

# TA to connectivity in the Western Balkans EuropeAid/13785/IH/SER/MULTI

## Sub Project

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*Area: Transport Infrastructure*

Technical Assistance for preparatory studies for Project:  
Motorway on Corridor Vc – from Interchange Johovac to  
Interchange Vukosavlje (36km)

## Biodiversity Assessment Report

March 2022



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03	28/03/22	J.Sjenicic	B.Sekulovic, Z.Varkonyi	D.Savkovic, C. Germanacos	Final Biodiversity Assessment Report

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## Information Class: EU Standard

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## Executive Summary

The study area included the floodplain of the Bosna River. A biodiversity assessment survey was conducted on the Project area to better understand the Project risks and threats in accordance with the EIB Standard 3: Biodiversity and Ecosystems, EU legislation, and National legislation. The survey included fieldwork and desktop analysis to confirm the presence of critical habitats and protected species in the area, and consultation with stakeholders on the potential protection status of the study area.

The habitats in the project area are dominated by semi-natural and urban habitats, mostly agricultural land with annual crops, which are in some places intersected with very narrow and degraded fragments of soft deciduous forests, oxbow and Bosna River flow. Several types of natural habitats also can be found in the project area, but almost all are not representative, small, isolated and under pressure of invasive species and waste disposal, so they have no conservation importance.

Twenty patches of forests in the project area were identified. Fourteen forests patches are predominantly willow, five is dominated by oak, and one by alder. These forest habitats are islands of relatively natural vegetation in an otherwise modified landscape and majority of them don't overlap with the project footprint. Just one part of the alder wood, which is well developed and an example of an Annex 1 Habitat under the EU Habitats Directive, overlap with the project footprint (approx. 2,5 ha) in area of Kožuhe. With some minor adaptations to the Project plans, especially during construction, the risks to these Woods can be managed satisfactorily in compliance with the EIB, EU and national requirements. None of the found plant species in the project area is of significance for protection at global or EU level. All found plant species of interest for protection at the national level, were recorded outside of the project influence zone. The river itself does not appear to host flora or fauna or habitats of conservation significance. However the river banks may also be a natural habitat, due to changeable hydrological conditions, and damage to them must be minimized. The small streams (eight were identified) which flow into the River Bosna, which host certain protected species of fauna, which must be preserved. Otters, beavers (listed on Annex IV of the EU Habitats Directive) and European pond turtle (EN according to IUCN; Annex II of Habitat Directive; Strictly Protected by National Regulation of RS) use the small streams which flow into the River Bosna (as well as intervening areas) and which must be protected. Three areas where large and medium mammals may cross the road corridor were identified: Kožuhe ("Dijelovi" locality), Dugo Polje ("Kutlovac" locality) and Botajica ("Botajičke luke" locality), so access across these must preserved as far as possible. Despite sporadically found protected bats species, the river Bosna valley is not an important bat habitat nor contains bat roost sites. Some nationally protected and globally threatened birds species fly over the area and use habitat within it in small number as part of a wider range. None of these species' nest in the Project footprint nor buffer and Project effects are expected to be negligible due to the low numbers and densities of the birds concerned, their high mobility and their wide distribution throughout the Project. There is no amphibian species requiring special protection measures. The data collected for insects do not indicate the presence of species of conservation interest, except for sporadic sightings of *Lycaena dispar* (IUCN - NT, Annexes II and IV of the Habitats Directive). but it is insufficiently represented in the Study area for it to be considered of conservation significance.

All currently protected areas and areas planned for protection, at the national or international level in RS, are outside the project's impact zone. The Bosna River is not an Emerald Site or Natura 2000 site, and has not been formally proposed as such by the authorities. As of the present date (2021), there are no plans to implement a Regulation of Establishing the Ecological Network in Republic of Srpska. In the Spatial Plan for Republika Srpska (RS) 2015 - 2025, the River Bosna is not planned for designation as a nature conservation area, nor is it included as one of 130 sites proposed for protection, at least as far as 2025.

As well as measures to restrict the working area of the contractor, the BAR stipulates that the following actions be taken: 1. Occupying the alder wood in Kožuhe should be reduced to a minimum, and the remaining part of the wood should be protected enabling the rainwater inflow from the eastern side of the Kožuhe village by building two culverts; 2. Add culverts to maintain and preserve the flow and habitats of the small watercourses which drain into the River Bosna, and animal movements through

them; and 3. Provide adequate crossings for wildlife at three proposed locations. These actions will be included in a Biodiversity Management Plan (BMP) to be developed before construction begins. The impacts of the construction works on biodiversity will be monitored during the monitoring in the construction phase.

The BAR therefore concluded that there are no imminent plans to designate any part of the Study Area as 'protected', and that provided that several specific steps are taken, the Project effects on biodiversity resources will be acceptable and will not contravene the requirements of the EIB Standard 3, EU Habitats and Birds Directives, or of National Legislation.

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## List of Abbreviations

ARS	Motorways of Republika Srpska
BAR	Biodiversity Assessment Report
BD	Bird Directive
BiH	Bosnia and Herzegovina
BMP	Biodiversity Management Plan
CSOP	Construction Site Organization Plan
CESMP	Construction Environmental and Social Management Plan
EU	European Union
EIB	European Investment Bank
ESAP	Environmental and Social Action Plan
FA	Fishing Association
FBiH	Federation of Bosnia and Herzegovina
HA	Hunters Association
HD	Habitat Directive
IUCN	International Union for Conservation of Nature
RS	Republic Srpska

# 1 Introduction

## 1.1 General Background

Corridor Vc belongs to the Pan-European network of corridors that connects the medium part of Adriatic coast, which has a great tourist potential, especially the port of Ploče, with Corridor X in the direction of Zagreb-Belgrade and ending at the hub in Budapest. Considering the planned increase in capacity of the port of Ploče, the corridor has the potential to really improve trade links for countries in the region, and for Bosnia and Herzegovina, the corridor has the potential to increase the trade with surrounding countries and Central Europe. The project will contribute to increased traffic capacity and reduced traffic load at the existing network of main roads.

The “JP Autoputovi Republike Srpske” (ARS) is a public company from Bosnia and Herzegovina (BiH) entity Republika Srpska in charge for management of motorway construction and management, maintenance and protection of motorway operation. ARS intends to select future design & build contractor (Yellow FIDIC book) to construct the 36-km road section from Interchange Johovac to Interchange Vukosavlje (the Project), which is part of the Trans-European Corridor Vc. The European Investment Bank (EIB) is considering providing finance for this section as part of the loan agreement signed with Bosnia and Herzegovina.

ARS developed the project design in accordance with regulations of the Republika Srpska and based on requirements and standards of the European Investment Bank (EIB). Environmental and Social Standard of EIB is the document in which EIB promotes the development based on environmental protection and sustainable development in all its activities. The projects financed by the Bank need to be in compliance with the best international practices related to nature protection and sustainable development. The Bank has defined the requirements to be implemented by clients in management of environmental and social risks and impacts.

Relevant requirements of EIB related to assessment and management of biodiversity are considered in the Terms of Reference (TOR) and “Environmental and Social Standards: 3 Biodiversity and Ecosystems”. In the context of Standard 3, there are a few key directives to be taken into consideration: Directive 92/43/EC (the Habitats Directive), Directive 2009/147/EC (the Birds Directive), Directive 2001/42/EC (the SEA Directive) and Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the EIA Directive).

During the process of analysing the situation in the field and available documentation on environmental protection related to construction of Corridor Vc, section “Vukosavlje-Johovac” of length of 36 km, and in accordance with TOR and provisions of local and international regulations, there was the need to conduct the Biodiversity Assessment (BA) and to define the scope for the Biodiversity Management Plan (BMP), by reviewing characteristics of biodiversity at the project site and having in mind the existence of information that the planned section possibly contains some of habitats and species of interest for protection.

Biodiversity Assessment did not consider the areas and impacts of implementation of small Hydropower projects and the Bosnia River Regulation Project, as well as the threats that those projects could cause on local biodiversity.

## 1.2 Objectives and Principles of the Report

Main goals of this Report are to present the official information on possible presence of protected habitats and species, to consider the impacts of the project on biodiversity and finally to propose measures for avoiding, i.e. mitigation/rehabilitation measures for negative impacts or compensation measures. In short, the purpose of this report is to complete the tasks and achieve the following goals:

- Conduct a desk review to identify species potentially associated with the project area, in particular Bosna River and its associated wetlands and woodlands.
- Review information including on fish, amphibians, reptiles, birds, mammals and butterflies/dragonflies. Determine EU status of these species. This exercise should also consider downstream ecological features and discuss their vulnerability to upstream development in the floodplain/ removal of bankside vegetation.
- Conduct a terrestrial walkover/drive-over survey along both banks of the River, and as appropriate within the floodplain.

- Quantify and map areas of natural vegetation and all areas of “environmental significance” or ecosystem importance.
- Record GPS locations of any feature of interest and delineate limits/ boundaries of “natural vegetation” areas.
- Identify potentially suitable habitat for any species of conservation interest/concern, whether at national or EU level. Taxonomic groups to consider include birds (wetland birds), mammals, amphibians, reptiles and invertebrates (e.g. dragonflies).
- Produce a simple map to demonstrate the findings
- Provide an opinion as whether the Project could give rise to “likely significant negative effects” on any feature that could potentially be identified for future protection within the Natura 2000 network, or the integrity of the “site” as a whole, i.e. the Bosna River ecosystem
- Prepare a biodiversity management plan, either as a standalone document or as part of the ESMP, to avoid, mitigate or manage possible negative impacts on natural habitats.

Principles the BA and BMP are based on are the following:

- ecosystem approach – developmental tendencies of ecosystem and their near natural structure are to be used as much as possible for achieving the goals;
- sustainability and multifunctionality – measures and activities have to be such as to ensure the long- term functions of the ecosystem;
- multisectoral approach and looking for synergies – in determining the measures for protection of habitat types and species all other functions of environment and needs of local community have to be considered to satisfy several interests at the same time;
- participation of stakeholders – people and organizations that may have the greatest impact on the implementations of measures and who might be affected the most must be offered the opportunity to participate in decision-making;
- precaution – if it is supposed that some activity might have harmful effects on the environment, i.e. on the biodiversity, and there is no scientific evidence that it is not harmful, then the person performing that activity must prove that it is not harmful.

Objectives and Principles of the Report are coordinated with EU Acquis, Appropriate Assessment, EIB standards for Biodiversity and Ecosystems and International good practice of biodiversity management and protection.

### 1.3 Stakeholders

List of Stakeholders in a context of local Biodiversity and Natural Resources that we have consulted or surveyed during the Assessment:

*Table 1 List of Stakeholders*

Name	Place
Republic Institute for Protection of Cultural and Natural Heritage of Republic Srpska	Banja Luka
Hunting Association "Majna"	Modriča
Hunting Association "Fazan"	Doboj
Fishery Association "Optima"	Modriča
Fishery Association "Bosna"	Doboj
Forestry Administration Modriča	Modriča

## 1.4 Project area

The Project area is situated in the north-east part of BiH, between the towns of Modriča and Doboj, and about 100 km east of the capital Banja Luka. It is a rural area with a number of linear villages formed along the two regional roads: The M-17 (single lane in each direction) passing along the left bank of the River Bosna and the R-465 (single lane in each direction) along the right bank, parallel to the railway road Doboj – Modriča.

The 36 km long proposed alignment is called Johovac - Vukosavlje and consists of two adjacent subsections: Northern Odžak-Vukosavlje Section which formally belongs to LOT 1 and Vukosavlje - Johovac Section belonging to LOT 2.

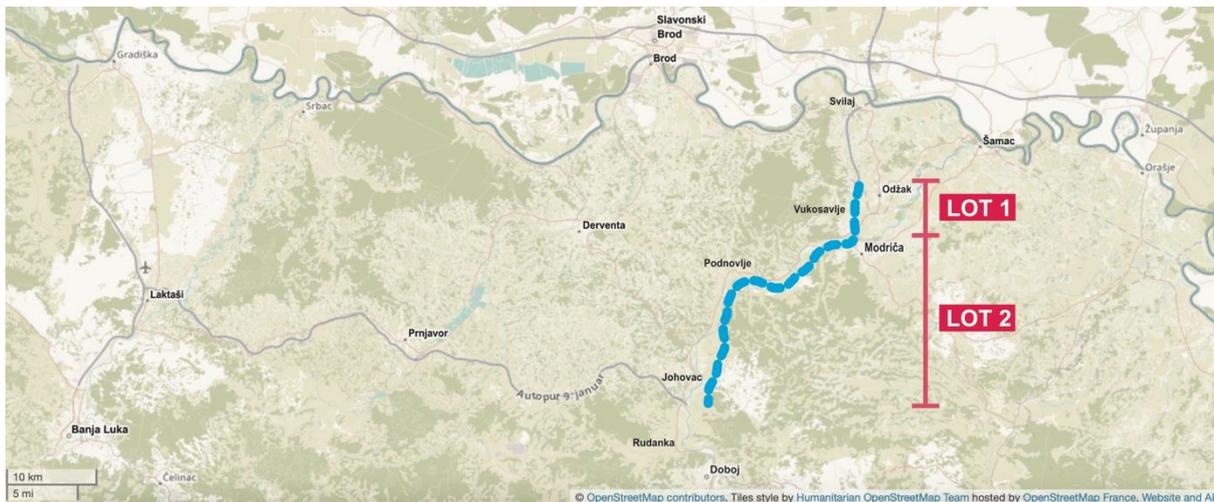


Figure 1: The Project location

## 1.5 Project description

The total length of the Project alignment is 36 km. The northern part of the alignment starts in the Municipality of Vukosavlje, about 6 km north of the town of Modriča.

