodiversity[2]

Area Herzegovina is characterized by a high degree of biological diversity of plant taxa and their communities that have a narrow area distribution. The wide height range and a very dynamic relief of karst region, which is influenced by the Mediterranean climate, has necessitated the development of very diverse climatogenic plant communities in the height sequence of vegetation: communities of oak and hornbeam (Ostryo-Quercetum pubescentis Ht. 1938), beech and fir (Abieti-Fagetum dinaricum Treg. 1957), subalpine forests of beech (Aceri pseudoplatani-Fagetum Fuk. 1958) and dwarf pine / creeping pine / (Lonicero borbasinae-Pinetum mugi Ht. 1938). Within these climatogenic phytocoenoses represented in extreme orographic-edaphic conditions (rocks, reefs, "shelves", sandbanks), as a permanent stages of vegetation, phytocenoses: hornbeam and black ash (Seslerio autumnalis-Ostryetum Ht. et H-ić 1950), black pine (Pinetum nigrae submediterraneum Anić 1957) and in higher areas whitebark pine (Pinetum heldreichii Ht. 1946). Together with canyons and gorges of the Neretva River and its tributaries these habitats are development centres of flora, fauna and vegetation expressed biodiversity and gene pool. Mesophilic habitats within the forest oak and hornbeam, in the north-exposed slopes with relatively smaller slope, take thermophilic phytocenoses of beech and hornbeam (Ostryo-Fagetum sylvaticae Wraber 1958), which also represent the permanent vegetation growing stages. On the cliffs, they have mosaic representation and often in alternation with plant communities of rocks and rock creeps. This area, inhabited by many endemic and rare plant and animal species, is the centre of conservation, formation and displacement of many species on the Balkan Peninsula. More than half of all rock-endemic species in Bosnia and Herzegovina is located in the high mountains of Herzegovina, which include: Prenj, Čvrsnica, Čabulja and Vran that is referred as an endemic centre of Herzegovina. This area biogeographically belongs to the so-called High -Prenj sector of High-Dinaric provinces within the Alpine High-Nordic region. Since ancient times mountains of Herzegovina endemic centre attracted the attention of many researchers, such as G. Beck-Mannageta and Karlo Maly, Ivo Horvat and Pavle Fukarek. Vegetation of Prenj investigated J. Pawlowski, Bjelčić, Slavnić, Šilić, Ćurić, and other. Alpine mountain zone, Prenj, Čvrsnica and Čabulja belongs to the group of transition mountains from coastal mountain to median Dinarics. In the pre-Alps and the mountain zone of Prenj and Čvrsnica develop ecosystems in rock crevices that are characterized by a high degree of biodiversity and the presence of endemic and rock-endemic communities. The characteristic vegetation units that develop in this sector are:Oxytropidion prenjae, 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 species are: Dianthus prenjus, Euphorbia hercegovina, Dianthus freynii, Saxifraga, Prenja, Amphoricarpus autariatus,

[2] STUDIJA RANJIVOSTI PROSTORA Grada Mostara, Institut za hidrotehniku Građevinskog fakulteta Sarajevo d.d., Sarajevo, CETEOR d.o.o., Sarajevo, Impro-impex d.o.oMostar; septembar/rujan 2010. godine

Campanula hercegovina, Edraianthus hercegovinus, Gentiana dinarica, Oxytropis prenja, Leontopodium nivale-hercegovinus, and others.

Ecosystems pre-mountain meadows of Bosnia and Herzegovina are now significantly degraded due to overgrazing, collecting medicinal plants and other human activities. Thermophile broadleaf-deciduous forests of the *Quercetalia pubescentis* Br.-Bl. (31) 32 forests have evolved in habitats with a specific combination of environmental factors, primarily light and hydrothermal regime, which caused that in these ecosystems develop very complex vegetation, a holder of the relatively large number of species, of which a large number of medicinal, edible and rich in vitamins, especially those that are rich in essential oils. Of the species that have significant involvement in building a community of vegetation should mention the following: black ash (*Fraxinus ornus*), hornbeam (*Ostrya carpinifolia*), *white* hornbeam (*Carpinus orientalis),* cornel tree (*Cornus mas*), smoketree (*Cotinus cogyggria*), hawthorn (*Crataegus monogyna*), Dalmatian laburnum (*Petteria ramentacea*), shrubs (*Coronilla emerus*), wayfaring tree (*Viburnum lantana*), buckthorn (*Rhamnus cathartica*), rock buckthorn (*Rhamnus saxatilis*), and other woody species.

The most important herbaceous species are: cyclamen (*Cyclamen europaeum, C. repandum*), oregano (*Origanum vulgare*), bastard balm (*Mellitis melissophyllum*), fragrant Solomon's seal (*Polygonatum odoratum*), lilly of the valley (*Convalaria maialis*), autumn moor grass (*Sesleria autumnalis*), skullcaps (*Scutelaria alitissima*), mercuries (*Mercurialis ovata*), liverleaf (*Anemone hepatica*), and others.

In extreme orographic-edaphic conditions as mosaic are represented phytocenoses of hornbeam and black ash alliance Orno-Ostryon on the stepped plateau "shelfs" in alternation with phytocoenoses of black pine and the pine (at higher position), which could be found on a very steep slopes and notches, together with phytocoenoses built by chasmophyte and heliophyte plant species in the limestone cliffs and screes. Among these plant communities there are numerous passes indicating their mutual connection as this is related to the representation of the different mix of vegetation.

On habitats that are characterized by shallow soils, which are under anthropogenic influence were developed community of thorn (*Rhamno-Paliuretum*). These communities represent degradation stages of forest and scrub community *Querco-Carpinetum orientalis*. In the northern part of the municipality of Mostar have been developed in the canyon of the river Neretva low degraded scrub hornbeam (*Querco- Carpinetum orientalis*) of typical botanical composition: *Quercus pubescens*, *Carpinus orientalis*, *Fraxinus ornus*, *Acer monspessulanum*, *Ligustrum vulgare*, *Coronilla emeroides*, *Prunus spinosa*, *Clematis flammula*, *Punica granatum*, and others. In the Mostar valley utmost importance and distribution has associations *Rusco-Carpinetum orientalis* Bleč. et Lakušić, 1966. This association is differentiated into several sub-associations such as the typical sub association (*Rusco-Carpinetum orientalis typicum* Bleč. Et Lakušić, 1966); sub-association with pomegranate (*Rusco-Carpinetum orientalis punicetosum granati* (Grez.) Muratspahić, Redžić et Lakušić) and sub-association with golden chain (*Rusco-Carpinetum orientalis petterietosum* Lakušić et al.). These communities are characterized by a high degree of

diversity, so that, for example, subas. typicum has over 30 species of trees and shrubs, and more than 80 herbaceous species).

Above this zone are less forested areas that occupy the forest of oak and hornbeam (*Querco-Ostryetum carpinifliae*) and black ash and hornbeam (*Orno-Ostryetum*). Forests of oak and hornbeam are on higher altitudes in the sub-Mediterranean area and are characterized by a great wealth of plants to different types of tree and herbaceous plants.

With edificators the downy oak or pubescent oak (*Quercus pubescens)* hop-hornbeam (*Ostrya carpinifolia)* represented are black ash (*Fraxinus ornus*), Montpellier maple (*Acer monspessulanum*), oriental hornbeam (*Carpinus* orientalis), wild service tree (*Sorbus torminalis*), rowan and mountain-ash (*S. aria*) silver lime (*Tilia tomentosa*), the Mahaleb cherry (*Prunus mahaleb*). Kind of shrubs are numerous: *Cornus mas, Coronilla emerus, Cotinus coggygria, Petteria ramentacea, Juniperus oxycedrus, Rhamnus cathartica, Rh. rupestris, Amelanchier ovalis, Cotoneaster tomentosa, Prunus spinosa and others.* In the ground flora are represented too many thermophilic species: *Sesleria autumnalis, Brachypodium pinnatum, Calamagrostis varia, Geranium sanquineum, Convallaria majalis, Galium purpureum, G. lucidum, Chrysanthemum corymbosum, Ch. leucanthemum, Melittis melissophyllum, Biscutella laevigata, Mercurialis ovata* and other. Mesophilic habitats within the forest of oak and hornbeam, in the north-exposed slopes with relatively smaller slope, take thermophilic phytocenoses beech and hornbeam (*Ostryo-Fagetum sylvaticae* Wraber 1958), which also represent the stages of permanent vegetation.

Thermophilic phytocenoses of beech and hornbeam (*Ostryo-Fagetum)* are distributed in a relatively favourable habitats, often on colluvial soils, on the northern exposures where are absent oak and hornbeam forests within which are frequently represented. They are developed at altitudes between 900 m to 980 m on Čabulja, in the canyon of Drežanka (Perutac, Striževo), Gola glava (975 m), Čvrsnica and on Prenj under V. Vidova (1451 m), and below locality Herać. These communities are characterized by great wealth of plant species, trees and shrubs and herbaceous plants. Together with edificators such as beech (*Fagus sylvatica*) and hop-hornbeam (*Ostrya carpinifolia*) are represented tree species: sycamore (*Acer pseudoplatanus*), Norway maple (*A. platanoides*), maple “gluhač” (*A. obtusatum*), black ash (*Fraxinus ornus*), European ash (*Fraxinus excelsior*), European or common hornbeam (*Carpinus betulus*), rowan and mountain-ash (*Sorbus aria*), small-leaved linden (*Tilia parvifolia*), largeleaf linden (*T. platyphyllos*), silver linden (*T. tomentosa*),and types of shrubs: *Rhamnus fallax, Lonicera xylosteum, Daphne mezereum, Staaphylea pinnata, Corylus avellana, Cotoneaster tomentosa*. A large number of species is characteristic for the composition of the ground flora of these forests: *Sesleria autumnalis, Mercurialis perennis, Asarum europaeum, Sanicula europaea, Lilium martagon, Festuca sylvatica, Melittis melissophyllum, Cardamine bulbifera, Geranium robertianum, G. sanquineum, Asperula odorata* and other. Plant community of montane beech (*Fagetum montanum illyricum* Fuk. et Stef. 1958.) were developed in the belt of mixed forests of beech and fir trees from which they were created under anthropogenic influences. Represent a transitional stage of the growing vegetation, the successive current development takes place by primary forests. Above them is developed belt of mixed deciduous forests of beech and fir