After the trumped-shaped interchange Vukosavlje (the main connection with the planned motorway to Serbia), the alignment enters the alluvial plain of the Bosna River and remains in the plain until the end. The area of alignment is located in its entire length along the basin of river Bosna and it is characterized by a typical agricultural use with small to medium size parcels and crops, several small villages and groups of houses, and a diffuse network of local and agricultural roads, mostly gravelly. The entire area is often flooded by the river.

The route is located on the embankment, except on the bridge constructions. The objects which are planned according to submitted documentation are presented in the following table, according to the subsections.

Due to the purpose of easier understanding and display on maps, the LOT is separated into 4 subsections (Table 2.).

Table 2 List and locations of objects relevant to BA and BMP

Subsections	Objects	Number of planned objects	Length of object	Stationing of objects
1 (km 0+000,00 - 5+900,00) Vukosavlje - Vranjak Donji	Tunnel „Dobor“	1	cca 1.300 m	0+800,00 to 2+100,00 km
	Bridge (Daulije-Tarevačko polje)	1		
	Underpass	3		
2 (5+900,00 km - 13+600,00 km) Vranjak Donji - Podnovlje	Bridge 1 (Prudovi)	1	661,00 m	6+977,48 km to 7+638.48 km
	Bridge 2 (Prudovi)	1	914,02 m	10+207,48 km to 11+121,50 km
	Underpass	3		
3 (13+600,00 km - 23+550,00 km) Podnovlje - Ritešić	Resting area (Kutlovac)	1		
	Interchange "Podnovlje"	1		15+700,00 km
	Bridge (Ritešičko polje)	1	664,21 m	20+716.43 to 21+380.64 km
	Underpass	5		
	Pipe culvert	5		
4 (23+550,00 km - 29+700,00) Ritešić - Johovac	Underpass	7		
	Pipe culvert	4		
	Interchange "Trebava"	1		
	Bridge	1		
Total		31		

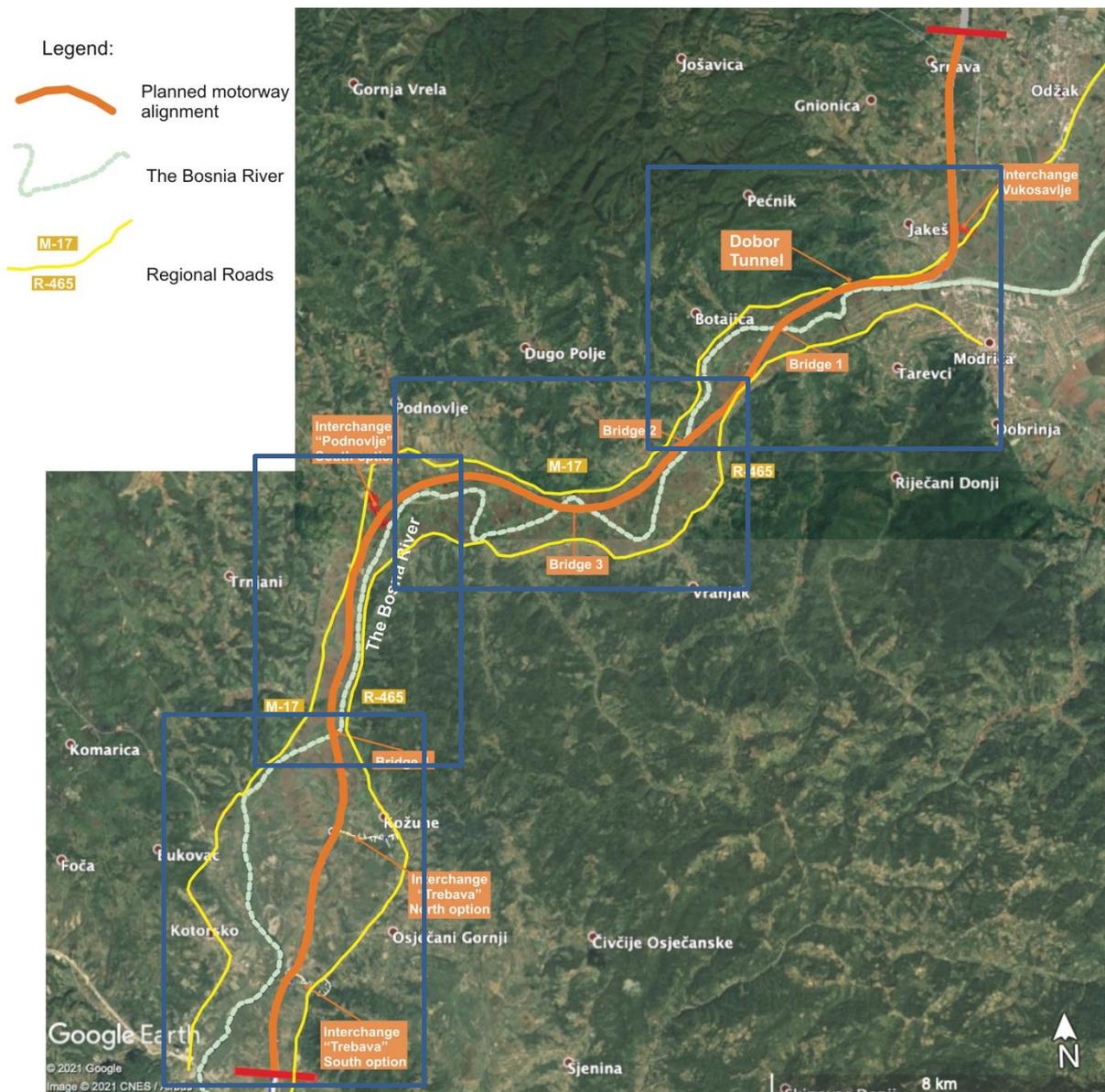


Figure 2: The Project alignment with subsections

The most important structures proposed along the alignment are the cut-and-cover tunnel Dobor (approx. 1 km) and four bridges over the Bosna River (up to 600 m each).

The cut-and-cover tunnel Dobor will be built along the existing regional road M-17, which will be diverted on top of the tunnel.

Besides four bridges across the Bosna River, a number of small water courses will be crossed by culverts. The local agricultural roads will be intersected by 18 underpasses.

The proposed alignment will intersect the existing regional roads by 5 over passes.

The entire alignment is proposed on the embankment with an average height of 4.25 m.

In the zone of Rastoka in Podnovlje village, on stationing approximately 15+700,00 km, there is a trumpet interchange „Podnovlje“, which represents the connection between motorway and existing freeway (M-17). Along with this interchange it is planned a widening intended for one point with accompanying objects for traffic control and pay tolls.

In the zone of Dijelovi in Kožuhe village there is a projected and subsequently adopted variant of the „trumpet“ interchange „Trebava“. On the location of the interchange Trebava the section Dobo – Modriča, is connected to regional road R-465. With this solution the connection between two road

directions, motorway and regional road R-465, is achieved by uneven connection with one bridge and one three-lane surface intersection. Pay tolls are projected on the part of connections.

The following text contains the summary technical description of main characteristics of the said motorway section, i.e. of those data that are important for spatial layout of structures, soil, materials, technological units, building technology and other important information for protection of the local biodiversity.

The subject stock of motorway Doboj – Modriča, belongs to the technical group A, meaning the most demanding group of traffic roads. The relevant speeds have been determined based on the adopted technical group of roads. Since this is basically a highway outside the settlement and technical group A, the following relevant speeds have been determined:

- Allowed speed  $V_{doz} = 130$  km/h
- Travel speed  $V_{put} = 100$  km/h
- Predicted speed for the calculation of boundary elements of design geometry  $V_{pred} = 130$  km/h

Based on certain relevant speeds, the basic elements of the geometric transverse profile for the open section of the road were adopted, with two separate roads for each direction of travel consisting of the following elements:

- Two lanes widths of 3.75m (road lane and overtaking lane)
- Edge stripes along dividing strip width 0.5m
- Edge stripes along stop lane width 0.2m
- Stop lanes width 2.5m

Dividing strip (belt) between the directed pavements was adopted in a width of 4m. Banks that serve to increase the traffic safety, the stabilization of road constructions and installation of vertical signalization were adopted in the width of 1.7m.

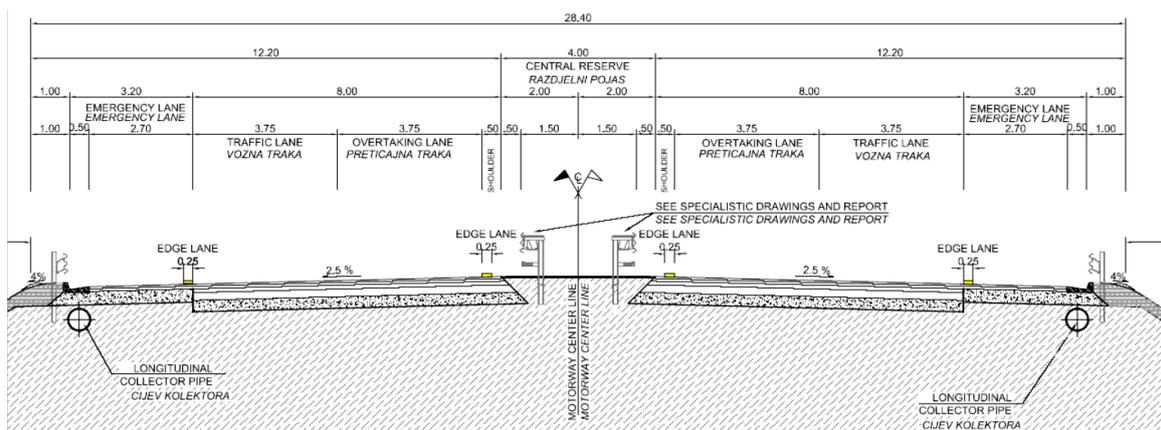
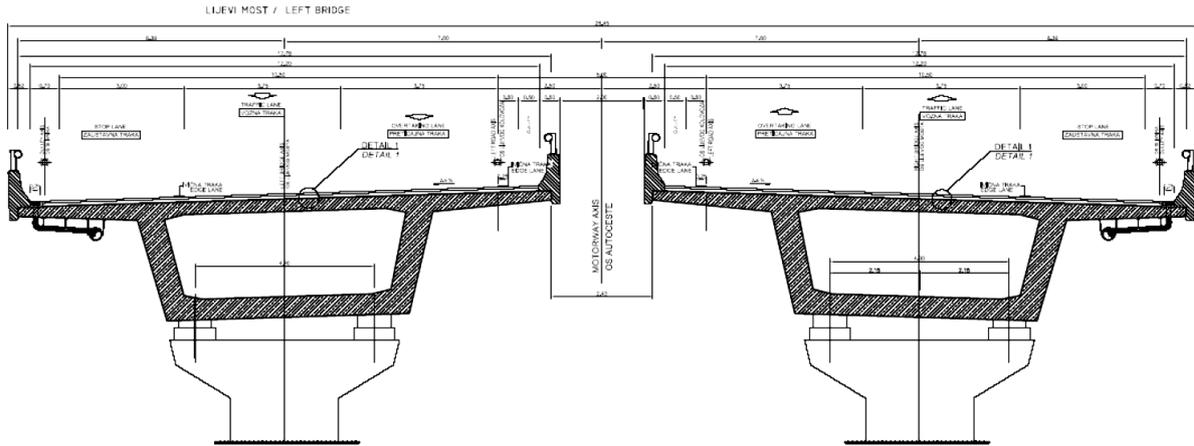


Figure 3: Section view of road

TYPICAL CROSS SECTION (BRIDGE MO-01,MO-02,MO-04)  
 NORMALNI POPREČNI PRESJEK (BRIDGE MO-01,MO-02,MO-04)



TYPICAL CROSS SECTION (BRIDGE MO-03)  
 NORMALNI POPREČNI PRESJEK (BRIDGE MO-03)

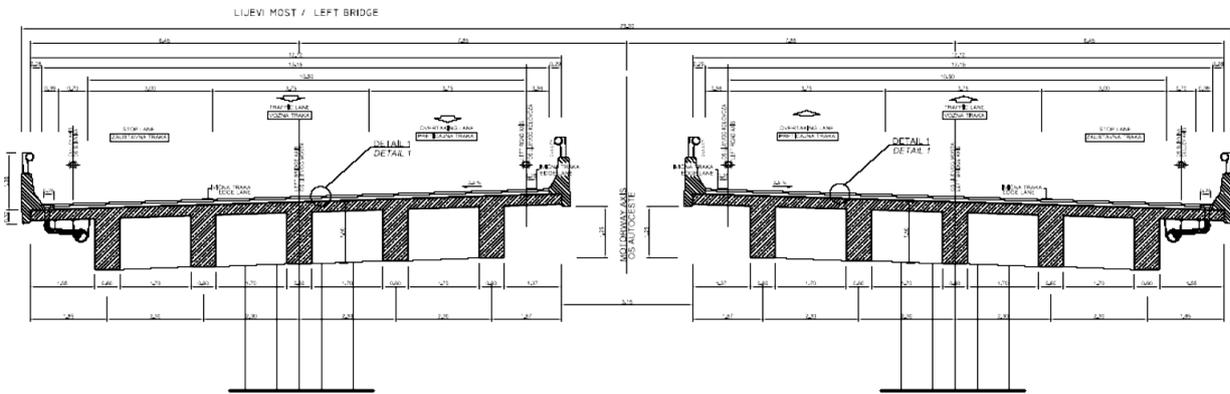


Figure 4: Typical cross section of bridge

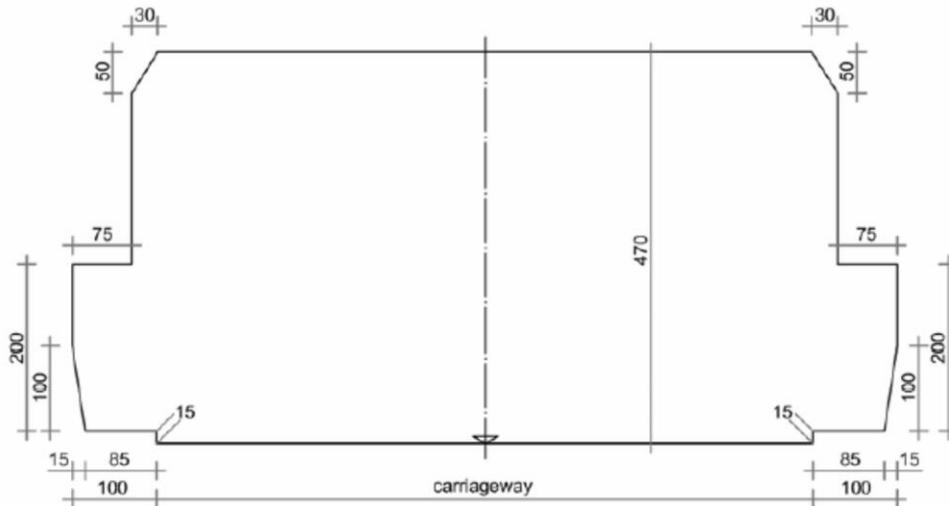


Figure 5: Section view of tunnel

Lighting will be installed at all intersections and all locations where the lighting is necessary for improvement of road safety.