(*Abieti-Fagetum*) whose surface today is very reduced because of the destruction in the past, among other things, to obtain pastures and partly converted into secondary forests of beech. Floor of trees, beside fir and beech, make sycamore (*Acer pseudoplatanus*), Norway maple (*A. platanoides*), European ash (*Fraxinus excelsior*), the wych elm (*Ulmus montana*). There are many types of shrubs: *Rhamnus fallax, Lonicera xylosteum, L. alpigena, L. nigra, Daphne mezereum, D. laureola, Evonymus latifolius.* Also the ground flora is characterized by a large number of plant species of neutrophil character: *Asperula odorata, Cardamine enneaphyllos, C. bulbifera, Sanicula europaea, Paris quadrifolia, Senetio nemorensis, Elymus europaeus, Lilium martagon, Lamium luteum, Mercurialis perennis, Actaea spicata, Polygonatum verticillatum, P. multiflorum and other.* Ground flora characteristic are also many kinds of ferns: *Nephrodium filix mas, Athyrium filixfemina, Polystichum lonchitis, P. lobatum, P. setiferum, Phyllitis scolopendrium, Cystopteris fragilis, C. montana, Dryopteris disjuncta.* On it builds belt of subalpine beech (*Fagetum subalpinum*) which are developed on mountain Čvrsnica manely above 1500 m a.s.l. These forests are now also very reduced and discontinuous due to the repression of the past in order to obtain pastures. In addition to the floristic composition of edificators beech (*Fagus sylvatica*) and sycamore (*Acer pseudoplatanus*) and a number of floral elements of beech and fir, also the specific sub-alpine plant species are present: *Adenostylles alliariae, Ranunculus platanifolius, Luzula silvatica, Phyteuma spicatum, Allium victorialis, Cirsium erysithales, Mulgedium alpinum* and other.

Above sub-alpine beech forest communities of juniper pine or creeping pine make the highest belt of forest vegetation. Physiognomic and floristic show that live under extreme environmental conditions in particular climatic conditions, often are dashed, with densely intertwined branches on the ground, the height of 2-3 m. With creeping pine (*Pinus mugo*) represented are sub-alpine floral elements, of different types of tree: *Sorbus chamaemespilus, S. aucuparia* var. *glabrata, Lonicera borbasiana, L. alpina, Ribes alpinum, Juniperus nana* and other., and in ground flora: *Luzula silvatica, Eryngium alpinum, Mulgedium alpinum, Viola biflora, Arctostaphyllos uva ursi, Ranunculus thora, Allium victorialis, Streptopus amplexifolius, Geum alpinum, Homogyne alpina, H. silvestris* and other.

In the area of these mountains have been developed rare and endemic plant communities such as community of European cinquefoil (*Potentilla clusianae*) on reefs exposed to strong winds, community of Prenj's saxifrage (Saxifraga prenjae) in gullies and sinkholes in which the snow retains long, community of silver grass-Savi (*Seslerietum argentae*) on rocky sites with a large number of endemic species. Particularly significant are community of pine munika- Bosnian pine (*Pinetum heldreichii hercegovinicum* Horvatić 1963) developed in the area around the middle course of the Neretva River, Prenj at 1400-1800 meters. This is the habitat of chamois. Munika- Bosnian pine individually or in groups, occurs on mountain Čvrsnica and Čabulja communities in high mountain communities or sub-alpine beech and creeping pine. This kind on the mountains of Prenj's sector builds a separate variety *P. heldreichii var. leucodermis* (Ant.) Markg. according to Fukarek (1966) in this area Munika – Bosnian pine builds plant communities: *Amphoricarpo-Pinetum leucodermis* Fuk. 1966 that

develops on Prenj at an altitude from 1300 to 1800 m, in the wind exposed very narrow dolomite reefs. Within this community there are numerous endemic species such as: *Amphoricarpus neumayeurei, Dianthus prenjus, Thesium auricilatum, Hieracium villosum*.

Besides xerophilous species of rocky phytocenoses, a greater proportion has the kind of alliance Orno-Ericion H-ić. In some stands black pine (Prenj-Ruište). Communities of *Senecio-Pinetum leucodermis* Fuk. 1966. that develop on Prenj also include endemic species, such as *Senecio vissianianus* and *Sesleria* coerulans. Of the species black pine forests alliance Orno-Ericion are common Calamagrotis varia, Scabiosa leucophylla, Erica carnea, Brachypodium pinnatum and others. The stands of Macedonian oak (*Quercetum trojanae*) are developed only in a few localities in the southern part of the municipality on the wider area of the site Pijesci with communities of Hungarian oak and Turkey oak (*Quercetum frainetto-cerris*), where covering smaller areas. Here dominates species: European nettle tree/ Mediterranean hackberry (*Celtis australis)*, Montpellier maple (*Acer monspessulanum*), Dalmatian laburnum (*Petteria ramentacea)*, Buckthorn/Schur/krušina (*Frangula rupestris*), shrub bladder-senna (*Colutea arborescens)*, terebinth and turpentine tree (*Pistacia terebinthus)* and others. Within the zone of the forest orographic-edaphic favourable positions, flattened fields with relatively deeper soils, habitats are forests of Hungarian oak and Turkey oak, extra-zone character. Azonal forest vegetation represent phytocenoses soft sawmills, forests of poplar and willow which belongs to a narrow strip on the recent alluvial soils of the Neretva River and Buna. Vegetation along these rivers belong to the type *Populetalia* with the most common types *Salix alba, S. purpurea*, *S. fragilis*, *S. babylonica*, *Populus nigra, P. alba, Humulus lupulus*, and so on. Level site of torrential sediments Dive Grabovice characterized by dispersing represented fragments phytocenoses gray willow. In these, in addition to a dominant species of gray willow (*Salix incana*), appear thermophilic and heliophilous elements, mainly individually represented, of tree species *Ostrya carpinifolia, Fraxinus ornus, Carpinus orientalis, Pinus nigra. Larger or smaller groups listed species are often divided by numerous torrential ravines. With them, the presence of many herbaceous and semi-woody plant species of heliophil character, adapted to sterile calcareous detritus, and most are: Lasiagrostis calamagrostis, Epibolium rosmarinifolium, Tussilago farfara, Melica ciliata, Scabiosa graminifolia, Satureja subspicata, Salvia officinalis, Onosma stellulata, Sesleria tenuifolia, Saponaria bellidifolia, Peucedanum officinale, Moltkia petraea. Of particular interest is the endemic communities of Tilovina with gray willow* (*Petterio-Salicetum elaeagni*, Redžić and sur. 1992), that develops on habitats around Mostar and upstream along the Neretva, where varies considerably the water level during the year, so that during the summer season, these communities suffer physiological drought. Vegetation in groove and rocks in considered area includes communities of *Moltkio-Inuletum candidae which* are the most thermophil communities on the rocks of southern Herzegovina; in Canyon Buna, and *Teucrio-Seselietum globiferi* which was also developed at the hottest canyon cliffs of the Buna River.

Forests and thickets in the zone are hornbeam, due to intensive logging, grazing and tillage equipment, subject to degradation. Thus gradually are formed rocky pastures and dry meadows. The most important line of vegetation of dry grasslands and rocky pastures of the

eastern coastal belt is *Scorzonero-Chrysopogonetalia*, characterizing the grass hrđobrada and zmijka, which mainly coincide with the belt of forest vegetation climatozonal fresh black and white hornbeam (*Ostryo-Carpinion orientalis*). On the steeper slopes and slopes exposed to storm are formed rocky pastures Grass and Common sage, a mixture of Stipa (grasses) and Salvia officialis, sage plants (*Stipo-Salvietum officinalis*). All of the grassland community are in the original form extremely diverse and characterized by a large number of species, and classified into a number of associations and facies, depending on the degree of degradation and exposure of soil, which depends largely on the impact and exploitation by man (pastures, hay meadows). Community of zmijak and grass hrđobrada (red Scorzonero-Chrysopogonetalia) are related to the sub-Mediterranean and Mediterranean-mountain belt (i.e. Area distribution of Quercus pubescens), while red sharp vlasika and kostrika (Cymbopogo-Brachypodietalia) are typical for the euro Mediterranean zone (i.e. The area of holm oak).

In plain areas, along agricultural area with supporting ruderal and weed communities (eg. Nitrophilic Chenopodietea vegetation class, paths and tread and Plantagineteamajoris, etc.), are the abandoned lands with shrub plant (Rhamno-Paliuretum). The soils have been developed, but the share of typical rocky heliophitic (sun-loving) plants reduced. Part of the area is under crops, mainly stands of cypress (*Cupressus sempervirens*) and fragrant pine (*Pinus halepensis*). The primary forest vegetation is long-lasting negative anthropogenic impacts heavily modified (unplanned logging, deforestation and usurpation of land, pasture and bud cattle, cutting fodder, and in the last twenty years, frequent forest fires in wider areas), which is, otherwise, a characteristic of broad sub-Mediterranean expanse Dinarides. In the real forest vegetation dominant place belong to forests of oak and hornbeam. Although different degraded, these forests have retained their rich floristic composition species dendroflora. They are represented by tree species, besides oak and hornbeam, flowering ash, Montpelier maple, Tilia argentea/ linden, service tree and wild service tree and in some parts even the Macedonian oak (Quercus Trojans), which is the Illyrian subendem. Further regression and destruction of shrubs formed phytocenoses of rocky terrain which are represented by perennial herbaceous semi-woody plant species, often greater cover and Physiognomic feature of this plant communities provide: sage (Salvia officinalis), winter savory (Satureia montana), Immortelle (Helichrvsum italicum), barberry (Spartium junceum). At the sub-Mediterranean forest habitats in places were established forest cultures of coniferous trees: Aleppo pine, black pine, maritime pine and cypress. The importance of this sub-Mediterranean forest vegetation is, primarily, to its outstanding ecological (protective) function: mitigating climate extremes, particularly of the wind and sunlight, soil protection and preventing its erosion, the regulation of the water regime, the absorption of carbon dioxide and release oxygen, the purification of air, biodiversity, etc. From the point of production functions, due to degradation of forest stands, use of timber is very limited and it mainly as an energy source and the stakes for the purpose of agriculture, and partly as a small technical wood. For the same reason forests in this area have primarily protective role while the economic aspect is almost negligible. Of other forest products, sub-Mediterranean forests and forest habitats are characterized by the presence of a large number of medicinal and edible plants, whose use is sporadic and disorganized. In these forests and forest habitats

exists a large number of plant species which are honey, and a perfect base for development of beekeeping.

Strong influence of man on the primary (forest) and secondary (meadow) ecosystems in the process of further degradation occurs tertiary vegetation, mostly on the soil with anthropogenic nature, which are to a significant extent degraded in terms of basic physical and chemical properties and are usually rich in nitrates for which this vegetation have title Nitrophilous vegetation.

Nitrophilous vegetation is most often developed in the vicinity of human settlements, roads, industry, etc., and in all those places where it is expressed any human impact (disposal of solid and liquid waste materials, disposal of land and garbage, digging soil, air pollution, etc.). It should be noted that in the framework of this vegetation does not come endemic and relict plant species, especially in the area of mountain and lower mountain belt (in the subalpine zone known as endemic species are some species that are a part of this vegetation such as Plantago reniformis and Barbarea illyrica). In the organic and phytopcenosis view the vegetation of tertiary ecosystems is differentiated in the number of types: (1) the vegetation in moderate wet nitrified habitats order Onopordetalia, (2) vegetation in wet nitrified habitats order Bidentetalia, (3) the vegetation in dry nitrified habitats order Artemisietalia, (4) vegetation in nitrified trampled habitats order Plantaginetalia maioris. Ruderal communities in the area of the municipality Mostar cover large areas, because the area is under significant anthropogenic influence. This group of communities include trampled habitats vegetation (ass. Lolio-Plantaginetum majoris), habitat vegetation nitrophile (Chenopodietea class), stagnant water and stream (row Bidentetalia Tripartita) etc. Widespread weed species are a huge threat to the natural vegetation, they will be glad to settle on any barren (degraded) surface, thus preventing the return of native species.

Flora

Bosnia and Herzegovina still does not have an official Red Book of flora, so the status of individual plant taxa from the study area is given in accordance with the List of rare and endangered and endemic plant species (Šilić,1996). In the area of the City of Mostar grow rare and endemic plant species such as the Herzegovina devesilje (Seseli hercegovinum) (typical endemic species that grows in rock crevices and on the rocks on Prenj, Čvrsnica and mouth of Diva Grabovica, blue Lasinja (Moltkea petraea) which grows in rock crevices on Prenj and Čvrsnica in the Neretva canyon and Diva Grabovica canyon. Rare species are: Herzegovinian woodruff (Asperula Herzegovina) Degen, Herzegovinian bellflower (Campanula Herzegovina) Degen & Fiala (Prenj, Čvrsnica, Čabulja), the Herzegovinian bells/ Rock Bells (Edraianthus hercegovinus) K. Maly (Čvrsnica), Croatian sibirea (Sibirea croatica Deg. Et Bald.) at the Prenj and Čvrsnica, species Leontopodium alpinum (L.) on the Prenj and Čvrsnica, Prenj's saxifrage (Saxifraga contrasts) the mountain grasslands and Herzegovina spurge (Euphorbia Herzegovina, and star sharp leaf (Onosma stellulata), Croatia mint (Micromeria croatica), Dalmatian insect-flower, Dalmatian pyrethrum (Tanacetum cinerarifolium). Rare species are *Reichardiabmacrophylla, Peucedanum neumayeri,* while *Acinos orontius is* vulnerable species plant (IUCN category V). Endemics

are melendorfova žumenica (*Alyssum moellendorfianum*) Aschers. Ex G. Beck) (slopes of Prenj), Handel-Macetijeva mišjakinjica (*Minuartia handelii*) Mattf.(Čvrsnica – Veliki Vilinac).

Vulnerable species are: *Freynov karanfil* (*Dianthus freynii*) Vandas (Prenj, Čvrsnica), Prenj's oštrica/ Prenj's locoweed (*Oxytropis prenja*) (G. Beck) G. Beck in Reichenb. & Reichenb. Fil. (Prenj, Čvrsnica, Vran), Herzegovina's devesilje (*Seseli hercegovinum*) K. Maly (Prenj, Čvrsnica, Grabovica, Neretva, mouth of Dive Grabovice, above mouth of Drežnice in Neretva). After the peripheral part of this area is growing Dalmatian Laburnum, (*Petteria ramentacea*). Of coniferous species are especially significant black pine (Pinus nigra), which in this area occurs singly or in small stands on the cliffs up to 1200 meters above sea level. White pine (Pinus silvestris) is less common.

Fauna

The number of different habitats in the wider region of Mostar indicates a high degree of biodiversity which points to the ecological sensitivity of the area. Mammals (Mammalia) are represented by 43 types which are members of different 16 families (Insectivora, Soricidae, Chiroptera, Lagomorpha, Myocastoridae, Sciuridae, Muscardinidae, Microtidae, Muridae, Canidae, Mustelidae, Felidae, Suidae, Bovidae, Cervidae). Among them is particularly important for relatively stable population of large carnivores wolf which, however, are very rare in most of Europe. Inaccessible regions of the mountains in the municipality of Mostar are suitable habitat for mountain game. According to the literature here live: chamois (Rupicapra) (Čvrsnica is among the highest and richest hunting of chamois - Mihic, 1973), bear (Ursus arctos), roe deer (Capreolus capreolus) - mostly on Prenj in Borašnica around Borak in deciduous forests. Significant species are wild boar (Sus scrofa), hare (Lepus europaeus), wolf (Canis lupus), fox (Vulpes vulpes), pine marten (Martes martes), marten (Martes foina), wild cat (Felis catus) and others.

Ornithofauna is very large and is represented by some authors with 163 species, however, states much larger number of birds including migratory species. Among the most important species of birds are found capercaillie (Tetrao urogalis) that lives on the cliffs Muharnice and its forests, imperial eagle (Aquila helliaca) on Prenj and Čvrsnica and partridge (*Alectoidis graeca*). Sandbanks and shallows are important for migration of waders, terns and gulls, reeds and the water moving and wintering of ducks, meadows and cutters for different songbirds.

In this area, nesting even some endangered species such as the bittern and the ferruginous duck, so reeds are important for nesting and various species of porzana, Gallinago gallinago and Acrocephalus paludicola /warblers.

Reptiles (Reptilia) are relatively numerous and represented with 20 species. These types are members of 7 families (Emydidae, Testudinidae, Gekkonidae, Lacertidae, Anguidae, Colubridae, and Viperidae), among which is the largest family Colubridae to which belongs 10 types of reptiles of this region. It is important to note that here live three endemic species (*Lacerta oxycephala, Laurenti, Podarcis melisellensis* and *Algyroides nigropunctatus*).

Amphibians (Amphibia) are relatively numerous given the significant presence of wetland and other aquatic habitats in municipality of Mostar. This group includes 12 species, of which two types of representatives of families Salamandridae, two species of the family Bufonidae, one species of the family Discoglossidae and Hylidae, while the largest family is Ranidae which five species of amphibians are significant for this area. According to ihtiofauna watercourses in Mostar municipality is represented by species from nine families from which the most dominant is family Cyprinidae, which includes 14 species

The family Salmonidae is represented with two types, and the remaining seven families of fish (Anguillidae, Ictaluridae, Cyprinodontidae, Cobitidae, Blenniidae, Gasterosteidae, Centrarchidae) is represented by one species. Especially important is to emphasize endemic species: Podustvu (Hondrostoma kneri Heckel), Sval (Leuciscus svalize L.), Zubatak (Salmo dentex L), and significant kind *Phoxinellus adspersus* related to the underground habitats. The largest group of invertebrate are insects (Insecta) consisting of 47 types of diptera (Diptera), 125 types of butterflies (Lepidoptera), 57 species of beetles (Coleoptera), 206 types of hymenopter (Hymenoptera), one type homopter (Homoptera), 6 types of True bugs (Heteroptera) and 31 of the dragonfly (Odonata).

Fish fauna (ichthyofauna) in the Neretva river and reservoirs near the motorway zone is represented with species from nine families of fish. The most numerous are the representatives of the carp family (Cyprinidae) with 14 species. Family trout (Salmonidae) is represented by two species, while other families (Anguillidae, Ictaluridae, Cyprinodontidae, Cobitidae, Blenniidae, Gasterosteidae, Centrarchidae) are presented only by a kind.

Amphibians (Amphibia) are also numerous. Here live the representatives of the families Salamandridae, Bufonidae, Discoglossidae and Hylidae, while the most numerous representatives belong to the family Ranidae.

Reptiles (Reptilia) are one group of animals to a high degree of diversity in the zone of the motorway route. According to the literature, as well as on the basis of field research, it can be concluded that this group is represented by about 20 species. The most numerous are the representatives of the family Smuk (Colubridae) with 10 species. The wider area is also home to three endemic species: Dalmatian lizard (Lacerta Dalmatocerta oxycephala or oxycephala) Adriatic lizard (Podarcis melisellensis) and brown lizard (Algyroides nigropunctatus).

Birds (Aves) are numerous and according to data from the Life project in this area can be found 163 species. There are also numerous migratory bird species that come to Hutovo Blato nature park and bird reserve, which is located only a few kilometres south of Pocitelj

The shallow water and sandy shores are important for migrating species Ćurlin (oedicnemus crepitans) while the meadows and thickets are also important habitats for birds. Here one can find certain endangered species of birds such as the American Bittern (Botaurus lentiginosus) and the ferruginous duck (Aythya nyroca).

Literature data indicate that in the area of the motorway can find mammals (Mammalia) from families: *Insectivora, Soricidae, Chiroptera, Lagomorpha, Myocastoridae, Sciuridae,*

Muscardinidae, Microtidae, Muridae, Canidae, Mustelidae, Felidae, Suidae, Bovidae, Cervidae.

In this area actively hunting club "Jarebica", established in 1994. From 2015, has signed a contract to use sports and economic hunting area "Čabulja" with about 40,000 ha. From 2015, has signed a contract for the use of sports and economic hunting "Čabulja" with about 40,000 ha.

Protected areas

According to the Spatial Plan for Bosnia and Herzegovina from 1980 in the category of the most valuable unit of natural heritage as a national value (object or area of natural heritage, which means uniqueness, rarity or uniqueness in B&H.) is protected Park Prenj which has a level of protection I-IV. According to the Spatial Plan for Bosnia and Herzegovina from 1980 the category of nature reserve in the area of the City of Mostar includes the following areas: • Regional value Blidinje lake, municipalities Tomislavgrad and Posušje, surface of 92.4 ha. The degree of protection I. • the local value

The river Neretva, Mostar municipality, measuring 150 ha. The degree of protection II-IV. Source Bunica with the lake and the mouth of the Neretva River. Mostar municipality, with an area of about 4 ha- degree of protection I.