Road equipment will be provided in accordance with relevant international standards (i.e. AASTO, DIN 17100, EN 1317-2 – Guidelines for Road Design, Construction, Maintenance and Supervision) for the whole length of the route, including the following:

- safety fence of the median and fence at the edge of the subgrade in the vicinity of bridges, at embankments (higher than 3 m) and at other locations;
- marking of the road;
- installation of traffic signalization.

Drainage of surface water includes the special treatment with purification, i.e. closed drainage system. Possibly polluted surface water is collected into the closed drainage system and treated before release into the recipient. Storm water on asphalt surfaces is collected, depending on the transversal gradient of the road, into drains located in shallow drainage channels, and before the water is released from the closed system, it is treated in the oil separator. The water from relevant areas surrounding the motorway and from embankment slopes is collected into channels at the embankment foot, and the position of channels and their recipients is determined in the Main Design. Selected types of channels are in accordance with design guidelines and they are executed depending on the longitudinal gradient of the level of channel.

The motorway equipment includes the following:

- marker posts,
- safety fence in median and shoulders,
- safety fence reflectors,
- reflectors on structures,
- motorway fence,
- permanently acting ecological and protective devices for prevention of wildlife access to motorway.

For the purpose of the report, the Project lifetime is considered to be at least 50 years. It is assumed that the project will be fully operational by end of 2025.

## 2 Biodiversity Impact Assessment Methodology and Approach

### 2.1 Study Area and Area of Analysis

The Study Area is shown in Figure 1 (and Annex 12, map 1) and encompasses the River Bosna between Vukosavlje and Johovac and its associated floodplain habitats, taking into account the wider upstream and downstream context. The southern limit is the southern the end of a built motorway (Johovac Interchange), and the northern extent is the location of future Modrica Interchange. The Study Area takes in the entire stretch of the Project, including the approach sections to the Trebava and Podnovlje Interchanges, and the five crossings of the River Bosna.

The following describes the method for defining the area (zones) of project influence in the construction and operation phase in the context of the Biodiversity Assessment Report, which is mostly in line with the requirements of TOR and EIB Standard 3: Biodiversity and Ecosystems.

**Project area of influence** - During field work and literature research, the area that directly occupies the route („Project footprint“) in the construction zone was primarily researched. According to the available project documentation, the zone of the direct project influence of the route is defined (up to about 50m on both sides of the route from the end of the planned embankment or bridges - "buffer") which has been also considered during detailed field research because it will be the zone of direct influence of construction works and the area that may be directly affected by disturbance, noise, emissions, effluents etc. in operational phase later. The criteria for defining the location and surfaces of this zone are ecosystems (i.a. existing watercourses, corridors of fauna, common vegetation, etc.) which in a certain way ecologically depend on the area that the route directly occupies (i.a. project footprint).

**Wider context** - Besides that, during field work we researched the zone outside of above mentioned two zones, that is wider context of the project which covers mainly entire floodplain of the river Bosnia between the mountains Vučjak and Trebava.

### 2.2 Review of Available Data

During exploring the existing data on biodiversity of the project area, the following relevant documents were reviewed:

- previous published flora and fauna studies conducted in the Study Area by universities, research centres, NGOs and experts,
- unpublished field data about the local flora and fauna collected during systematic and non-systematic research on biodiversity (bird fauna, mammals, fish) of individual experts and associations,
- Fishing, hunting and forest management base documentation (fishing and hunting plans, forestry maps etc.) and related documents on natural resources of the subject area based on biodiversity resources,
- Opinions and surveys of hunters Hunting Association (HA) "Fazan" from Dobož and HA "Majna" from Modriča and fishermen from the Sports and Fishing Associations (FA) "Optima" from Modriča and "Bosna" from Dobož,
- Various Maps of Study area (vegetation, geology, climatology, hydrology etc.),
- Government of Republic Srpska & Bosnia and Herzegovina Nature protection legislation, policies, strategies and plans (Nature Protection Law and Regulations, Spatial Plan of Republic Srpska 2025, Strategy and Action Plan for Protection of Biological Diversity in Bosnia and Herzegovina 2015-2020, etc.)
- the List of Wetlands of International Importance (Ramsar 2021) and list of Important Bird Areas (IBAs) (BirdLife International),
- IUCN Red List of Threatened Species,.

The National Red List of Wild Flora and Fauna of Republic of Srpska or Bosnia and Herzegovina with a categories of threatened species does not exist.

BA has been carried out and BMP is to be developed in accordance with professional instructions and valid regulations that regulate this area both locally and internationally.

International criteria, regulations and standards:

- EIB Environmental and Social Standard: 3 Biodiversity and Ecosystems
- The Convention on Biological Diversity of 1992 (CBD)
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora – *The Habitat Directive*
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds – *The Bird Directive*
- Council of Europe, 1979. Convention on the Conservation of European Wildlife and Natural Heritage. Bern, Switzerland
- Convention on the Conservation of Migratory Species of Wild Animals (CMS, or Bonn Convention)
- The Convention on International Trade in Endangered Species of Wild Flora and Fauna, 1975 (CITES)
- The Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971 (Ramsar Convention)
- Convention concerning the Protection of World Cultural and Natural Heritage, 1972 (UNESCO World Heritage Convention)
- COST 341: Wildlife and traffic: A European handbook for identifying conflicts and designing solutions

National laws, regulations and standards:

- Law on Nature Protection (“RS Official Gazette”, No. 20/14)
- Decree on strictly protected and protected species of the Republic of Srpska (“RS Official Gazette”, No. 65/20)
- Regulations on special technical and technological solutions that enable unobstructed and safe wildlife traffic (“RS Official Gazette”, No. 66/17)
- “Directorate of Roads FBiH” & RS “ARS” (2005): Guidelines for Road Design, Construction, Maintenance and Supervision, Volume 1: Designing, Section 1: Road designing, Chapter 6: Road and Environment, Guideline 4: Animal passages.
- Law on Environmental Protection (“RS Official Gazette”, No. 71/12, 79/15, 70/12)
- Law on Hunting (“RS Official Gazette”, No. 60/09, 50/13)
- Law on Fisheries (“RS Official Gazette”, No. 58/09, 72/12)
- Forest Law (“RS Official Gazette”, No. 75/08, 60/13) Article 42 regulating cutting of forest
- Law on Agricultural Land (“RS Official Gazette”, No. 93/06, 86/07, 14/10, 05/12)
- Law on Waters (“RS Official Gazette”, No. 50/06, 92/09, 121/12, 74/17)

## 2.3 Field Survey Methodology

A walkover priority habitats and species survey of the project footprint and buffer was undertaken between June and September 2021. The primary objective of the survey was to increase the current level of understanding regarding existing priority species’ habitat usage and behaviour in the surrounding of the project.

Critical Habitats were considered and mapped within the project footprint and a 50 m buffer either side of the proposed road embankment. Other critical habitats are also explored and mapped in a wider area (in the plain of river Bosna, out of "project footprint").

All locations spotted as interesting on *Google Earth* or in existing documentation and literature were visited during field survey. Special attention has been paid to diversity of flora and habitat types at locations of future bridges over the River Bosna and areas designated as possible wildlife passages. i.e. area of Kutlovac, Botajica-Tarevačko polje and Kožuhe.

Habitats located in the study area were classified based on the EUNIS and EU Habitats Directive Annex I habitat types classification system (European Environment Agency, 2018).

A site visits to the Study Area and a field survey focusing on habitats, flora and fauna was conducted from 17 June to 29 September 2021 (total of 11 field surveys). An initial scoping visit was conducted over the wider context of project area (by vehicle and by foot), to identify key biodiversity features and identify areas worthy of a more focused investigation.

Researching of vegetation and flora was performed by walking/driving along the planned road and stopping at 22 points along sections of regional and local roads (Annex 12, map 1). At every point that

was selected for sampling, the notes on present plant species, habitat edifikators, the composition of the plant cover were made, according to the standard protocol for phytocoenological survey.

The researching related to mammals included search for signs of their presence like animal excrement / foot prints / fur / remains of prey, signs of eating, etc. Some data about small mammals is presented as literature data obtained during the investigation on diet of long-eared owl (*Asio otus*) in Posavina trough analysis of owl pellets (Sjeničić et al, 2019).

Birds were observed visually using binoculars of various magnifications (8x30 and 10x50). Methods used during the research are: kilometer transect method, census, free method and playback method (Gregory et al. 2004). Nesting status categorization is given according to EOAC nesting categories and codes, according to Sharrock (1987) and Hagemeyer&Blair (1997).

Bat activity transect surveys were undertaken on two surveys, the first on 8th July, and the second on 13th July 2021. The walkover transect routes were determined prior to the commencement of survey during daylight hours and potential bat roosting sites were recorded. Both surveys were undertaken in a range of habitats in suitable weather conditions. The surveys started 15 minutes before sunset and finished approximately 3-4 hours after. We used a GPS unit to follow the transect route and a handheld bat detector (i.e. Batlogger M, Elekon) was used to detect the echolocation (calls) of different bat species during the survey. We recorded key information i.e. location, time of echolocation and species name.

Reptiles and amphibians were researched during transect, collecting by hand and net, and the "sit-and-wait" method at individual sites was used on some locations. Species determination was based on recognizing adult and juvenile individuals. Also, audio recognition method and egg clutches were used for determination anuran species (Schlupmann & Kupfer, 2009). During the herpetofauna research we used visual method as the main method during the day and night field research. Also, amphibians and reptiles were searched depending on their main habitats using photo camera, binoculars, hand nets, traps and hand gloves. Dead on road (DOR) amphibian and reptile individuals were determined (if it was possible) along the main road and a local road.

Standard manuals for identification of species were used in identification of all vertebrate groups.

The list of animal species and locations of collisions with vehicles on regional road R-465 and existing freeway M-17 within the wider area of the designed Corridor Vc (Vukosvlje-Johovac section) has been made based on archive field data of the author. The animals were recorded in a non-systematic research, when eventually spotted from vehicles during driving. Species identification was performed using standard identification manuals. Identification of the animal was performed only when it was possible, taking into account the condition of the animal (e.g. corpse condition). Photographs of death animal were taken, the place and time, GPS coordinates of the findings were also recorded and the circumstances were described.

The only available data on invertebrates were collected during the field investigation of reference spots, by catching individual insects with entomological net, water net and with hand. Observations are mainly based on imagines, while exuviae and larvae were searched for only sporadically. During the survey weather was favorable for observing dragonflies at most days.

Aquatic fauna was researched by analyzing the results of regular field research as part of surface water monitoring in the Republic of Srpska, which was preform by experts from the Faculty of science and mathematics, University of Banja Luka as a subcontractor of the Institute for water, Bijeljina. Sampling is conducting two times annually every year, at two localities: Modriča – old bridge and Dobož – Johovac interchange, which corresponds to the part of the water course that follows the motorway route, which covers the entire project area. Fish fauna was determined by annexing local fishermen and the fisherman associations. Data on fish diversity are also derived from the fisherman catch listed in the "Fishing water usage program" of FA Dobož and FA Modriča. There were no special field ichthyology surveys in this part of Bosna River so far.