Source Radobolje, municipality of Mostar (Ilići) area of 4 ha. The degree of protection II. According to Section 7 and Article 25. - Special measures to protect nature, the existing Law on Nature Protection in Federation of Bosnia and Herzegovina - The protected area is defined as an "area of land and / or sea specified for the protection and maintenance of biological diversity, natural and cultural resources." According to legal guidelines from the same point the following categories of protected areas are envisaged: • Protected natural areas established for scientific purposes or for the protection of wildlife; • National parks established for the purpose of ecosystem protection and recreation; Nature monuments established for the purpose of conservation of specific natural features, • Protected landscapes created for the preservation of terrestrial landscapes, coastal areas and recreation.

NP Prenj-Čvrsnica-Čabulja

This nature park includes portions of Prenj, Čvrsnica, Čabulja with a part of the watercourse of the Neretva River and its tributaries. Within this park Diva Grabovica because of exceptional natural beauty and rare flora has the most stringent protection regime. Facilities and units of this category belong to the inventory of the national natural heritage. Currently, this area has the status of a significant area of natural heritage (natural parks Prenj, Čvrsnica, Čabulja), based on Article 30 of the Law on the Protection and Use of Cultural and Natural Heritage (Official Gazette of SR B&H No.20 / 85) according to which all that was recorded as natural heritage has treatment of protected object. According to the Law on Spatial Planning (Official Gazette of FB&H, No. 52/02, Article 16 and Article 80) and the Nature Protection Act (Official Gazette of FB&H, No. 33/03, Article 27 and Article 30) was presented a proposal for the designation of areas "Prenj-Čvrsnica-Čabulja" as area of

importance for the Federation of Bosnia and Herzegovina and the declaration of a protected area - national park. Draft Law on National Park "Prenj - Čvrsnica - Čabulja -Vran", 26.06.2007. (02-02-598 / 07 Government of the Federation B&H), the decision on designation of Prenj, Čvrsnica and Čabulja as areas with specific characteristics of significance for the Federation of Bosnia and Herzegovina, and a proposal for the designation of Prenj, Čvrsnica and Čabulja as areas with specific characteristics of significance for Federation of Bosnia and Herzegovina provided the following explanation:

Article 19 and Article 23, paragraph l. Law on Spatial Planning and Land Utilization in the Federation determine that the Federation Parliament brings spatial plan for areas with special features and a decision on preparation of spatial plans of areas with special features, so for the areas that have been declared as areas of special features in 2007 by the decision of the Federation Parliament are necessary to make decisions to start with the development of regional plans for these areas as well as the decision on the establishment of these areas as areas of importance for the Federation of Bosnia and Herzegovina.

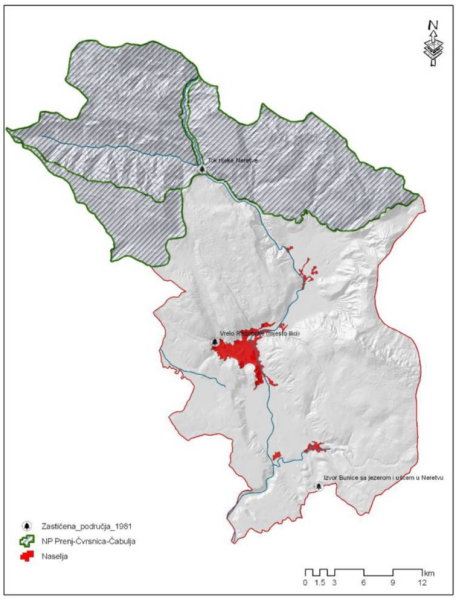


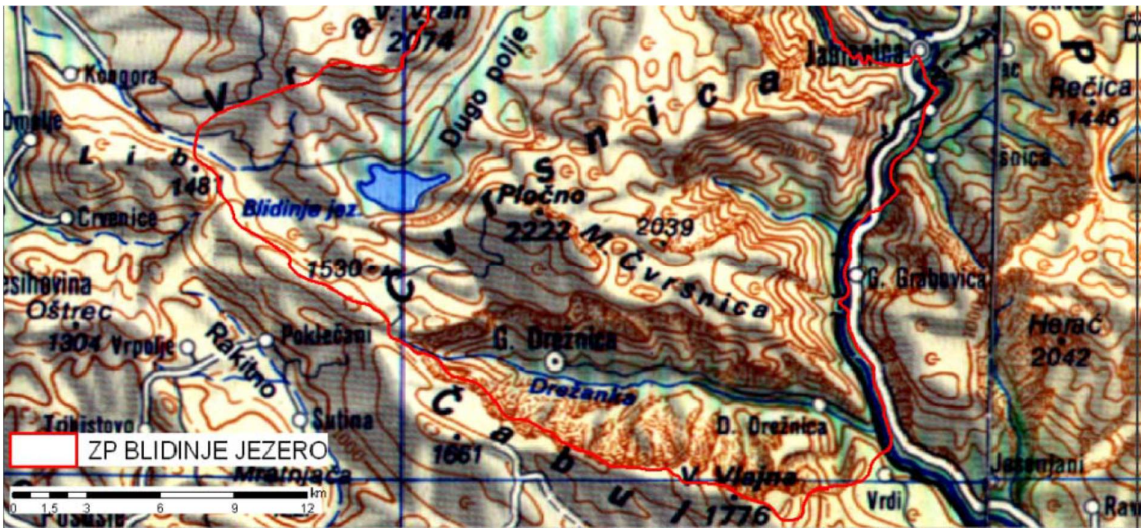
Figure 6. NP Prenj-Čvrsnica-Čabulja

Natural park ”Blidinje”

In the area of the City of Mostar is a protected nature park "Blidinje". This protected area has historical and legal continuity of care, since the fifties. Current activity in this area is its re-categorization to the IUCN guidelines. The protected area includes approximately 456.9 km 2 (the data are only approximate, and is obtained by digitizing the park boundaries, which are also a lot generalized on the map). The park is bounded by mountains Čvrsnica (2228 m),

Plasa (1721 m), Čabulja (1780 m), and Vran (2074 m). At an altitude of 1150 - 1300 m is located the wide field 25 km long and 3-5 km wide in which is the Blidinje lake.

In the nature park there are about 1,500 different species of plants with a large number of endemic species such as Bosnian pine (Pinus heldreichii var. Leucodermis) that in the area of Masna luka build the largest association of this kind in Europe.



Continuing existence of heterogeneous flora and fauna is recorded in this area. Even the last two glacial epochs recorded in this area have not stopped animal process.

Some plant and animal species have managed to survive this natural disaster, such as several types of “encijal”, surviving endemic ice age, and the great “tritron”, endemic species. Flora of this park is rich in a variety of Mediterranean and mountain plant species including a large number of endemic species, such as special types of mushrooms and Bosnian pine. Bosnian pine grows in the area of Masne Luke and its environment represents the largest forest complex of its kind in Europe. Among the large number of animal species that live in the park, it is important to mention the king of the forest brown bear and decoration of the tops of Čvrsnica –chamois. Very rich fauna includes three rare species: mountain salamander (Salamandra atra prenjensis), a brown bear (Ursus arctos) and chamois (Rupicapra). This primarily refers to the mountain Prenj, Čvrsnica, Vran and others which are located within the park, so this set of mountains in phytogeography called the Herzegovina endemic development centre, because of a large number of endemic plants, where some of them exist on these mountains only and others are represented in the wider areas of the Dinarides..

3.9. Soil and agricultural lend

Through the EIS in March / March 2007 was analysed the route of the Corridor Vc, LOT 4, in terms of agricultural and forest land in a width of 250 m on both side of the axis of the road. Land use will be given to the basic division of agricultural land into three subcategories (agro-zone) as follows:

- ✓ Agro-zone I - Highly valuable agricultural land
- ✓ Agro-zone II - Medium valuable agricultural land
- ✓ Agro-zone III - Less valuable agricultural land

Agro-zone I - Highly valuable agricultural land (map code a1)

This zone is the most valuable agricultural land where is organized an intensive production of vegetables, fruit, grapes, herbs, flowers and seedlings (1-4 land cadastral or land suitability grades). It is found in natural and very gentle terrain to 5% slope in valleys of the Neretva, Buna, Bunica and Trebižat, and in karst fields (Mostarsko polje). On these areas are used systems for drainage and irrigation of agricultural land with the use of modern machinery and production system in closed and controlled environment, respectively the greenhouses and hothouses (made of plastic and glass).

Agro- zone II– Medium valuable agricultural land (map code a2)

This zone represents medium valuable agricultural land where is organized production of vegetables, fruit, grapes, herbs, flowers and seedlings that because of reducing opportunities for use of the irrigation is not intensified to the extent as in the Agro zone I (land or cadastral or land suitability 5-6 class). In addition to the above culture on these soil is a common meadow culture.

Agro – zone III– Less valuable agricultural land (map code a3)

Compared to the other two categories this agro-zone mainly includes shallow, skeletal and rocky, poorly productive agricultural land with steep slopes up to 30% and with very great limitations in the use of machinery. On these lands are mainly organized grazing livestock and collecting medicinal herbs. The agro-zone III represents the weakest agricultural land that cannot be specifically protected, in essence they are the least valuable space that could be used for designing and planning the construction of the route.

Through "The study of the environmental impact of the motorway on Corridor Vc Mostar North - the southern border", LOT 4 -km 0+000,00 - 67+329,00 (March 2007) we analysed the route of the Corridor Vc LOT - 4, in terms of agricultural and forest lot in width of 20 m and 250 m from both sides of the road axis.

By the analysis were separated four (4) categories of land (agricultural land, forest and forest land, water and other land) and their surface were identified according to two criteria. The first refers to land within the scope of 40m which will be fully in function of the motorway construction (the space between the two fences) and the other on the land in the area of the potential impact of transport on land management.

The following was used:

1. The submitted digital data
    - ortho-photos of the terrain
    - Layout of the route from Preliminary Design
2. Data collected in the field (photographic record of field)
3. Existing legislation and technical literature.

Within the agricultural land are determined three (3) sub-categories (AGRO-ZONES) of agricultural land (code «a1», «a2» and «a3»), and 3(three) subcategory of forest and forest land (code «S1», «S2» and «S3»). Also determined are the other land surfaces (construction land and roads- code "o") and the water.

As a final result of the analysis were made thematic maps as follows:

Map 1: layout of land categories in area of the route of the _500 m

Map 2: layout of land subcategories in area of the route of the _500m

Map 3: layout of land subcategories in area of the route of the _40 m

(Map 1 is the graphics attachment No.12.3.8.1., Map 2 is the graphics attachment No.12.3.8.2., while the third map was created but is not among attachments to studies, because it is seen on the previous map - Map 2)

These maps are provided as attachments to the "Environmental Impact Assessment of the motorway on Corridor VC" Mostar.