## 2.4 Critical Habitat Determination

The criteria used in assessing the presence of critical habitat were aligned with the EIB standard 3 as follows:

Table 3 Critical Habitat Determination criteria

Criterion no.	Description
<b>1.</b>	<b>Highly threatened or unique ecosystems</b>
1a	Priority Habitats listed in Annex I of the Habitats Directive and habitats considered to be their equivalent in countries outside the EU;
1b	≥5% of the global extent of an ecosystem type meeting the criteria for IUCN's Red List of Ecosystems with a status of critically endangered or endangered
1c	Examples of ecosystems outside the EU and not yet assessed by IUCN, but determined to be of high priority for conservation on the basis of regional or national level systematic conservation planning or informed specialist input
<b>2</b>	<b>Population of critically endangered, endangered or vulnerable species, as defined by the IUCN Red List of threatened species and in relevant legislation</b>
2a	A population of an IUCN Red-listed endangered or critically endangered species that is ≥ 0.5% of the global population and/or ≥ 5 established reproductive units of an endangered or critically endangered species
2b	Significant concentration of an IUCN Red-listed vulnerable species or of multiple IUCN Red-listed vulnerable species, especially where the loss of the area would result in the change of the IUCN Red List status to endangered or critically endangered
2c	Nationally or regionally-important concentration of a species listed as endangered or critically endangered on a regional/national IUCN Red List, or equivalent on national/regional listing
<b>3</b>	<b>Population range or distribution of endemic or restricted-range species, or highly distinctive assemblages of species</b>
3a	They regularly hold ≥10% of the global population size and support ≥10 reproductive units of an endemic or restricted-range species.
3b	They are considered by relevant specialists to support unique or rare assemblages of species that occur there habitually, predictably or repeatable. The constituent species may not meet other critical habitat thresholds mentioned here in their own right, but may present assemblages that are considered important to maintain high biodiversity in the area.
<b>4</b>	<b>Habitat required for the survival of migratory species and/or congregatory species.</b>
4a	They sustain ≥ 1% of the global population of a migratory or congregatory species at any point of the species' lifecycle on a cyclical or otherwise regular basis
4b	They are needed to support migratory or congregatory species during periods of environmental stress
<b>5</b>	<b>Biodiversity and/or ecosystem with significant social, economic, or cultural importance to local communities and indigenous groups</b>
	Priority ecosystem services are services (including cultural services) on which people depend strongly for their livelihood or wellbeing, with limited access to acceptable alternatives.
<b>6</b>	<b>Habitat of key scientific value and/or associated with key evolutionary processes</b>
6a	Landscapes with high spatial heterogeneity and therefore high levels of species diversity
6b	Environmental gradients, also known as ecotones, that produce transitional habitat which is associated with the process of speciation and high species and genetic diversity
6c	Edaphic interfaces that juxtapose soil types (e.g. serpentine outcrops, limestone and gypsum deposits), which have led to the formation of unique plant communities
6d	Connectivity between habitats (e.g. biological corridors) with importance for species migration and gene flow, which is especially important in fragmented habitats and for the conservation of metapopulations. This also includes biological corridors across altitudinal and climatic gradients and from "crest to coast"
6e	Sites of demonstrated importance to climate change adaptation for either species or ecosystems

## 2.5 Impact Assessment Criteria

The framework for this biodiversity impact assessment mostly follows the general principles of the CIEEM Guidelines for Ecology Impact Assessment in The UK and Ireland (September, 2018). The assessment only describes the characteristics that are relevant to understanding the project related impacts to a particular biodiversity feature, according to the EIB Standard 3. Impacts were also classified as direct or indirect project-related impacts as follows:

- Habitat loss, degradation and fragmentation(including risk of collision with traffic)
- Introduction or spread of invasive alien species;
- Overexploitation or species loss;
- Hydrological changes and Nutrient loading
- Pollution;
- Pre-existing threats and the extent to which the project might exacerbate them; and,
- Spill-over effect.

The assessment of impacts to biodiversity features/receptors was undertaken using the impact matrices presented in Table 4. and Table 5.

*Table 4 Habitat Impact Assessment Matrix*

		Magnitude of Impact			
		Negligible	Small	Medium	Large
		Impact is within normal range of variation.	Affects a small area of habitat but without the loss of viability / function of the habitat	Affects a significant proportion of the habitat such that the viability and function of part of the habitat or the entire habitat is reduced but does not threaten the long-term viability of the habitat or species dependent it.	Affects the entire habitat or significant proportion of the habitat, where the viability / function of the entire habitat is reduced and the long-term viability of the habitat and the species dependent on it are threatened.
Sensitivity	Negligible	Not significant	Not significant	Not significant	Not significant
	Low	Not significant	Not significant	Minor	Moderate
	Medium	Not significant	Minor	Moderate	Major
	High	Not significant	Moderate	Major	Major (high)

### Habitat Receptor Sensitivity

Sensitivity Ranking	Characterisation
Negligible	Habitats that are very common and widespread across their natural global range. Habitats significantly degraded by anthropogenic activities that are characterised by a low floristic value (i.e. low species diversity and / or abundance, and / or a high proportion of non-native vascular plants). Habitats that have negligible biodiversity value for species as feeding or breeding areas (or migration routes). Habitats that are not nationally protected or internationally recognised areas for biodiversity.
Low	Habitats that are common and widespread in Republic Srpska and Europe. Habitats generally degraded by anthropogenic activities that are characterised by a low floristic value. Habitats with low conservation value in expert opinion. Habitats that are not nationally protected or internationally recognised areas for biodiversity. Habitats that naturally recover quickly following disturbance.

Medium	Habitats that are regionally rare and threatened and are small sized or scattered in their distribution but are not rare and threatened in Republic Srpska. Annex 1 priority habitats. Habitats that include an assemblage of species that are uncommon in Republic Srpska. Habitats that have a slow rate of recovery following disturbance. Low value habitats used by medium value species as important feeding or breeding areas (or migration routes). Internationally recognised areas such as Key Biodiversity Areas, Important Bird Areas and Important Plant Areas. Habitats that are nationally protected areas for biodiversity.
High	Habitats that are rare and threatened in Republic Srpska and Europe. Habitats with limited global extent. Habitats that are highly unlikely to naturally recover following disturbance. Habitats supporting an assemblage of unique or important species. This includes habitats used by high value species as important feeding or breeding areas (or migration routes). Highly threatened and/or unique ecosystems and areas illustrative of key evolutionary processes (i.e. including Areas for Zero Extinction). Sites of international importance / designated for protection at the international level (i.e. World Heritage Sites, Ramsar sites).

*Table 5 Species Impact Assessment Matrix*

Species Value		Magnitude of Impact			
		Negligible	Small	Medium	Large
		Impact is within normal range of variation.	Affects a small proportion of the population but does not substantially affect other species dependent on it or the population of the species itself.	Affects a sufficient proportion of a species population such that it may bring about substantial change in abundance and / or distribution over one or more generations, but does not threaten the long-term viability of that population or any population dependent on it. The size and cumulative effect is also sufficient such that a medium magnitude impact multiplied over a wide range area would be regarded as a large magnitude	Affects an entire population or species in sufficient scale to cause sufficient decline in abundance and / or change in distribution beyond which natural recruitment (reproduction, in-migration from unaffected areas) may not return that population or species, or any population of species dependent upon it to its former level within several generations, or when there is no possibility of recovery.
Sensitivity	Negligible	Not significant	Not significant	Not significant	Not significant
	Low	Not significant	Not significant	Minor	Moderate
	Medium	Not significant	Minor	Moderate	Major
	High	Not significant	Moderate	Major	Major (High)

## Species Receptor Sensitivity

Sensitivity Ranking	Characterisation
Negligible	Commonly occurring species, not subject to significant decline (i.e. distribution and abundance) at their range at the global and national scales (i.e. species listed as Least Concern by IUCN). No specific value or importance attached to the species. Species that are not legally protected. Introduced or alien invasive species.
Low	Species not protected, listed as widespread or abundant at the national scales but are listed as Near Threatened at the global scale by IUCN and does not meet the criteria for high or medium value species. Species that will re-colonise disturbed areas, particularly following habitat restoration and rehabilitation but perhaps at a slower rate than other commonly occurring species.
Medium	Species listed as Vulnerable or Data Deficient on the IUCN Red List of Threatened Species. Not meeting the criteria for high value species.
High	Species included on the IUCN Red List of Threatened Species as Critically Endangered and Endangered. Edge species. Keystone species that are critical for the maintenance of high biodiversity in Republic Srpska and / or a single population of Critically Endangered and Endangered species. Endemic and/or range-restricted species that trigger Critical Habitat in accordance with Performance Standard 3 thresholds. A migratory and/or congregatory species that is present in globally significant numbers thus triggering Critical Habitat in accordance with Performance Standard 3 thresholds.

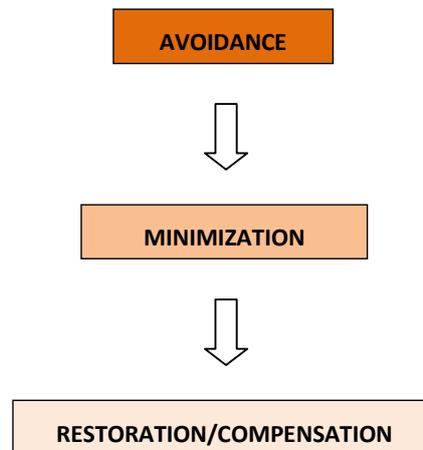
## 2.6 Mitigation Methodology and Hierarchy

As it is stated in EIBs Environmental and Social Standards: 3 Biodiversity and Ecosystems, one of the main goals of biodiversity conservation and sustainable management of living nature is the adoption of a mitigation hierarchy with the aim of avoiding the net loss of biodiversity and to achieve the net gain in biodiversity if possible. The BA has been carried out and the BMP is to be developed with the main aim of achieving that goal.

The mitigation hierarchy was applied to the strategy planned in this report. In essence, this procedure may be described as the process in three steps:

- **Avoidance:** this is the first step in the mitigation hierarchy and is defined as measures taken to avoid causing direct and indirect project-related impacts from the outset. Examples of avoidance measures include the spatial or temporal relocation or removal of infrastructure, to completely avoid impacting key components of biodiversity (i.e. particularly priority species, habitats or ecosystem services). Avoidance is often regarded as the most effective way of reducing potential negative impacts to biodiversity and ecosystem services.
- **Minimization:** this is the second component of the mitigation hierarchy. Minimization measures (or mitigation measures) are designed to reduce the duration, intensity and / or extent of direct, indirect and cumulative project-related impacts that cannot be completely avoided, as far as is practically feasible. Robust and pragmatic minimization measures can be effective in reducing biodiversity impacts below significance thresholds.
- **Rehabilitation / Restoration:** this third step in the mitigation hierarchy should be applied to rehabilitate or restore biodiversity and / or ecosystem services that are impacted by project activities that cannot be completely avoided and / or minimised. An example includes rehabilitating degraded habitats or restoring cleared habitats to reduce residual project-related impacts.
- **Offset:** Biodiversity offsets are measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, to achieve no net loss or a net gain of biodiversity. Biodiversity offsets are measurable positive conservation outcomes on priority biodiversity features that are attributed to Project activities, and whose magnitude outweighs that of the residual adverse biodiversity impacts arising from the Project development. Offsets require investments in conservation management protection where the results of these investments can be quantified. Offsetting

is based on systematic biodiversity accounting based on the explicit calculation of biodiversity losses and gains at matched impact and offset sites.



Graphic 1: Hierarchy of mitigation procedures during measures for conservation of biodiversity

Within the BA, the location for wildlife passage is proposed, as well as several technical instructions for execution of existing overpasses, underpasses and pipe culverts in order to have them being used as animal passages beside their main function. Dimensions of wildlife passages are determined according to height, width and length (according to: Cost 341 and National Legislation). Index of free space of underground passages, that has to be equal or larger than 1.5 in order for the passage to be functional, is calculated in the following way:

$$FSI = OW \times OH/L$$

where:

FSI = Free Space Index

OW = opening width

OH = opening height

L = length

## 2.7 Approach to Biodiversity Management

A summary of the Project's approach and commitments to achieving best practice biodiversity management are listed as follows:

- identification and characterisation of biodiversity baseline conditions for the Project based on primary and secondary data sources,
- identification of important biodiversity features (priority species and habitats) of high conservation value and relevance to the Project based on critical habitat screening,
- application of the mitigation hierarchy to avoid, minimise and rehabilitate Project related impacts to these biodiversity features during Project construction and operation,
- compensation of significant residual impacts to biodiversity receptors,
- adherence to national regulatory requirements.

## 3 The Biodiversity Baseline

### 3.1 Existing data of local biodiversity

In general, the data on local biodiversity features of this area are very poor and includes several systematic researches in the last 15 years (fish and birds), while the older data represent the results of sporadic or casual notes or results of review papers for the entire area of Posavina or the whole Bosnia and Herzegovina.

Official published data on flora or vegetation do not exist, not even in the forestry management documents, because the forest areas along the River Bosna and in its floodplain are neither representative nor interesting ones from the aspect of forest exploitation and management, since they cover the small area (fragments of natural vegetation), contain soft broadleaved wood that is of no high value as technical wood (willow, poplar etc.).

The analyses of natural resources covered the analysis of data of FA "Bosna" from Dobož and FA "Optima" from Modriča, in the form of "Program of fishery area usage", while the data on hunting game (mammals and birds) were taken from "Annual plan of hunting areas usage" and "Hunting Plans", developed by HA "Fazan" from Dobož and HA "Majna" from Modriča.

Papers published on fauna of this area include data on birds outside the nesting period that occupy the water habitats and also include the population data from international waterbirds census (IWC) during the winter period.

Data on fish fauna include common and widely distributed fish species for watercourses in the lowland region of Posavina and are presented in the fish fauna section of the report.

For the sake of clarity, all collected literature data are presented collectively in tables in the section on vegetation and flora, fauna, and habitats. Literary sources are specially marked.