3.10. Landscaping

The basic elements of the landscape in the analysed area are:

• Natural systems (forest)

• The system created by human activity (agricultural land, settlements and infrastructure).

Settlements are closely linked to the transport system and beyond that, with natural morphology. Landscape of the area to be analysed in the study looks like a continuation and integrates with existing natural environmental characteristics. Thus the landscape is in a very sensitive equilibrium with characteristic values (natural and human).

3.11 The specific elements identified in the previous EIA

In carrying out the procedures of environmental impact assessment, in phase prior to impact assessment, the Consultant did not receive written comments relating to subsection Stanojevići- Buna-Mostar South-Suhi Do. Implemented procedures for environmental impact assessment are described in detail in the introduction to this study.

4. DESCRIPTION OF LIKELY SIGNIFICANT IMPACTS OF PROJECT ON ENVIRONMENT

"The environmental impact study of the motorway on Corridor Vc Mostar North - South border," LOT 4 - km 0+000,00 - 67+329,00 (March 2007) is a detailed analysis of possible impacts during construction and operation stage, including subsection claimed Stanojevići-Buna-Mostar South-Suhi Do.

The study has analysed in detail the impact on all components of the environment in Chapter 4 - "Description of the likely significant effects of the project on the environment." The above analysis has included the following components of the environment:

• Land use, land acquisition and resettlement

• Climatic characteristics

• Noise and vibration

• Water Resources

• Waste management

• Landscape and visual impact

• Cultural and historical heritage

• Economy and Employment.

In relation to the possible direct and indirect impacts, and the ability to assess the potential adverse effects of the motorway construction, consideration of this area included the belt of one kilometre on either side, the final contour lines of this great facility.

4.1. Land use, land acquisition and displacement

Study on environmental impact assessment for Lot 4 (which includes section Stanojevići-Buna-Mostar South-Suhi Do) has estimated that along the corridor of motorway, at a width of 500 m, under the direct influence will be the following soil types:

- ✓ Agricultural land - 19% (land of high quality - 33.57%, less valuable land - 55.74%, the lowest quality land, i.e. Pastures, meadows - 10.7%);
- ✓ Woodland - 77%; and
- ✓ Others - 4%.

The study listed the detailed measures to reduce the impact on agricultural land. One of the measures represents avoiding the option - scenario that the motorway route passes through

the area of this type, which is applied on the section Buna - Počitelj. Potential impacts include:

- ✓ Purchase of houses (physical transfer) that are located within the motorway corridor or the safety of their residents is threatened.
- ✓ Loss of other assets such as crops, trees, fences, barns, wells, other smaller structures.
- ✓ Loss of agricultural land (including land which is no longer feasible to use) or access to land (permanent and / or temporary), resulting in an economic relocation.
- ✓ Damage to land or goods that are not in the zone where it was carried out the purchase for the project.

Studies on the impact on the environment have indicated that there is a possibility of pollution of land along the route of the motorway that will require a ban on growing crops that can accumulate harmful and dangerous substances (eg. Lettuce, spinach, onions, chard) near the motorway.

4.2. The impact on the climate characteristics

The climate of this area has a Mediterranean and sub-Mediterranean features. However, the seasonal distribution of rainfall and temperature of the area is characterized by two opposite seasons: moderately warm and very abundant rainfall winter and beam and dry summer, as the climate of this area gives more arid than humid character

For this climate special significance is given to the north wind (Bura) and the south (jugo). Bura is a strong, cold and dry wind blowing at high speed in the fall, winter and early spring. His strength, speed and dryness affects the very quick drying of the soil and thus makes climate considerably drier than it was expressed by rainy factors.

In addition, power and speed of winds affect the removal of large quantities of the smallest particles of dry soil on the big distances. In this part of Herzegovina is highly expressed wind erosion thanks to which occurring partly to the entire complex of almost bare rocks. Construction of motorways will not have any influence to change the current microclimate.

4.3. Air quality

During the construction and earthworks, quality of air may be periodically interrupted by emission of dust, and the emission from the generator and the vehicle. During the use of the motorway, emission of flue gases from traffic will adversely affect the quality of air near the motorway. However, it is expected that the concentration of pollutants remain within the prescribed value of the FBiH. Limit values of the air quality in FBiH are prescribed by "Regulations on the manner of monitoring air quality and defining the types of pollutants, limit values and other standards of air quality" ("Official Gazette of B&H", no. 01/12). The adoption of this Regulation, inter alia, transposed the limit values for air quality from EU Directive on ambient air quality and cleaner air for Europe, which was adopted in 2008

(Directive 2008/50 / EC). Regulation defines limit values and tolerance on ambient concentrations of pollutants, and the deadlines for reaching limit values.

The limit values of air quality in the Federation of the polluting substances relevant for assessment of the quality of air in thermal power plants (sulphur dioxide, nitrogen oxides, and particulates) are given in Table 8.

Table 8: The limit values of air quality in terms of human health protection in the Federation of B&H ("Official Gazette of FB&H" no. 01/12)

Period	Limit value	Tolerance limit	Tolerance Values	The deadline for achieving the limit value
sulphur dioxide				
One hour	350 µg/m^3, must not be exceeded more than 24 times in a calendar year	150 µg/m3 (43% of the limit values), January 1, 2010, shall be reduced by 1 January 2012, and then every 12 months in equal annual percentages in order to reach 0% by 1 January 2021	500 µg/m^3	**January 1, 2021**
One day	125 µg/m^3, must not be exceeded more than 3 times in a calendar year	-	125 µg/m^3	**January 1, 2021**
Calendar year	50 µg/m^3	-	50 µg/m^3	**January 1, 2021**
nitrogen dioxide				
One hour	200 µg/m^3, must not be exceeded more than 18 times in a calendar year	50% of the limit values, January 1, 2010, shall be reduced by 1 January 2012, and then every 12 months in equal annual percentages in order to reach 0% by 1 January 2021	225 µg/m^3	**January 1, 2021**
One day	85 µg/m^3	47% of the limit values, January 1, 2010, shall be reduced by 1 January 2012, and then every 12 months in equal annual percentages in order to reach 0% by 1 January 2021	125 µg/m^3	**January 1, 2021**
Calendar year	40 µg/m^3	50% of the limit values, January 1, 2010, shall be reduced by 1 January 2012, and then every 12 months in equal annual percentages in order to reach 0% by 1 January 2021	60 µg/m^3	**January 1, 2021**
particulate matter PM10				
One day	50 µg/m^3, must not be exceeded more than 35 times in a calendar year	50% of the limit values, January 1, 2010, shall be reduced by 1 January 2012, and then every 12 months in equal annual percentages in order to reach 0% by 1 January 2021	75 µg/m^3	**January 1, 2021**
Calendar year	40 µg/m^3	20% of the limit values, January 1, 2010, shall be reduced by 1	48 µg/m^3	**January 1, 2021**

Period	Limit value	Tolerance limit	Tolerance Values	The deadline for achieving the limit value
		January 2012, and then every 12 months in equal annual percentages in order to reach 0% by 1 January 2021		
particulate matter PM2,5				
Calendar year	**25 µg/m^3**	**20% the limit values on 31.12.2011., is reduced following 1 January 2013, and then every 12 months for a year equal percentages to achieve 0% by 1 January 2021,**	**30 µg/m^3**	**January 1, 2021**

The Regulations prescribe the requirements for data quality for assessment of air quality (maximum measurement uncertainty, minimum data availability and minimum time coverage).

Thus, for fixed measurement of sulphur dioxide, nitrogen oxide and carbon monoxide, the maximum uncertainty of 15%, of the particulate matter (PM 10 and PM 2.5) 25%.Minimum availability of data is 90%. Minimum time coverage is prescribed only for benzene.

For indicative measurement, the maximum measurement uncertainty for the measurement of sulphur dioxide, nitrogen oxide and carbon monoxide is 25%, and for particulate (PM10 and PM2.5) 50%. Minimum availability of data is 90%. The minimal coverage for the measurement of sulphur dioxide, nitrogen oxides, carbon monoxide and particulate matter (PM 10 and PM 2.5) is 14%. Also, according to the Law on Air Protection ("Official Gazette of FB&H" 33/03, 04/10) according to the level of air pollution, which are determined by measuring, using standardized mathematical models and other evaluation models, there are three categories of air quality:

- I Category: clean or slightly contaminated air - area which is not exceeded the limit values (LV) for a pollutant;
- II Category: moderately polluted air - areas in which they exceeded the limit values (LV) for one or more pollutants and no exceed of tolerance values (TV) for any pollutants, and
- Category III: excessive air pollution - areas where the tolerance values are exceeded for one or more pollutants.

Monitoring air quality is obligation of the Federation of Bosnia and Herzegovina. Monitoring system is managed by Federal Hydro meteorological Institute.

4.4. Noise and vibrations

The noise caused by traffic can potentially be cause to significant inconvenience at nearby receptors. In the construction phase of the project, the level of emitted noise will be

increased, but this phenomenon will be temporary and limited to a daily period. There is no significant noise sources along the planned route on the section Stanojevići- Buna-Mostar South-Suhi Do and only a small number of residential buildings will be exposed to noise from traffic.

4.5. Water resources

The route on section of Stanojevića- Buna-Mostar South-Suhi Do passes through the area of karst, which is highly permeable and with an increased risk of groundwater contamination and therefore must be protected. Except these, there is no other water resource (e.g. water sources for drinking water supply) that may be exposed to the harmful effects of the project.

At the stage of using the motorway, the main problem in the field of water resources will be control of pavement drainage, as well as responding to cases of accidents at carriageways.

The "Study of the environmental impact of the motorway on Corridor Vc Mostar North - the southern border", LOT 4 km 0+000,00 - 67+329,00 (March 2007) highlighted the problem of water in the area of LOT 4 in which in July and August appears frequent drought, when the water flows, present on the ground, become the only source of water for agricultural purposes, supply of people and livestock. Therefore, should be paid maximum attention to the protection of water during the construction of the motorway. The planned route of the motorway crosses 5 (five) watercourses: Buna, Bunica, Neretva, Studenčica and Trebižat and intermittent streams (in winter during the wet season) Posrt and Rotimski potok. Particularly sensitive place is the space between and around the rivers Buna and Bunica, which are used for irrigation of agricultural land agro-zone a1 and for watering livestock. The situation is similar for other rivers.

The area covered by the route of LOT-4 is the catchment area of the Adriatic Sea, which means that any pollution ends up in it.

JP Autoceste FBIH d.o.o. Mostar has received decision-Preliminary water authorization for the purpose of project documentation for the construction of motorway section on Corridor Vc. The approval is issued on the basis of fact and valid for 3 years till 04.04.2017.

This document provides that the authorized person makes the main design of sewage water for motorway sections and junctions, traffic areas and facilities, crossings and roads with detailed hydrologic and hydraulic calculations.

Biodiversity and nature protection

The construction project will cause the loss and fragmentation of the surrounding habitat. Clearing of vegetation and other construction activities may cause disturbance of mammals, reptiles and nesting birds, especially on the section Stanojevići- Buna-Mostar South-Suhi Do. The route of this section passes at a distance of about 8 km north of wetland of international importance and areas of international importance for birds (IBA) - Nature Park Hutovo blato. An estimate of the impact on biodiversity, with particular focus on vulnerable habitats and species along the route of the future motorway was done in 2016.

4.6. Water management

Main type of waste generated during the construction of the motorway is the excavated soil material excess (rock and soil). Excavated material disposal sites will be managed by the contractor in accordance with the legislation of FB&H and the Waste Management Plan, whose preparation is required. Other types of waste during construction (including hazardous waste) will be appropriate separated, marked, temporarily deferred, recycled or safely finally disposed by the contractor in accordance with the legislation of FBiH. During use (maintenance) of motorway in smaller quantities will emerge municipal waste, vegetable waste, sediment, sludge from the unit for wastewater treatment, waste paint. JP Autoceste will manage the waste incurred in cooperation with this authorized companies.

4.7. Supply and transport of material, including borrow pits

A significant amount of soil will be needed for the construction of the road embankment. Borrow pits will be selected by the contractor. JP Autoceste implemented a management system that will ensure the selection of transport routes to and from borrow pits. From the very borrow pits are required to operate in accordance with the legislation of FB&H including regulations on environmental protection. Measures to mitigate the harmful effects will be applied during operation of borrow pits and relate to the transport of materials in order to avoid adverse impacts on air quality and noise emissions.

4.8. Landscape and visual impact

Motorway represents a linear structure, therefore the route of the motorway will modify the existing appearance of the landscape. During construction there will be changes in land use which will have an impact on the landscape and create a visual impact. However, these impacts will be temporary. The proposed route of the motorway on the section Buna - Počitelj will pass through a flat area, away from the village and therefore overall visual impact will be limited. Other mitigation measures to be applied:

- Removal of natural vegetation will be carried out only in zones where necessary;
- After completion of the work, all degraded surfaces will be repaired and brought to the previous state, wherein possible;
- Tunnel portals and retaining walls will be covered with natural stone so that visually fit into the surrounding landscape;
- Slopes of embankments and cuttings will be protected by planting native plant species;
- Belts of indigenous vegetation will be planted along the outside of the motorway;
- Native vegetation will be planted exclusively, vegetation with specific character of the local landscape;
- Service areas will be designed in a way to fit into the look of the existing landscape and will be built from local materials (i.e. Colour and texture).

4.9. Cultural and historic heritage

There are several zones with identified archaeological sites and cultural and historical resources on the section Stanojevići - Buna-Mostar jug - Suhi Do. The Institute for Protection of Monuments therefore required preventive archaeological research before the start of earthworks.

JP Autoceste will require Contractors on both sections to develop and implement procedures for the management of random archaeological findings in order to ensure that in the case of finding, all the works are immediately suspended and the department notified to perform the appropriate action, in accordance with the regulations of the Federation. If during the construction works reveal archaeological heritage the Contractor is required to terminate activities and inform the Investor who must notify the relevant department - to inform the institutions responsible for the protection of the heritage of the findings (Institute for Protection of Monuments of the Federal Ministry of Culture and Sport). Only after the guidance and approval of the competent services works can be continued.

The impact on the cultural, historical and natural heritage (the old core of Mostar on the UNESCO list, Blagaj and Počitelj on the Tentative UNESCO list, Hutovo Blato on the Ramsar list of wetlands of international importance and protected by the source of the Buna in Blagaj source of the Bunica, the river Neretva in Mostar area, valley Trebižat, an island on the Neretva river near Počitelj, cave Ševrljica and Green cave in Blagaj, and an unnamed cave in Podveležje);

Protected natural areas will not be affected if one respect protection measures of the Environmental Impact Study for the motorway. Given its proximity to the motorway and the permeability of karst and vulnerability of travertine barrier ecosystems is necessary to ensure protection measures in case of accidents. Source of the Buna (distance 1.7 km), Bunica river spring (1.0 km distance) and Hutovo blato (distance 3.0 km) are not directly threatened.

4.10. Economy and employment

Traffic infrastructure is one of the key factors that have an impact on economic, social, spatial and social development of individual regions and countries. Transport infrastructure in the process of realization of the purpose and use of space is reflected in the following elements:

- Allows use of natural and man-made resources;
- It affects the location of the natural capacities of the population and other spatial functions, content and purpose of the system;
- It affects the flow of urbanization, the development of settlements and the quality of the environment;
- Generates and affects the development of less developed areas;

- Enables regional, interstate and intercontinental connection and interaction of different developmental, cultural and civilizational identity;
- Improved access to markets for local producers;
- Improving opportunities for investment in the local economy;
- Possibilities for direct and indirect jobs during the construction of motorways, i.e. on construction works, procurement of construction materials and equipment and other goods;
- Employment opportunities during the use of the motorway, i.e. Management and maintenance of motorways and various service facilities (in studies of the environmental impact has been estimated that there will be about 1,000 new jobs) and indirect employment (in studies estimated about 10,000 jobs);
- Potential short-term disruption of local economic activities due to disturbance during construction and increased / interrupted traffic, for example temporary difficulties in the performance of local economic activities.

The development of the motorway will result in attracting part of the traffic that will instead regional two-lane road now use a modern motorway (2x2 lanes) containing protective measures and devices for the control of environmental pollution. It is expected that this could result in a positive impact on the environment.

4.11. Cumulative impacts

Cumulative impacts can arise when the impact of a project is combined with the influence of some other previous, current or future projects. The route of the section Stanojevići- Buna-Mostar South-Suhi Do passing an area where there are no significant air pollutants as well as noise sources so the cumulative effects are not expected.

5. MITIGATION MEASURES FOR NEGATIVE IMPACTS ON ENVIRONMENT DURING CONSTRUCTION WORK – REQUIREMENTS FOR CONTRACTORS - ENVIRONMENTAL PROTECTION ISSUES

In "Study on the environment of the motorway on corridor Vc Mostar North - southern border", Lot 4 km 0+000,00 - 67+329,00 (March 2007) are detailed measures for reducing the negative environmental impact, which can be look at the study in chapter 5. "Rating measures to mitigate the negative impact on the environment."

Measures during and after construction

5.1. Air Quality

- Ensure that all engines in construction machinery and vehicles meet the standards of FB&H and that are held regularly;
- Regularly spray roads with water and deposit soil material;
- Vehicles that transport the earth and other bulk material should be covered;
- At the construction site with dirt roads limit the speed of the vehicle, in order to reduce dust emissions;
- In the area between the road and the village plant dense vegetation with a lot of leaves in order to filter the pollutants.
- The speed of the transport vehicles should not exceed 30 km / h. Contractor should avoid unnecessary idling of vehicles.
- The Contractor shall use modern machines and vehicles that meet environmental standards in terms of emissions (complete combustion), use filters to reduce particulate emissions, supply and use of fuel which has a favourable chemical composition (low sulphur content) and efficient (safe) streaming.

5.2. Noise and vibrations

- In the phase of the main design preparation also will be done a design of noise protection, which will define the ways of protection from noise.
- Before the beginning of the motorway use the barriers for noise protection will be set up in order to ensure that the noise level in the zone to closest receptors does not exceed the prescribed value of the FB&H.

- Technical details of barriers (length, height, choice of materials) and their exact location will be determined on the basis of measurements and modelling the dispersion of noise and will be considered in consultation with the local community;
- It should make "program for planting vegetation" due to the reduction of noise levels.
- The Contractor is required to use vehicles that have isolated sources of noise (engines, exhaust system). This involves the purchase of new machinery or additional measure of installing the sound insulation, and constant maintenance of accuracy of sound insulation. In addition, the recommended work of mechanization is only in a period of 7-20 hours (in all parts of the route which is located less than 200 meters from the settlements).

5.3. Waste management

A detailed description of the waste management is elaborated in a document that is an integral part of this Study, "Waste management plan":

- ✓ The excavated material will be disposed in the vicinity of surface water and shall be protected against erosion;
- ✓ Only natural building materials (eg. Gravel) may be disposed adjacent to surface waters;
- ✓ It is necessary to carry out frequent and controlled disposal of municipal waste in the prescribed manner and establish a continuous monitoring during construction work in the presence of specialists in environmental protection. All premises with an impermeable surface should provide for accommodation and servicing of construction machinery, outside the defined sensitive zones. On site locations for the needs of workers is necessary to ensure ecological toilets.
- ✓ The Contractor is obliged to comply with the recommendations and arrange temporary landfill for construction materials, space for rinsing of concrete pumps and mixers, as well as space for washing the wheels with the appropriate clean-up.

5.4. Water protection

- ✓ Construction equipment will be stationed on impermeable surfaces equipped with adequate protection in the drainage system;
- ✓ Storm water from the area of the site will be collected in watertight tanks and treated (on or off site) before entering into the recipient;
- ✓ Tunnelling techniques will be implemented so as to avoid influence on the way of movement of ground water and to prevent the influx of surface water; and
- ✓ In case of accidental discharge of pollutants during construction will be implemented a Plan- preparedness and response in emergency situations to prevent pollution of water resources;
- ✓ Drainage of major route is divided into external and internal drainage according the law. In principle the external drainage collects rainwater from the slopes in the trenches and transfers it to culverts and further to the recipient. With internal drainage waters from

carriageways go to channels/gutters and further to filter and to the recipient. The design of drainage is done within the Main Design.