#### **The existing Environmental Impact Assessment study (2011)**

The Environmental Impact Assessment study (EIA) provide only information about general vegetation characteristics of the region of northern Bosnia. The flora has been superficially assessed. There is no data on the used literature, while the some given data of about the flora are not realistic. Some parts of EIA Report for the "LOT2: Vukosavlje-Johovac" provides a incorrect list of recorded plant species proposed for conservation.

In the study, the fauna has been more realistically assessed, but still there are not mentioned some of the present bird species such as waterbirds. There is no explanation of the methodology which was used to collect the data of the presented species. In this study the possible effects on fauna and the measures of mitigating/ preventing are elaborated in details and those predict the control of the works, fencing, underpasses, tubular openings and green bridges.

The EIA lists the actions that must be implemented to address the E&S risks and impacts identified. These are in outline form only in some cases and the Contractor will be required to prepare a comprehensive Construction Environmental and Social Management Plan (CESMP) to take into account the EIA requirements, and any other requirements. This will be reviewed and approved by the Supervising Engineer for the construction works.

#### **Biodiversity Screening Report (2017)**

The only relevant source of local biodiversity data was the "Biodiversity screening" that was performed in May 2017 by the consulting company Zyllwood Consulting UK, in cooperation with local experts as subcontractors (Society for Research and Protection of Biodiversity, Banja Luka). The report contains all the data obtained in field research in May 2017 of the section Rudanka - Podnovlje (via Johovac) and provides the analysis of flora, vegetation, habitats, fauna of fish, reptiles, amphibians, birds and mammals, with special attention paid to aquatic or semi-aquatic species, while the fauna of terrestrial invertebrates was also partly analyzed, as well as some of representatives of the macro-zoobentos fauna in the River Bosna.

A Screening Exercise on the River Bosna was requested by EBRD to better understand the potential project related risks and impacts in accordance with the EU Habitats Directive and Performance

Requirement 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. At the request of EBRD, a Biodiversity Screening Study was conducted on the south part of the Project area (Rudanka - Podnovlje intersection), to provide a better understanding of the potential Project related risks and impacts on biodiversity, and to ensure that the project will comply with EBRD's Performance Requirements, and with EU legislation on protecting biodiversity, such as the EU Habitats Directive. This involved biodiversity experts from RS, supported by an international team. They surveyed the terrain to determine the presence of habitats or species considered significant and took consultations with stakeholders.

The main findings and conclusions of this study are:

- There are fifteen small, isolated patches of willow-popular or alder woodland, one of which lies close to the proposed Motorway,
- Certain stretches of the riverbanks (possibly, although this was not confirmed in the survey due to the lack of vegetation), unavoidable damage to which must be minimised,
- The small streams (eight were identified) which flow into the River Bosna, which host certain protected species of fauna, which must be preserved,
- Some protected birds species are known to fly over the area, but none nest in the Project corridor and the Project effects should be minimal.
- Two areas (one of them is in area of Kožuhe) where large and small mammals may cross the road corridor were identified, so access across these must preserved as far as possible.

In summary, some areas of important habitat were identified, and the presence of some protected species was found in the area. However, with some minor adaptations to the Project plans, especially during construction, the risks to these protected biodiversity resources can be managed satisfactorily in compliance with the the EU requirements.

### 3.2 Baseline Conditions

In forming of biodiversity of certain area, the significant role is played by the diversity and contents of the area, i.e. the relief, climate, surface and underground water, etc. For that reason, the following are the general characteristics of macro and microlocation of the project area.

**Geomorphologic conditions** – In geomorphologic sense, section from Vukosavlje to Johovac is located in the plain, up to 142 m above the sea level. In hydrographic network, the River Bosna is dominating, with the relatively dense network of permanent or temporary streams and watercourses (Ljuteš, Glogovica, Ljubioča, Vranjačka stream etc.).

The relief along the said section belongs to the fluvial-accumulation type by its genesis. This type of relief belongs to morphological structures of sinking, i.e. neotectonic descending of terrain. It was made by fluvial and accumulation processes in the valley of the River Bosna. It depends on the dynamic, seasonal changes in quantity of material brought by the water and deposited or suspended, mainly along the riverbed of Bosna, and in the lesser part along smaller watercourses.

This type of relief creates a wide lowland that provides river flow and creates meanders (curves in the river). The lowlands and meandering of the river affect water overflow during the flood period (spring and autumn).

**Geological conditions** – Quaternary sediments (Q) are present on the whole surface of the said area and they are in direct contact with the motorway route. These are materials generated by disintegration, transporting and depositing of rocks in geological substrate, or by anthropogenic activities like construction of roads and railways. Depending on the genesis, there are the following types of quaternary sediments, i.e. the surface layers:

- Anthropogenic fill materials, and
- Alluvial sediments.

Anthropogenic fill materials (H) are the least present type of layer. Their presence is limited to zones along existing roads and railroads. They contain limestone blocks, crashed stone, finely crushed stone and other fill materials. The thickness of such layers is variable: from few decimeters in road embankments to maximum of 5,0-6,0 m in railroad embankments.

Alluvial sediments are represented by flooding sediments (dust-sandy clays, dust and silt-clay sands) that are significantly represented, and sediments of the riverbed that are only partially uncovered (gravels and sands of various grades, with particles of clays).

In such geological conditions, river flows have been formed that carry river material and meanders and the former and today abandoned oxbow that lie on loose rocks (gravel) and in depressions. This favors the development of specific plant communities and habitats in such localities.

**Pedological conditions** – The main data source for soil types is the Pedological map of Yugoslavia, 1:50 000 (1972-1977) Bosnia and Herzegovina, soils of the section: Brod 4; Derventa 1, Derventa 2, Derventa 3, and Derventa 4. In this area, the following alluvial soils or fluvisol are present:

- Alluvial carbonate sandy soils on gravels (pšAk),
- Alluvial carbonate sandy soils on sands (ppAk),
- Alluvial carbonate sandy soils on clays (piAk).

Areas covered with these soils are not large and are limited to zones along watercourses, mostly along the River Bosna and also along its tributaries.

The soil is carbonate and deep, often of light mechanical composition, by structure loam or clay sandy soil, permeable for water. Surface layers are drained well and get dried, while deeper layers may be more humid. Underground water is often found below 2 m. Surface layers of these soils have pretty stable microstructural and macrostructural aggregations and pretty large absolute capacity for water, making these soils favorable for agriculture. Especially considering the alkaline reaction of the soil that causes active microbiological life.

**Climate conditions** – The area around lower Bosna River and Posavina (area around Sava River) have moderate continental climate with mean annual air temperature around 11°C and annual precipitation of 745-907 mm. During the larger part of the year (April-October), mean monthly air temperatures are above 10°C, while the remaining months are cold with significantly lower temperatures. Winters are often harsh here, while summers are moderate. Average annual air temperature in the area of lower Bosna River is around 10.5°C. Maximum precipitation is in the second part of spring and the first part of summer. In summers, storms and heavy rains are typical. On average, around 60% of those storms happen during the summer, 26% in the spring, 14% during the autumn and only 1% in the winter. June and July are months of the most frequent storms.

During the year, in the area of lower Bosna River the dominant winds are north-west-west winds, south-west winds and north-east winds. Relative air humidity is high from September until March – over 80%, with maximum values during the winter, and the lowest values from April until August. In this area, the snow is present usually from November until April, rarely in May, June or October.

The wider area has relatively high number of fog days, which is mostly caused by topographical conditions and the Bosna River.

Vegetation starts as early as in March, for average temperatures are above 5°C. It may be said that vegetation period lasts until December, when the temperature drops significantly below 5°C.

**Hydrological conditions** – The dominant watercourse is the River Bosna. Its largest tributaries in this area are Lukavica, Glogovica, Velika Rijeka, Vranjačka Rijeka. The highest water level is in the period March-May and in November, while the lowest water level is in August and September. The Bosna River freezes only in very cold winters. The width in the lower part is 80-250 m, while the general depth is 1-7 m. The characteristic flowrate Q (m<sup>3</sup>/s) for the Doboje area is 152. The specific flowrate of 100-year water (m<sup>3</sup>/s/km<sup>2</sup>) for the Doboje area is 0.313.

Flooding risks in the Doboje municipality area are recognized to be caused by the River Bosna and its tributaries, especially Spreča and the dam on Spreča near lake Modrac, and also by torrent streams. Regarding the situation of riverbeds, torrent streams pose the highest flooding risk in the period of maximum water level, in spring and autumn. Flooding of the majority of town of Doboje are mainly caused by the Bosna River, and in minor part by rivers Spreča, Usora and Lukavica. Direct causes of flooding are most often heavy rains, sudden melting of snow or the combination of two. The height of the flood wave is mainly affected by high and fast concentration of long-lasting precipitation. At elevation of +6,00 of the water level of Bosna River, flooding would cover areas from the river to the railroad on the right bank.

The river plane and the lack of embankments and other infrastructure to regulate the Bosna riverbed have allowed the valley to occasionally overflow, flood old riverbeds and backwaters, and develop almost all the typical biodiversity groups in the area, including most species of conservation interest.

**State of the Environment** - Air quality is generally good as there are no major industrial plants. Road traffic and the use of coal and firewood contribute to certain emissions of pollutants into the air. Noise and vibration levels are also low. The Bosna River is the main recipient of untreated industrial and municipal wastewater from settlements in the basin, and its ecological status is categorized as 3rd class (moderate status). According to the data from continuous monitoring of River Bosna quality and based on the analyses of physical, chemical, microbiological and biological parameters, the quality of river water in the project area (Monitoring point1: Rudanka-Kostajnica and Monitoring point2: Modriča) is mainly class II and III (according to the Decree on Watercourses Classification and Categorization (“RS Official Gazette”, No. 42/01)). Water supply in the villages was provided from local wells (drilled and dug). Wastewater collection system does not exist in villages along the Bosna river, and wastewater is discharged either into private septic tanks or directly into local streams and river without treatment. The area is poor covered by waste collection services from a competent utility company. However, there are numerous locations for illegal disposal of communal waste, most often along forest roads and a river.

### 3.3 Landscape and Habitats

#### *Landscape*

The wider area around the motorway section is characterized by the **valley type landscape** which border with **hilly landscape**. The wider study area is characterized by the contact zone of these two landscape types with elements of both types. The landscape of lowland areas is determined mainly by agricultural and small forest areas that alternate in landscape. The valley landscape is cut longitudinally along Bosna River. The hills of the hilly landscape are covered most with oak forest and pastures. The hilly area has family houses built of the suburban type with developed landscape architecture.

#### *Habitats*

The study area included the floodplain of the Bosna River. The habitats are absolutely dominated by agricultural lands with annual crops (mostly cereal crops), which are in some places intersected with very narrow and degraded fragments of soft deciduous forests, oxbow and Bosna River flow.

The EU Habitats Directive lists threatened Natural Habitats in Annex I (“Annex I Habitats”). Annex I priority Natural Habitat types are indicated by an asterisk in Annex I and are considered to be particularly threatened and in “danger of disappearance”. The majority of the habitats located within the footprint of the proposed motorway and the adjoining buffer are common and widespread in nature and as such do not qualify as Annex 1 habitats.

#### 3.3.1 Surface standing waters

In the area of potential motorway influence from Vukosavlje to Johovac, there are no significant larger ponds or wetlands of natural origin. At several locations, there are abandoned water-filled gravel pits with macrophytic and similar non-flow water vegetation that has developed over time. Existing abandoned gravel pits filled with water, intersecting the motorway route, does not have a particular importance for species of interest for protection. Natural depressions mostly represent the old flows of the Bosna River and are filled with water for a short time during floods or heavy rainfall. They are mostly surrounded by willow and poplar trees. The localities with this habitat type are spatially limited to small areas and are mostly used as illegal communal waste disposal sites (Figure 6).

During the late spring, summer and early autumn, streams – Bosna River tributaries, and cutoff channels in its lower flow, accumulate sediment and trees, and temporarily turn into stagnant waters. Characteristic vegetation and habitats of standing waters develops in these water bodies at several locations (Annex 12, marked on the maps 2. and 3.). Vegetation and habitats of standing waters develop in these waters at several locations. Among the recorded habitats, not representative fragments of Natura 2000 habitat type: 3150 'Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*', can be recognized only in few localities (Figure 7.), but outside the project influence zone of the motorway that could jeopardize the hydrological conditions of the reservoirs in which this type of habitat can be found.



Figure 6 One of abandoned gravel pits filled with water near Podnovlje village as a place of communal waste disposal

### 3.3.2 Surface running waters

In some zones, there are creeks that meander through the left and right floodplain of Bosna River and have slow-flowing water (see map 2. and 3., Annex 12).

These habitat types are not priority for protection or recognized as a “critical habitat”, but the smaller watercourses that flow into the Bosna River and intersect with future motorway have been recognized as important for a number of protected terrestrial (reptiles, mammals) and aquatic species (fish). The species of mammals that are likely to use these water flows are: *Castor fiber* and *Lutra lutra*, which are recorded near the Bosna River and also in small tributaries. The pond turtle (*Emys orbicularis*) was also found in or near these habitats. These tributaries are used by other common species like fish, amphibians and other smaller animals that move between the upper parts of the tributaries and the Bosna River. These tributaries are marked on the Maps 2., 3. and 4 (Annex 12), and are known to the designers of the motorway project. It is important to ensure the permeability of these watercourses as migratory corridors of fauna.