- ✓ Pavement (carriageway) drainage will be effected by closed, waterproof and controlled system that includes wastewater treatment in oil separators (lagoons and the attenuation in the zone of Počitelj) before discharge to the recipient;
- ✓ Unit for wastewater treatment will be regularly maintained by an authorized contractor and the waste sludge will be disposed according to regulations FBH;
- ✓ Protection against erosion will be conducted by means for stabilizing and plants that prevent erosion;
- ✓ Means for de-icing of roads (salt, ice melting chemicals) will be selectively applied in an optimal regime, following the weather and avoiding application of any excess; and
- ✓ The plan in case of accidental spills of chemicals on the road will be applied to prevent or mitigate possible water pollution;
- ✓ In order to reduce impacts on the river and the coast, the foundation works for the bridge support piers, retaining walls and other structures on or near watercourses will need to be performed during the months of low water levels, which are mostly during summer from June to September. During the construction should seek to avoid any pollution by oils and lubricants or other substances hazardous to groundwater or surface water. Lubricants and oils should be biodegradable. It is essential to have proper site management.
- ✓ Specific conditions will be stipulated in the water legislation:

It is necessary that an authorized legal entity makes the main design of drainage water for motorway sections and junctions, traffic areas and facilities of crossings and access roads with detailed hydrological and hydraulic calculations and appropriate drawing enclosures, and which should include facilities for the collection, treatment and disposal of waste water, under the following conditions:

- ✓ In areas of high risk of water pollution are being designed solutions that include closed drainage system and water purification to a level I class according to Regulation on classification of waters and coastal waters of Yugoslavia within the borders of the Federal Republic of B&H (SR B&H Official Gazette no. 19/80), and the Regulation on hazardous and noxious substances in the water (a III class Official Gazette of 43/07). In high-risk areas is necessary to provide fixing of the boards with a warning to the passage through the zone of high risk to water, plates with the speed limit of the vehicle and the stopping plates to the prohibition of vehicles carrying hazardous and harmful substances in the water;
- ✓ In areas of moderate risk of contamination, find solutions for the treatment of pavement wastewater which in addition to grease traps include further treatment in lagoons, filter fields and the like.

- ✓ In zones of low risk of water pollution can be carried lower protection measures i.e. purification of water from pavement only in the oil trap.

Water protection measures during the preparation and construction:

- ✓ should be applied a special way of blasting,
- ✓ material from the excavation that will not be used in construction activities must be deposited outside the risk zone,
- ✓ deposit the excavated material must not be carried out along the banks of watercourses, water protection zones, water estate,
- ✓ near watercourses should be made for use only pure material for filling,
- ✓ used water from the construction site is necessary to collect by safe system of sewers, collect it in the appropriate tanks and purify on the spot or to remote devices,
- ✓ Repair of machines and oil change should not be made at the construction site but in designated areas outside the zones defined as areas of high risk of contamination. Oily water must be purified to levels prescribed by regulations mentioned above.
- ✓ It is necessary to develop operational plans and measures in case of various accidents (for oil spills and the location of construction basis, services, asphalt plants is necessary to ask for a separate water acts).

5.5. Flora

- ✓ Access roads for mechanization, as well as sites of landfill sites will be determined in a manner to cause the least damage to vegetation. Wherever possible - it will be used the existing network of roads.
- ✓ Removal of natural vegetation will be reduced to a minimum and after completion of the works in degraded areas will again be planted indigenous vegetation;
- ✓ Surplus building materials from the excavation will be under control postponed and will not be aligned with the ground, because it destroyed large areas under indigenous vegetation;
- ✓ The ramps will be constructed in a manner to prevent landslides, erosion and adverse edge vegetation;
- ✓ After completion of the work, all degraded surfaces will be repaired and brought to the previous state, prior to the work;
- ✓ Along the motorway will be built a fence 2 m high to prevent the entry of animals;

According to the Study on the environmental impact assessment for the motorway Mostar North - Southern border, km 0+000,00 - 67+329,00, is proposed:

- ✓ On the ground and in collaboration with professional service hunting (hunters and game wardens) is necessary to consider usual paths of games and movement of wildlife and timely undertake all measures necessary to prevent damage that can be caused by hitting the wild animals with cars and properly mark respective places with traffic signalling.
- ✓ By determining travel routes and corridors for the movement of people and vehicles protect the areal from unnecessary and uncontrolled entry and movement on the hunting ground.
- ✓ In collaboration with the hunting unit leaseholders move existing hunting management and technical facilities (feeding, watering hole, hunting spots) to other locations or replace by new ones.

5.6. Land, population, displacement

- ✓ The households affected by the project will be moved to the appropriate alternative locations.
- ✓ The persons affected by the project that are considered vulnerable will be timely identified and their cases followed up and for them will be specifically defined measures of relocation and / or re-establishing income sources.
- ✓ Elaborate of expropriation and investment programs will ensure that there are funds for monetary compensation or adequate replacement for agricultural land.
- ✓ Providing compensation in the amount of the cost of full replacement of property or transfer of land will be carried out on time to avoid loss during the harvest; measures to re-establish a source of income, determined in detail in the Action Plans for displacement, will be applied also.
- ✓ The surface of the soil that will be affected during construction will be minimized and it will be ensured that access to land is not too limited or cut. Contractors and workers will be instructed that during work use only the necessary surface of the ground and stay within the marked area.
- ✓ Local communities will be consulted and informed about places crossing the road, including those for machinery and animals as well as the establishment of alternative routes.
- ✓ Where possible, on all the roads that will be affected by the construction and operation of the future motorway will be established and maintained overpasses and underpasses.
- ✓ In order to access agricultural plots, buildings and residential buildings during construction, will be provided alternative roads.
- ✓ During the preparation of Resettlement Action Plans for both sections, it will be determined whether the land in the corridor of motorways is used for growing vegetables which will be banned (in accordance with the measures proposed in the studies of environmental impact); assessment of the likelihood pollution of soil will be conducted and will be determined protection measures such as greenhouses, provided help in

changing agricultural practices for growing plants and vegetables that will not be affected by pollution, planting trees along the motorway in order to protect agricultural land from dust, wind and pollution.

5.7. Economy and impact on the social situation

- ✓ Contractors will hire workers from the local area, whenever it is possible (depending on the qualifications and skills);
- ✓ Procurement policy will give preference to local suppliers;
- ✓ In order to reduce obstacles during construction and provision of alternative access roads will apply good international practice;

In addition to ensuring adequate resources for personal protection for all workers, other measures will include the following:

- ✓ Preventive health examinations;
- ✓ Details of engaged workers and accommodation of workers, who are not from the local area, have not yet been defined (contractual terms will be fixed). However, contractors will be encouraged to use local labour and local suppliers. Additional measures will be the following:
  - Code of Conduct for workers will be defined and will set requirements in terms of their behaviour and integration into the local community;
  - The need for accommodation will be estimated and labour camps will be established in accordance with good international practice;
  - It will be implemented procedure for resolving complaints of workers and local communities.

5.8. Culture landmarks

- ✓ Cultural, historical and natural heritage: the greater distance from the protected area, control the quality of air, water, soil, control the disposal of materials and waste, especially hazardous waste, organizing traffic during the construction work, cooperation with institutions;
- ✓ For the Protection of the Cultural and Natural Heritage, reclamation of damaged land, etc.;

5.9. Infrastructure and transport

- ✓ Timely maintenance and rehabilitation of local roads that are used during the construction of the motorway;
- ✓ Provide adequate water supply in situations when it is expected the local disruption in supply;

- ✓ Measures ensuring continuous supply the local population with water and electricity will be undertaken.

5.10. Other mitigation measures

- ✓ Building contractors will sign a contract that will oblige contractors to follow the practice of environmentally friendly construction, i.e. in accordance with the applicable regulations in the field of environmental protection, during all activities of construction works and to minimize damage to vegetation, soil, groundwater, surface water, landscape and obstruction of settlements and local communications.
- ✓ The application of environmental protection measures and mitigation of the negative effects and monitoring will be carried out in parallel with all the activities at the site.
- ✓ The Contractor is obliged to appoint a person with appropriate education and practical experience in environmental protection, which will be responsible for ensuring coordination and monitoring of all works with the laws and objectives of the system of environmental protection, safety at work and fire protection. That person will for and behalf of investor (according to the relevant administrative bodies and inspection) submit the relevant reports on the execution of environmental protection measures (monthly and final) when operating on the route, possible problems and how to troubleshoot these problems. In addition that is the first person responsible for coordinating the monitoring to be carried out by contractor or specialized organizations. For all of these duties Contractor can hire the specialized company (with the authority to do the job) to act in his name and to lead these activities and responsibilities.
- ✓ The measures to be met by the Contractor relate to the strict adherence to the order, discipline and professional responsibility of all employees on construction sites and work sites. Work, retention and stay should be exclusively in the zone of works (inside the fence) and should avoid injuring of space, property and crops of local people. Nevertheless, it is necessary at the level of general Contractor to make contact with representatives of the local people (local communities) and maintain regular communication with the aim of exchanging information and resolving any disputes (arising from the infringement of property rights, the damage incurred in the execution of the works, etc.).

5.11. Supply and transport of materials

Contractor's obligations is to obtain materials from quarries, borrow pits, separation, and the concrete mixing plant of asphalt or all entities with a valid environmental permit. It is necessary to keep separate records on procurement of these materials in order to accurately determine the quantity purchased and material used by companies that have fulfilled the legal obligations (at the right cost) and have a valid environmental permit issued by the Federal or County / Cantonal ministries relevant to environmental permitting. An investor should take appropriate measures to illegal manufacturers who do not have an

environmental permit in order to prevent them to sell their material to the detriment of environmentally conscientious and responsible companies that have environmental permit.

For example:

- *Make comparisons with registered capacity and amount of sold materials. If the capacity of an asphalt base is 100 t/h (has an environmental permit for the capacity) it cannot deliver 150 or 200 t/h of asphalt (if would happen if the Contractor shows higher consumption in the field of declared production). It is a simple indicator that in the delivery participate some manufacturer (illegal) which has been operating without an environmental permit (environmentally irresponsible, illegal), and with advantages (lower costs) over that manufacturer who has an environmental permit and acting responsibly towards the environment protection and due that has a higher unit costs.*

In "The works contract" should enter the item which the Contractor fined for multiple value of the illegally acquired products (asphalt, aggregates, etc.) that is installed or attempted to be installed and that it is according to the above example can be proven. In case of repetition of this offense should immediately terminate the contract with such performers, which also needs to be defined in the contract of works. In no case can be allowed to be in a significant project as the construction of a motorway and allow illegal profit to those companies and individuals who has irresponsible attitude towards the environment and that it pollute.

5.12. Specific measures on the site during construction

- ✓ The Contractor shall ensure compliance and certification of construction equipment according to the local regulations and preferred is compliance with EU standards..
- ✓ During construction the Contractor is obliged to ensure proper handling of petrol and diesel fuels, lubricants and paint and waste oil and waste materials disposed in the area outside the route in cooperation with the institution authorized for disposal. Workers who handle these substances should undergo additional training.
- ✓ The Contractor shall use biodegradable lubricants and gear oils. Maintenance, filling and cleaning of machines must perform off-site and outside the area of surface water.
- ✓ During motorway construction the Contractor shall apply continuous spraying of blank surfaces and use the covers to cover the dried material.
- ✓ The Contractor shall provide the conditions to avoid any deposit of material in the bed of the river and along the banks of the watercourse.
- ✓ The Contractor is required to provide the controlled garbage removal. Uncontrolled disposal of waste must not be allowed. The waste should be collected in accordance with the contract signed by the Contractor with the relevant company for collection of waste.
- ✓ The duty of the Contractor is preparation of the Study of Environmental Protection which will include all the requirements of the EIA and environmental permits.

- ✓ The duty of the Contractor is preparation of the Waste management plan which among other should define locations for disposal of excess material.
- ✓ The Contractor shall obtain all necessary permits for disposal of surplus materials, and other permits requesting the legislation in force.
- ✓ In addition to creating, updating and implementation of this plan, the person in charge proposes measures of prevention, reuse and recycling of waste and supervises compliance with legal requirements for waste management and submits a report in writing.
- ✓ The Contractor shall draw up intervention plans in the event of a leakage of fuel and lubricants, which includes a program of emergency cleaning in case of unforeseen leak of fuel, oil, chemicals or other toxic substances. The plan should include at least the following:
  - o Designate teams to react in case of leakage with clearly defined duties and responsibilities,
  - o Train team members to respond in the event of leak, on prevention measures and the cleaning measures and handling of toxic substances,
  - o The establishment of the reporting process of leaks which includes informing the relevant government bodies,
  - o Care and maintenance of equipment (material for absorbing, absorbing pads, pumps, bins and tanks for collecting, levers and ropes) to react in the event of leaks and means for the project area based on the types of leaks that could potentially happen,
  - o Assessment of area and high-risk operations in terms of leaks, and obligatory documents with the features of oil, the amount of oil fuel and chemicals used and stored, frequency of delivery, the method of operation, the proximity of surface water,
  - o Establish procedures for the safe removal and disposal of contaminated materials that were used to collect spilled material in soil,
  - o Ensuring the fees and cost recovery,
  - o The protocol for informing the public after the incident, the serious leaks and which procedures must be taken to avoid risks to health and safety,
  - o The implementation of procedures to ensure that Contractors that have signed the subcontract adopt contingency plans highlighting and dealing with emergencies, and that the transport of toxic materials must be registered in the project.
- ✓ The Contractor shall provide all necessary information and data necessary to produce annual reports on the environmental, health and safety of employees.

5.13. Mitigation measures after the completion of works

- ✓ Remove all temporarily constructed structures that were used for the storage of materials, tools and equipment, as well as all temporary facilities that were built and used for the accommodation of people for the purposes of site management, nutrition workers, wardrobe.
- ✓ Remove all temporary connections of site for communal facilities, as well as temporary electricity connections, and clean places of work and lead to a state of safety as it was before the commencement of works..
- ✓ All surfaces that have been used as a temporary landfill for materials, tools, equipment and machinery, as well as surfaces that are damaged to temporarily deposit of material from excavation, must be completely cleaned and repaired all the damage caused to these areas.
- ✓ All the temporary traffic signs mounted for the requirements of the site functioning and traffic regulation, must be completely removed after the work completion, and return to the previous regime of transport.
- ✓ Asphalt road surfaces disturbed and damaged during construction work need to be in accordance with the project restored by the new asphalt and ground layers, with the correct machine cutting of existing asphalt at joints with new asphalt.
- ✓ After the work and the individual phases of the works are completed, it is necessary to clean the site from all the waste building materials, timber, reinforcement, formwork and other waste. Also it is necessary to remove all temporary scaffolding, barriers and security fences and other construction tools, equipment and machinery.
- ✓ Environment affected and devastated by construction of the structure must be biologically rehabilitated. Therefore it is necessary to stabilize all of cuts, embankments and other areas, in addition to technical measures with adequate green by autochthonous plant species.
- ✓ Greening and landscaping of the remaining free soil surfaces are provided by the specific design of horticulture and should be aligned with the access roads. In this respect, the rehabilitation of the surfaces should include planning and bringing roads used in minimally-existing condition, and flattening and greening the area around the road.

During the remediation of site particular attention should be paid to the following:

- ✓ Felled trees and stumps, which are deposited at the stage of clearing but not removed from temporary sites and designated landfill, remove without causing subsequent damage and cover all recesses of the extracted landfill with material as on the surrounding ground;
- ✓ All road entrances to the building site should be arranged according to the visual requirements of the environment, and those roads that permanently remain in operation rehabilitate according to the criteria for normal traffic, depending on the class and use of roads;
- ✓ Previously formed landfills and borrow pits regulate and plan in order to fit in with the natural environment as much as possible, and to lesser extent endanger closer neighbouring buildings,
- ✓ Complete zone devastated by intervention brings into good condition, i.e. to the level of the original condition.

List of quarry, separation, concrete plants and asphalt plants that have an environmental permit is available on the website of the Ministry of Environment and Tourism (http://www.fmoit.gov.ba). Preliminary design is defined by the following:

" PLANNING AND RESTORATION OF SITE"

A. MEASURES DURING CONSTRUCTION

Since the construction activities will cause devastation of the environment, and within the planned location - the plot, after construction it is required to back in a condition that would somewhat alleviate the newly created urban space;

Before the start of work the Contractor shall develop a Plan of work organization, which will prove that he has taken into account all the environmental protection measures during construction. Work can begin after approval of the Plan by the supervising engineer.

Removing vegetation should be carried out only in the field of construction work.

Before realization for all the cuts is necessary to make mining projects. Especially for high cuts, height 20 m and more, prior to implementation besides the project of mining it is necessary to define technology and development of excavation in phases. All this should be made by the Contractor and approved by the Supervising engineer.

All quality material from the excavation is installed in the body of the embankment, while a material that cannot be incorporated into the embankment must be transported to dump for building materials at the discretion of the supervising engineer and local governments. All transport must take place on existing roads.

The noise of construction machinery may not exceed 75 dBA at 100 m from the place of work. Raising dust during operation in dry weather should prevent by pouring water on the place of work.

B. MEASURES AFTER CONSTRUCTION

1. Remove all temporarily constructed structures that were used for the storage of materials, tools and equipment, as well as all temporary facilities that were built and used for the accommodation of people for the purposes of site management, nutrition workers, wardrobe etc.

2. Remove all temporary connections of site to communal facilities, as well as temporary electricity connections, arrange and clean places of work and lead them to a state of safety as they were before the commencement of works.

3. All surfaces that have been used as a temporary landfill of materials, tools, equipment and machinery, as well as surfaces that are damaged in order to temporarily deposit material from excavation, must be completely cleaned and all the damage caused to these surfaces must be repaired.

4. All the temporary traffic signs mounted for the requirements of the functioning of the site and to regulate traffic, must be completely removed after the work is completed, and return to the previous function and regime of transport.

5. Asphalt road surfaces disturbed and damaged during construction work is necessary to restore with new asphalt and ground layers, with the correct machine cutting of existing asphalt on joints with new asphalt, in accordance with the project design.

6. After the work is completed and the individual phases of the works, the site must be cleaned from all the waste building materials, timber, reinforcement, formwork and other waste. Also it is necessary to remove all temporary scaffolding, barriers and security fences and other construction tools, equipment and machinery.

Affected and devastated environment by construction of the respective structure must be biologically rehabilitated. Therefore it is necessary to stabilize all of cuts, embankments and other areas and additionally to technical measures apply adequate planting of native species.

Greening and landscaping of the remaining free soil surfaces is provided by the specific horticulture project design and should be aligned with the access roads. In this respect, the rehabilitation of the soil should include planning and bringing roads used in minimally-existing condition, and flattening and greening the area around the road.

During the remediation of site particular attention should be paid to the following:

- Felled trees and stumps, which are at the stage of clearing deposited but not removed from sites and temporary designated landfill, must be removed without causing subsequent damage and all recesses of the extracted landfill must be covered with material as in the surrounding ground;
- All road entrances to the construction site must be arranged in line with the visual requirements of the environment, while roads that permanently remain in operation must be rehabilitated according to the criteria for normal traffic depending on the road class and use.
- Previously formed landfills and borrow pits must be regulated and planned as much as possible to fit in with the natural environment, and to lesser extent endanger closer neighbouring buildings.
- Complete zone devastated by the intervention; bring in good condition i.e. the level of the initial conditions.

7. All these works, as well as other possibly necessary repair works on the environment, are not accounted for as separate items of expense, they are considered to be costs that the Contractor should include in the unit prices of works.“

6. A DRAFT OF BASIC ALTERNATIVES CONTAINS A DESCRIPTION OF ALTERNATIVES AND REASONS FOR CHOOSING THE ALTERNATIVES, TAKING INTO ACCOUNT ENVIRONMENTAL IMPACTS

Ministry of Communications and Transport of Bosnia and Herzegovina, addressed to the Ministry of Environment and Tourism, with the Request for prior assessment of the environmental impact of building the Corridor Vc Motorway, section LOT 4: Mostar North - South border.

The study was prepared in 2006 and this document considered in detail all the alternatives and characteristics of the motorway.

The documentation that was submitted at the time, considered several possible routes among which was selected one route by application of the multi-criteria analysis and explained why the other alternatives (routes) were dropped. Alternatives are described in detail in "Environmental Impact Study on motorway corridor Vc Mostar North - southern border", Lot 4 km 0+000,00 - 67+329,00 -Chapter 7. The study was submitted to the Federal Ministry of Environment and Tourism, and as such 19.09.2007 approved by the Decision no. UPI / 03 / 02-23-4-53 / 05.

The study is available at http://www.jpautoceste.ba/

Through this Study was included in the Environmental Impact Assessment for the chosen variant as described in the section "Description of the proposed project.".

7. DIFFICULTIES DURING EIA DEVELOPMENT

During the project, difficulties were caused by lack of detailed technical basis and research as well as the anticipated date for the Study. Data for sociological analysis generally are not updated. Some data are largely taken over from the documentation that was done for the purpose of the Spatial Plan of the City of Mostar. Waste Management Plan was not available during the preparation of the Study. Also, investigated corridor of modified route is not regulated by planning documents. In period of preparing the Study on Environmental Impact Assessment the Preliminary design has been repeatedly corrected.