Figure 7: Rijeka creek, Vranjak, one of the Bosna River tributaries (Vranjak)

### 3.3.3 Littoral zone of inland surface water bodies

Along the river, on many locations, different materials are developing: gravel, sand and silt. In the littoral zone of the Bosna River, muddy shores alternate with vegetation of alliance *Bidention* ('Rivers with muddy banks with *Chenopodium rubri* p.p. and *Bidention* p.p. vegetation', Natura 2000 code: 3270) (Figure 8) and amphibious vegetation on the mud of alliance *Nanocyperion* ('Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea*', Natura 2000 code: 3130) which are listed on the EU Habitat Directive, and are not habitats of priority. Considering these habitats are in the downstream part of Bosna River, as well as in downstream of other large Sava River tributaries, they are representatively developed and are outside of the direct influence of the highway route so the conservation of these habitats are not priority and there will be no negative impact. These habitats are not shown on maps of project area because their distribution depends on hydromorphological processes that are unpredictable and changeable in the lower course of the Bosna River.

River and muddy banks without vegetation, which are developing along slow-flowing water, depend on water level variation, and often on riverbed maintenance and river material exploitation, are widely distributed along the river flow and are not priority for protection.



Figure 8: Not representative muddy river banks (Vranjak)



Figure 9: Gravel river banks showing Trash Accumulation and under pressure of gravel extraction works (Tarevci)

### 3.3.4 Grassland habitats

Along the river course, seasonally wet and wet grasslands meadows rarely occur on both river banks. Most often, these are now abandoned former meadows or pastures, which are in process of natural succession, and are often under the pressure and penetration of invasive species (Figure 10). Apart from its nearly-natural nature, this has no conservation significance. Only in some localities, outside the project footprint and buffer, there are individual and scattered fragments of 'Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)' (Natura 2000 code: 6510), which are mowed and are regularly closer to settlements. They are most often dominated with *Arrhenatherum elatius* or *Festuca pratensis*, and they are in a rather unrepresentable state due to the limited space they occupy and neglect. The two medium-sized areas (approximately 19.5 ha) where these habitats can be identified are marked on the map 2, Annex 12, are located on the right floodplain of Bosna river. They are not representative and not in the zone of influence of the project. As it does not work in the type of habitat that is not a priority, they cannot be treated as „critical habitats“.



Figure 10 Early Successional Stages Towards Mesophilous Grassland on Abandoned Cropland (Tarevačka polja)

### 3.3.5 Shrubby habitats

Along Bosna River, willows, poplars and black alder grows as initial stage of development of high softwood forests on fluvisols, mostly next to rivers and old trees, which are constantly flooding and having new fine material brought by rivers. These shrubs are in a very not representative stadium, with many invasive plants, and with no significance for protection. Only active measure is to find the solutions in reduction and maintenance against invasive plant species.

The false indigo bushes appear everywhere in places of cleared forests and abandoned arable lands. These habitats are not recognized as important for protection.

### 3.3.6 Forest habitats

Fifteen isolated forest stands of soft deciduous forests on fluvisols, coastal willow-poplar and alder wood 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*' (Natura 2000 code: 91E0\*) were identified, mostly structurally and floristically degraded.

*Willow-poplar forests* are represented by fourteen small patches near the river. These forests are developed in the form of smaller fragments (5-8 ha), mostly along the riverbed of Bosna River or along the oxbow. They are mostly degraded by illegal logging, gravel excavation, invasive species and waste deposition (Figures 11. and 12.). However, they represent remnants of natural vegetation. Although representing the typical forest stands, while listed on Annex I of EU Habitat Directive as a priority habitat type, these stands recorded cannot be identified as "critical habitat" in the context of realization of this project. These forest stands are mostly far from the route of the planned motorway.



Figure 11 Degraded Willow Woods near Botajica



Figure 12 Willow Woods Showing Trash Accumulation (Vranjak)

*Alder forests* are represented by one well developed stand in an old riverbed near the village of Kožuhe, as marked on Map 5 in Annex 12. See also Photo 13 below. Alder forests are primarily found in depressions, at the lowest terraces of the river flow or at the oxbow in lowland areas of northern Republic Srpska and B&H. These are basic, moist gley soils where groundwater level is very high and can stagnate on the surface for several months. Standing water bodies can flood occasionally, mostly in early spring and summer. The stand is well developed for the habitat type, with characteristic or typical species. This habitat can't be considered as a "critical habitat" because it's not unique, it is relative small and isolated in the area between the Bosna River and the hilly part of Trebava mountain and it is surrounded by plots with intensive agricultural production. These habitats are distributed in other zones along the route of the project area, i.e. along the valley of Bosna River. In this area, this habitat type is not endangered because the largest area of same habitat types are located in locations that are planned as protected and are left to natural succession processes, and where logging and melioration are not carried out (mostly along the Sava River). A small part of this area of the alder wood will be under construction of the additionally planned "Trebava" interchange in Kožuhe. This size of this isolated alder forest is about 17 ha, and about 2.5 ha (15%) of forest is planned for removal during the construction works.

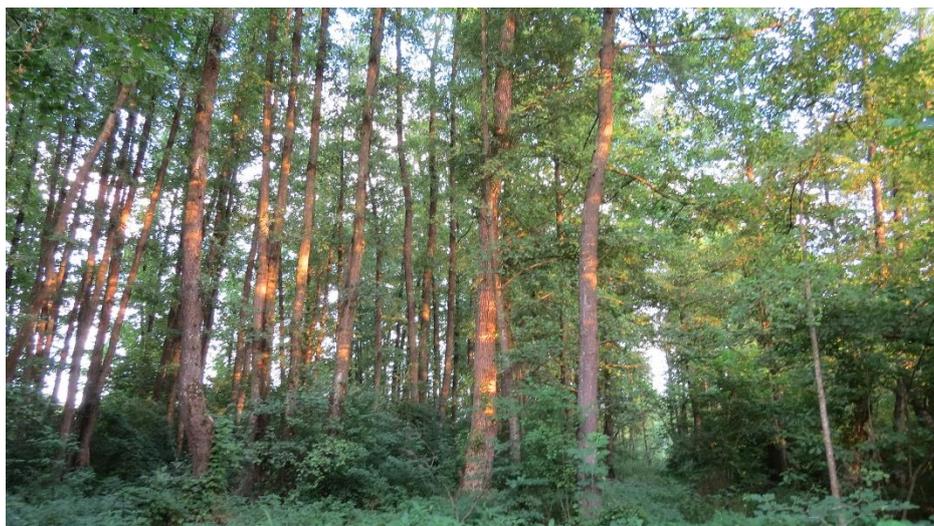


Figure 13 Alder Wood Near Kožuhe Village

Four isolated forest stands of soft deciduous oak-hornbeam forests were identified in the area of village Osječani Gornji and Kožuhe, structurally and floristically mostly degraded. The project footprint also overlaps with small area of the oak-hornbeam forest in the northern part of the project area near the hill "Dobor" (Jakeš) which is a part of a large area under the oak forest that covers the hills of the mountain

Vučijak under it is located. This habitat is also listed on the Annex I as 'Illyrian oak-hornbeam forests (Erythronio-Carpinion)' (Natura 2000 code: 91L0) and it's not a critical habitat.

*Sessile oak and hornbeam forests*: Sesile oak and hornbeam forest in the project area of influence are located in the northern part of the route around the Dobor hill. Forests of *Quercus petraea* and *Carpinus betulus* are the most widespread forests type in this part of the Republic Srpska and grow mostly on deep neutral to slightly acidic brown forest soils, with mild humus mostly in hilly and submontane regions, river valleys and the plains. This habitat does not meet the criteria for a critical habitat.

### 3.3.7 Cultivated or artificial habitats

Most of the habitats in subject area are represented with arable land under monokulture, but they consist of smaller uncultivated plots, and in some areas meadows that are semi-intensively used for mowing. There are also objects and infrastructures that, together with previous types, are not important for protection.

## 3.4 Flora and Vegetation

Based on the review of the list of plant species detected in field research and found in available references, it may be concluded that none of the found plant species in the subject area is of significance for protection at EU or global level. Ten registered plant species are protected or strictly protected according to the Regulation on strictly protected and protected species of the Republic Srpska. A complete list of plant species found during flora and vegetation research is in Annex 4. The following list presents species that are protected or strictly protected at the national level:

Table 6 List of registered protected and strictly protected plants

No.	Species	IUCN Global Red List	Annex of HD	Strictly protected or protected in RS	Localities (Flora Site ID)
1.	<i>Carex strigosa</i>		-	SP	9, 10, 13, 14, 16, 20, 21, 22, 26
2.	<i>Carex vesicaria</i>		-	P	10, 11, 13, 16
3.	<i>Cyperus fuscus</i>	LC	-	P	24, 29, 27
4.	<i>Cyperus glomeratus</i>	LC	-	P	24, 29, 27, 28
5.	<i>Galium uliginosum</i>	LC	-	P	13, 22
6.	<i>Polygonum amphibium</i>	LC	-	SP	25
7.	<i>Peucedanum aegopodioides</i>		-	P	9, 10
8.	<i>Phalaris arundinacea</i>		-	P	9, 10, 11, 15, 16, 17, 18, 19, 20, 21, 26
9.	<i>Taraxacum paludosum</i>		-	P	8, 9
10.	<i>Thalictrum flavum</i>		-	P	25

The list and coordinates of the sites where these species were found are given in Appendix 1. The localities where these species were found are presented on map 1, Annex 12. All sites are located outside the project influence zone and in not representative habitats.

According to the publication „Ecological-vegetation regionalization of Bosnia and Herzgeovina“ (Stefanović et al. 1983), the study area belongs to the Pripannonia area or the North Bosnian area. In

terms of vegetation, the subject area belongs to climax communities of deciduous forests, but they are mostly degraded and altered, so today in this area we find mosaic habitats of natural, partly natural and artificial (agricultural and urban) ecosystems.

In almost every researched area, there is a high proportion of alien and invasive species. Areas with natural composition of flora are rare and scattered and can be found along the subject area in fragments, mostly structurally and floristically degraded coastal willow-poplar and alder forests.

In terms of vegetation, this area belongs to the Euro-Siberian-North American region, which is differentiated in lower phytogeographical units or provinces: Illyrian, Moesian and Central European. This area belongs to Central European province.

The muddy banks of the rivers in lowland and hilly area are overgrown with annual pioneer nitrophilus plants of the alliance *Chenopodion rubri p.p.* i *Bidention p.p.* In spring and early summer, the habitat is bare and vegetation develops later in summer. Characteristic species are: *Bidens frondosa*, *Xanthium sp.*, *Polygonum lapathifolium*, *Chenopodium rubrum* and other.

In littoral part of the Bosna River, along the canals, mouth of streams, and some ponds, the vegetation of alliance *Magnocaricion* NJ Koch. 1926 i *Phragmution* NJ Koch. 1926 has been developed.

Along the Bosna River and its tributaries, canals, oxbow and ponds on alluvial lands, the assemblage of *Salicetum albae* Soo and *Populetum nigrae-albae* Slavnić (1942) 1952 appears, and are closely related to non-forest vegetation. White willow forests (*Salicetum albae* Soo) are developed in the form of smaller fragments along the Bosna riverbed, with the absolute dominance of white willow (*Salix alba*), which is sometimes joined by poplar (mostly *Populus nigra*, but also *P. alba*, *P. canescens*, *P. tremula*.). Willow forest are located along the banks and in the areas between riverbeds and regional roads. These forest stands are mostly severely degraded by illegal logging, gravel excavation, invasive species and garbage deposits. Typical species found are: *Salix alba*, *S. fragilis*, *Populus nigra*, *Rubus caesius*, *Urtica dioica*, *Galium aparine*, *Phalaris arundinacea*, *Carex remota*, *Glechoma hederacea*, *Rumex sanguineus*, *Lycopus europaeus* and others, with presence of invasive *Acer negundo* dominating in almost all studied localities, and other allochthones and invasive plants: *Fraxinus pennsylvanica*, *Morus alba*, *Parthenocissus quinquaefolia*, *Fallopia japonica*, *Echinocystis lobata* etc.

Fragments of the hygrophilus forest of the black alder assemblage *Alnetum glutinosae* together with hygrophilus forests of black alder alliance (*Alnion glutinosae* Malc. 29) are appearing azonal. Alder forests are found in shallow, swampy depressions in the lowlands where stagnant water is common, but usually dries out in the warmer parts of the year. Alder forests have been developed in the village of Kožuhe. This forest stand is with typical species: *Alnus glutinosa*, *Frangula alnus*, *Rubus caesius*, *Carex riparia*, *C. vesicaria*, *C. remota*, *C. strigosa*, *Iris pseudacorus*, *Caltha palustris*, *Ranunculus repens*, *Galium uliginosum*, *Circaea lutetiana*, *Peucedanum aegopodioides*, *Ficaria verna* etc.

The route of motorway passes through the hilly region only in the northern area around Dobor hill.

On these slightly higher terrains of 200-300 m a.s.l. on the acid brown soils, forests of sessile oak and common hornbeam are developed, the association of *Quercus-Carpinetum betulii* Ht.em Bleč. 1958. In addition to the main edificator species of sessile oak (*Quercus petraea*) and hornbeam (*Carpinus betulis*), there are also: linden (*Tilia grandiiifolia*), maple (*Acer campestre*), beech (*Fagus sylvatica*) and other species. Species in the understory of shrubs are rare, except in the burnt areas, and there can be found: *Ligustrum vulgare*, *Acer tataricum*, *Rosa canina*, *Crataegus monogyna* and others. At the ground vegetation dominates: *Pulmonaria officinalis*, *Stellaria holostea*, *Fragaria vesca*, *Hedera helix*, *Asarum europaeum*, *Anemone nemorosa*, *Oxalis acetosella*, *Hieracium murorum*, *Veronica officinalis* and others.

In the hilly part of the northern zone of the planned highway route along the Bosna River on cleared areas and bush areas in forests are well developed and built by many species. Some of them are: *Corylus avellana*, *Euonymus europaeus*, *Viburnum opulus*, *Crataegus monogyna*, *C. oxyacantha*, *Rosa arvensis* and others.

Acacia (*Robinia pseudoacacia*) is present on the former arable land and overgrown plots, which may form clean forest stands.

Secondary (semi-natural) vegetation types include smaller areas or narrow fields of early successive stages of mesophilic meadows on abandoned arable land, which are not representative nor important for the protection. Within the ecosystems of the floodplain around rivers and canals, on wet and humus soils, vegetation of order *Deschampsietalia caespotosae* H-ić 1930. with species such as: *Centaurea*

*jacea*, *Daucus carota*, *Trifolium pratense*, *Trifolium repens*, *Rumex acetosa*, *Achillea millefolium*, *Galium mollugo* and other common and widespread plant species. In the vicinity of the settlements, where the meadows are more often fertilized, productive mowing lowland meadows of *Arrhenatherion elatioris* are located outside the zone of influence of the motorway.

The presence of various ruderal habitats (around households, infrastructure, dry and wet landfills, yards and boarder areas along fields) has conditioned the development of tertiary ruderal ecosystems. These habitats are nitrophilic which caused the appearance of indicator species of these ecosystems. In populated areas and around infrastructures, ruderal vegetation, vegetation of degraded habitats, vegetation of nitrophilous habitats and vegetation of wet landfills are developing.

Arable land are artificial ecosystems or agroecosystem created under the influence of man. These are: granaries, orchards, gardens with ecological conditions created for growth of weed flora and vegetation. The weed flora and vegetation of this area is very diverse and widespread because of the largest areas of the planned motorway route is under arable land, suitable for development of before mentioned flora and vegetation. These types of vegetation have no conservation significance and therefore we do not describe them in detail.

During the field work, a significant presence of ragweed (*Ambrosia artemisifolia*) was determined. It builds facies (pseudogley, eugley and semigley) on different soils, dense population that spreads occupying significant areas of subject area.

#### *Flora and vegetation around Fortress of Dobor*

On northern and northwestern side of the Fortress of Dobor there is a culture of white and black pine, which is in quite neglected stadium, about forty years old. It occupies very small area. The assembly of trees is very dense so there is no undergrowth. South and south-eastern part of Dobor fortress is formation of offspring forest stand of sessile oak and hornbeam *Quercus-carpinetum*. In addition, there can also be found: *Acer campestre*, *Prunus cerasifera*, *Prunus avium*, *Crataegus monogyna*, *Corylus avellana*, *Paliurus (australis) spina christi*, *Abies alba*. This vegetation is specific, developed under the influence of man so it is not specifically considered for protection, and protection measures should be included in the consideration of cultural and historical monument as a single entity with its environment, with future project of landscaping around Fortress of Dobor after the completion of highway construction.

## 3.5 Fauna

The data on fauna were collected within the Study Area, and particularly from the Survey Sites marked in Map 1., Annex 12 and in the table of Annex 2.

### 3.5.1 Aquatic fauna

Out of the representatives of invertebrate aquatic fauna, there are macroinvertebrates, out of which the most significant are water insects (stoneflies, caddisflies, mayflies, dragonflies, etc.) with pretty equal distribution in the watercourse. None of the species registered during water monitoring is under protection regime at the national or international level.

The most often found fish in the River Bosna in the area of Dobož and Modriča are usual for valley rivers and stagnant waters, and they are mainly species tolerant to pollution. The species of fish that might be found in this area (*Esox lucius*, *Rutilus rutilus*, *Squalius cephalus*, *Chondrostoma nasus*, *Barbus barbus*, *Alburnus alburnus*, *Abramis brama*, *Vimba vimba*, *Carassius gibelio*, *Cyprinus carpio*, *Silurus glanis*, *Ameiurus nebulosus*, *Lepomis gibbosus*, *Sander lucioperca*, *Perca fluviatilis*) are usual for the whole length of the River Bosna, from Dobož to Modriča.

Significant findings for the impact area of this route are the following: *Gobio obtusirostris*, *Romanogobio uranoscopus*, *Romanogobio kesslerii*, *Rhodeus amarus*, *Misgurnus fossilis*, *Cobitis elongata*, all species are on Annex II od Habitat Directive, and species threatened by IUCN *Alburnus sarmaticus* (IUCN - EN) and *Cyprinus carpio* (IUCN - VU). All these species are also on the list of protected and strictly protected fish species in the Regulation on Protected Species of RS. The presence of genetic status of indigenous wild carp (*Cyprinus carpio*) is unexplored due to unplanned fish restocking and the introduction of carp farmed in fishponds. Other species are widespread along the river's course, and the river Bosna does not represent a unique habitat, nor does it support a significant population of any

of these species. Only *Misgurnus fossilis* and *Cobitis elongata* species use standing rivers or slow-flowing tributaries of the Bosna River (e.g. Ljubioča, Bosnica). These rivers, which are the habitats of these species, are not intersected by the planned highway, and other tributaries are provided with culverts in order to maintain the continuity of watercourses flowing into Bosnia.

### 3.5.2 Amphibians and Reptiles

Of the amphibians, species have been recorded that do not have special conservation significance, are widespread, and are well adapted to the current environmental conditions. Edible frog (*Pelophylax kl. esculentus*), a hybrid whose presence was confirmed in most water habitats. Several zones within the wide area of project influence may be significant as locations suitable for reproduction of amphibians, but not for species of conservation interest. All seasonally flooded and wet habitats along the river are potentially favorable for amphibian reproduction, but there is no evidence of the presence of species or populations particularly important for protection.

The dice snake (*Natrix tessellata*) and the Grass snake (*Natrix natrix*), are the common snakes species which depends on water bodies. The second most common species of reptile is the green lizard (*Lacerta viridis*).

Recorded fauna of amphibians and reptiles in general have neither composition nor abundance in the wider area of motorway route to be of significance for selection of localities strictly important for protection of their populations. The only species of interest that was recorded is european pond turtle, *Emys orbicularis* (EN according to IUCN; Annex II of Habitat Directive; Strictly Protected according the National Regulation on Strictly protected and Protected Species of RS) at the locations Dugo Polje (Kutlovac), Kožuhe and Vranjak, but that is outside of the subject section of the motorway, although indicating the sporadic presence of this species in stagnant waters and backwaters near the Bosna River. The findings represents only three older individuals on three different locations (Annex 12; maps 6,7,8). don't indicate a presence of larger habitats suitable for reproduction of pond turtle after a detailed search of the surrounding terrain where the individuals were found. However, based on the literature and field data, the considered section of the planned route of the motorway does not separate any recorded important habitat of European pond turtle from the River Bosna and it is not visible in the field that any habitat of European pond turtle might be threatened directly by the motorway. Field data so far show that there is no permanent route used by any species of protected amphibians or reptiles that would be cut by the motorway.



Figure 14 European pond turtle in a small channel near Vranjak village

### 3.5.3 Birds

The lower part of the Bosna River represents the habitat of many bird species due to its favorable geographic position, various and numerous sources of food and presence of water during the whole year (Sjeničić, 2013; in litt.). For all those reasons, mitigation of impacts on birds was discussed detailed within the report. During data survey on birds existing along the route, we noticed that neither are there

areas that contain significant populations of protected species, nor individual nesting sites of key species that might be in the zone of direct impact of the construction works. Habitats of possible significance for birds like river, river banks, alluvial woods and oxbow are mostly outside the zone of motorway direct impact.

The list of birds recorded in the area is found in Annex 10. Recorded species found in project area include 124 species in total. Most of the species found here are common for the continental biogeographical region, and are widespread in the Republic of Srpska and the region.

Registered species that are of interest for protection (internationally threatened according to IUCN, special species 1 and 2, species from Annex I of Bird Directive) that nest in the valley of Bosna river are: *Lanius collurio* (Annex I; IUCN - LC), *Lanius minor* (Annex I; IUCN - LC), *Streptopelia turtur* (IUCN - VU), *Alcedo atthis* (Annex I; IUCN - LC), *Haliaeetus albicilla* (Annex I; IUCN - LC) All nesting sites of mentioned bird species are outside the project influence zone of the project and some of them are marked on the map. The nesting sites of the species *Lanius collurio* and *Streptopelia turtur* are not marked on the map because the species are widely common, widespread and numerous for these and many other habitat types common for RS. Populations of the rest recorded species are small (< 5 five breeding pairs) and most populations of these species are found in other ecosystems that are widespread in the environment (e.g. Sava River, karst fields). The nesting of the species *Haliaeetus albicilla* represents data from previous year, and abandoned nest was found in the field in the Kožuhe village, about 400 m from the planned route, but nesting was not confirmed in year 2021. Regardless, the species is listed as a nesting bird in this area because there is a possibility that it will breed again in the next period.

Table 7 List of birds that have been recorded in the project area and are important for protection

No.	Species	Breeding confirmed	Migration	Wintering	Other (feeding, vagrant etc)	Annex of Bird Directive	IUCN Global Red List	National protected or strictly protected
1.	<i>Streptopelia turtur</i>	Yes	Yes			IIB	VU	SP
2.	<i>Grus grus</i>	No	Yes			I	LC	SP
3.	<i>Ciconia nigra</i>	No	Yes		yes	I	LC	SP
4.	<i>Ciconia ciconia</i>	No	Yes		yes	I	LC	SP
5.	<i>Platalea leucorodia</i>	No	Yes		yes	I	LC	SP
6.	<i>Ixobrychus minutus</i>	No	Yes			I	LC	SP
7.	<i>Nycticorax nycticorax</i>	No	Yes		yes	I	LC	SP
8.	<i>Ardeola ralloides</i>	No	Yes		yes	I	LC	SP
9.	<i>Ardea purpurea</i>	No	Yes		yes	I	LC	SP
10.	<i>Ardea alba</i>	No	Yes	Yes	yes	I	LC	SP
11.	<i>Egretta garzetta</i>	No	Yes		yes	I	LC	SP
12.	<i>Vanellus vanellus</i>	No	Yes			IIB	NT	SP
13.	<i>Tringa glareola</i>	No	Yes			I	LC	SP
14.	<i>Sternula albifrons</i>	No	Yes		yes	I	LC	SP

15.	<i>Sterna hirundo</i>	No	Yes		yes	I	LC	SP
16.	<i>Circaetus gallicus</i>	No	Yes			I	LC	SP
17.	<i>Circus cyaneus</i>	No		yes		I	LC	SP
18.	<i>Haliaeetus albicilla</i>	yes		yes	yes	I	LC	SP
19.	<i>Alcedo atthis</i>	yes		yes		I	LC	SP
20.	<i>Picus canus</i>				yes	I	LC	SP
21.	<i>Dryocopus martius</i>	No		yes	yes	I	LC	SP
22.	<i>Leipicus medius</i>	No			yes	I	LC	SP
23.	<i>Falco vespertinus</i>	No	Yes			I	NT	SP
24.	<i>Lanius collurio</i>	Yes	Yes			I	LC	SP
25.	<i>Lanius minor</i>	Yes				I	LC	SP

Other registered species are using the Bosna River valley or the river itself only during migration or feeding and visit this area in small number or rarely.

The following species of stork and herons: *Ciconia nigra*, *Ciconia ciconia*, *Platalea leucorodia*, *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardeola ralloides*, *Ardea purpurea*, *Ardea alba*, *Egretta garzetta* (all species are LC according to IUCN Global Red List and on Annex I of Bird Directive) were recorded along the river, usually near the water. These species use the river occasionally or feed on ponds or flooded areas. All species were recorded as single individuals or a maximum of four individuals. Shore birds like *Vanellus vanellus* (IUCN - VU, Annex IIB of BD) and *Tringa glareola* (IUCN - LC, Annex I BD) are using the Bosna River valley during migrations and they occasionally stay around the water but not in the areas where the motorway is planned, and terns *Sternula albifrons*, *Sterna hirundo* (both on Annex I, IUCN - LC) nests downstream in the area further than 20 km of study area but using the upstream area during daily migrations, flying only over the water surface in search for food. There are no suitable habitats or areas where these bird species gather in numbers greater than five individuals in the area of project influence.

*Grus grus* (IUCN - LC, Annex I of BD), passes over at higher altitudes (over 300 m). There is no data on the numbers of these species flying over the area, but none were recorded as stopping or congregating at any location along the river. This species generally nests at distant sites outside of Bosnia and Herzegovina. There is unlikely to be any Project effect on these species. All these bird species of conservation interest are shown in table 7. Minor impact on migratory species is expected because these species are commonly found migrating over a wide area.

*Circaetus gallicus* (IUCN - LC, Annex I of BD) and *Falco vespertinus* (IUCN - NT, Annex I of BD) have been recorded as species that fly over space during migration, and in literature two individual cases have been reported for this area. *Circus cyaneus* (IUCN - LC, Annex I of BD), a common wintering species, uses the wider area of Bosna River and whole Posavina region during winter and the Bosna River valley is not registered as wintering ground for this significant population of species.

Species of woodpeckers: *Picus canus*, *Dryocopus martius*, *Leipicus medius* (all on Annex I, IUCN - LC) are occasionally found in the valley of Bosna River on feeding, but they most often nest in the surrounding mountain forests. Nesting was not confirmed in the project footprint or buffer zone.

All the above-mentioned species have the status of strictly protected species under the Regulation on strictly protected and protected species of the RS.



Figure 15 White-tailed eagle nest near "Dijelovi" area, Kožuhe



Figure 16 Herons and other wetland birds are mostly found near the river water (Botajica)

### 3.5.4 Mammals

The list of important registered species of large mammals confirmed on field research in the area of Bosna River valley includes 50 species that can most often be found along the river, and additional number of species from the previous field researches and data from hunting associations.

Annex 11. lists the main species of mammals recorded in the area of the Bosna River valley in the field or by surveying the local hunters or from the literature sources. This includes species that are most commonly encountered along the valley of the river Bosna.

Small mammals were registered mostly sporadically and by unsystematic research. According to the areal maps and considering ecological needs of certain species of small mammals, taking into account the intensive use of agricultural land, small mammals expected in the subject area are listed (see Annex 11). All presumed or registered small mammals are common species in this area, numerous and they do not require special protection measures. There is no significant habitat for this species group along the Bosna River that would require additional and specific research.

On territory of whole Bosnia and Herzegovina there are around 32 known bat species from 3 families (Rhinolophidae, Vespertilionidae and Molossidae) (Mulaomerović&Sjeničić, in litt.). Data come from different sources, mostly from literature and the existing collections of Center for Karst and Speleology and the Lands Museum in Sarajevo.

Of the 32 bat species recorded in B&H, the bat surveys undertaken in July 2021 confirmed that 11 bat species use habitats within the survey area, which is likely to be attributed to the mosaic of different habitats found in the area (i.e. river, ponds, woodland, agriculture land and abandoned houses and infrastructure) and the absence of artificial lighting. The majority of bat species identified in the survey area are categorised as Least Concern by the IUCN Red List of Threatened Species.

A total of five bat species recorded in the survey area are rare and threatened at the national, regional and global scales. These are listed as follows:

Table 8 Protected bat species

No.	Species	Annex of Bern convention	Annex of Habitat Directive	Annex of Cites convention	IUCN Global Red List	Strictly protected or protected by National Regulation
1.	<i>Myotis capaccinii</i>	II	II, IV	II	VU	SP
2.	<i>Barbastella barbastellus</i>	II	II, IV	II	NT	SP
3.	<i>Miniopterus schreibersii</i>	II	II, IV	II	VU	SP

Despite the recorded presence of bats, there are no confirmed roosting or foraging habitats for bats. Data about open roost sites are only known from literature. There are no reliable data for speleological objects (caves and pits) in the study area. While older trees and underground habitats still provide key roost sites, many bat species are heavily reliant on artificial structures, such as buildings and /bridges. In fact, the Bosna River Valley itself is not a key habitat for bats. Any bats that do exist in the Study Area are most likely to roost in abandoned residential buildings and church towers, and in the wider area, in the mountainous areas on either side of the Bosna River Valley. The most likely flight paths for bats foraging in the area are the forests and the river channel.

The mammal species related to watercourses which have a protection status are: *Castor fiber* and *Lutra lutra*.



Figure 17 Signs of beaver presence (Botajica)

The project footprint and buffer do not provide suitable habitat to support foraging, commuting and breeding otters. However, oxbow, small tributaries and associated network of waterways located in the environs were considered to offer potentially support beaver and otter activity. *Lutra lutra* is included on Annexes II and IV of the EU Habitats Directive and should therefore be protected wherever it occurs.

The locations where beaver activity was found are marked on the maps 6. and 7. (Annex 12). No nests were observed. The beaver population increases on the Bosna River in last few years. A number of conservation measures have contributed to the recovery of beaver in Europe, including reintroduction and translocation, hunting restrictions, and habitat protection. It is listed under the Bern Convention (Appendix III) and the EU Habitats and Species Directive, being included on Annex II and IV.

Both species have been recorded close to the river Bosna and also in the smaller tributaries as shown on Maps 2 and 3 in Annex 12 The Projects could affect their access to habitat if effective crossings and culverts are not provided.

Several species of mammals noted in the Study Area are considered game for hunting - *Lepus europaeus*, *Vulpes vulpes*, *Canis aureus*, *Martes foina*, *Martes martes*, *Meles meles*, *Capreolus capreolus*, *Sus scrofa*. Based on information from the survey and confirmation from local hunters, these are particularly represented at three points:

- Kožuhe, locality "Dijelovi"
- Dugo polje, locality "Kutlovac"
- Botajica locality, "Botajičke luke"

These three locations represent zones of frequent presence of medium and large mammals. These locations are marked in red in Map 12, Annex 12.

In a surrounding of 40 kilometers distance from project area, there is no recorded presence of large carnivores such as brown bear and grey wolf. In a surrounding of 80 kilometers distance (or even more) from project area, there is no suitable habitat nor recorded presence of a lynx.

### 3.5.5 Dragonflies

The dragonfly fauna of Bosnia and Herzegovina is still rather poorly investigated. All collected data about dragonfly species indicate that common species are widespread in the valley of Bosna River. None of them are key species important for protection.

### 3.5.6 Butterflies

The data collected for butterflies do not indicate the presence of species of conservation interest, except for sporadic sightings of *Lycaena dispar* (Large Copper Butterfly; IUCN - NT) which is listed in the Annexes II and IV of the Habitats Directive. However, this is insufficiently represented in the Study area for it to be considered of conservation significance. Data on recorded butterflies invertebrates are given in Annex 4.

## 3.6 Protected Areas

### 3.6.1 Existing Protected Areas on International and National Level

#### International Level

Internationally protected areas have been declared based on the conventions and agreements which Bosnia and Herzegovina is signatory, therefore, the areas that are recognized according to international criteria and officially declared at the level of the whole of Bosnia and Herzegovina are presented.

There is a three Ramsar sites and four Important Bird Area (IBA) in the territory of Bosnia and Herzegovina.

Table 9 IBA areas in B&H

Country/Territory	Site name	IBA Criteria	Final Code
Bosnia and Herzegovina	Bardaca	A1	BA003
Bosnia and Herzegovina	Boracko jezero	B2	BA002
Bosnia and Herzegovina	Hutovo blato	A1, A4i, B1i, B2, B3	BA001
Bosnia and Herzegovina	Livno karst field and Busko lake	A4iii, B1i, B2, B3	BA004

(Source: <http://datazone.birdlife.org/site/mapsearch>)

Table 10 Ramsar sites in B&H

Site	Date of designation	Region, province, state	Area	Coordinates
* Bardaca Wetlands	02/02/07	Republic of Srpska Entity	3,500 ha	45°06'N 017°27'E
* Hutovo Blato	24/09/01	Federation of Bosnia and Herzegovina	7,824 ha	43°03'N 017°47'E
* Livanjsko Polje	11/04/08	Federation of Bosnia and Herzegovina	45,868 ha	43°51'N 016°49'E
Total:	3 Ramsar sites, 56,779 hectares			

Source: The List of Wetlands of International Importance Published 11 November 2021  
(<https://www.ramsar.org/sites/default/files/documents/library/sitelist.pdf>)

According to the situation shown in the tables 9 and 10 and on the figure 18, it is noticeable that the project area is not located on the area or in the zone of the direct, indirect or any other impact on the internationally declared protected areas on the territory of Bosnia and Herzegovina.

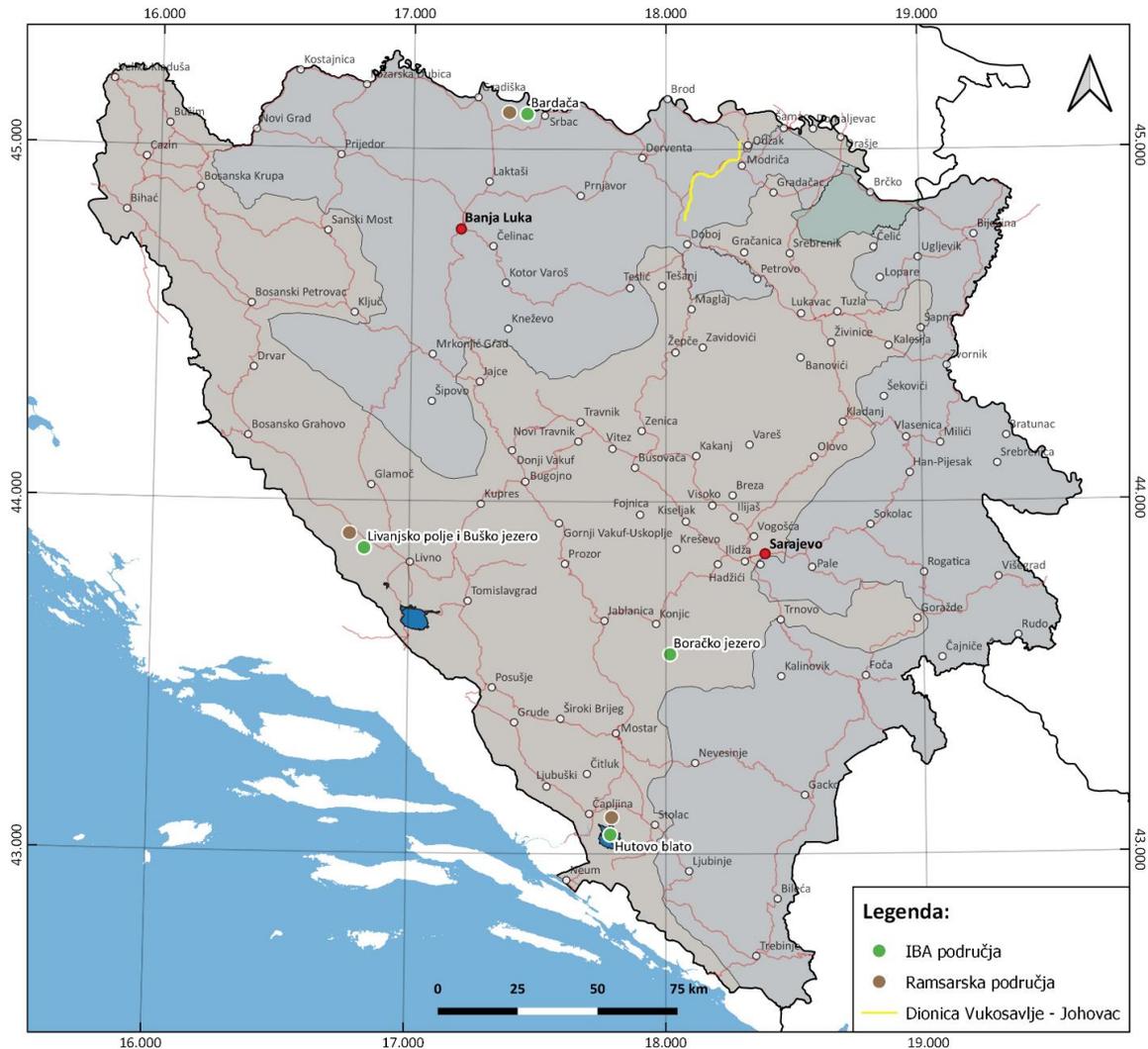


Figure 18 Map of IBA and Ramsar areas in B&H

### National Level

In the Bosnia and Herzegovina, nature protection the responsibility of entities Republika Srpska and Federation of Bosnia and Herzegovina and it is regulated by Nature Protection Law ('Official Gazette of the Republic of Srpska' no. 24/12). Considering that the highway is located on the territory of Republika Srpska, the closest protected areas are listed. Categories of protection are coordinated with the IUCN criteria and imply international categories implemented in domestic legislation.

According to the current legislation of Republika Srpska, the surface of nature protected areas is about 53,211.21 ha, which is a 2.16% of the territory of Republika Srpska. 29 areas are protected: 2 Nature Reserves (IUCN category Ia), 3 national parks (category II), 15 Natural Monuments (category III), 2 Protected Habitats (category IV), 4 Nature Parks (category V) and 3 Protected area with sustainable use of natural resources (category VI);

The area of the planned motorway route is not located in the protected parts of nature. By reviewing the Registry of Protected Natural Areas at the Institute for Protection of Cultural, Historical and Natural Heritage of the Republika Srpska and in online database *GisPass*, it is obvious that in the area of Doboje, Vukosavlje and Modriča municipalities there are no presently protected areas. The closest protected area of the natural monument "Cave Rastuša" (GPS 44.695025°, 17.798452°) in the municipality of Teslić is about 25 km away towards south-east, and the protected natural habitat "Tišina" (GPS

45.044075, 18.479347), ie. wetland complex of ponds, marshes, swamps, canals, floodplain forests, connected to the Sava River and groundwater, protected by the Decision of the Government of the RS in October 2019, and it is about 25 km away towards north.

All other protected areas at the level of Republika Srpska are at a distance of more than 50 km from the route.

Table 11 The closest protected areas in Republic Srpska

ID	The site name	IUCN Category	Area (ha)	Municipality	Management	Act
304	Natural Monument „Cave Rastuša“	III	11,39	Teslić	Teslic Municipality	Decision on the protection of the Natural Monument Pećina Rastuša (SG RS No. 87/12)
402	Protected Habitat "Tišina"	IV	196,49	Šamac	Šamac Municipality	Decision on the protection of the Protected Habitat Tišina (SG RS No. 83/19)

Source: Register of protected areas of Republic Srpska; Institute for protection of cultural and natural heritage, Banja Luka

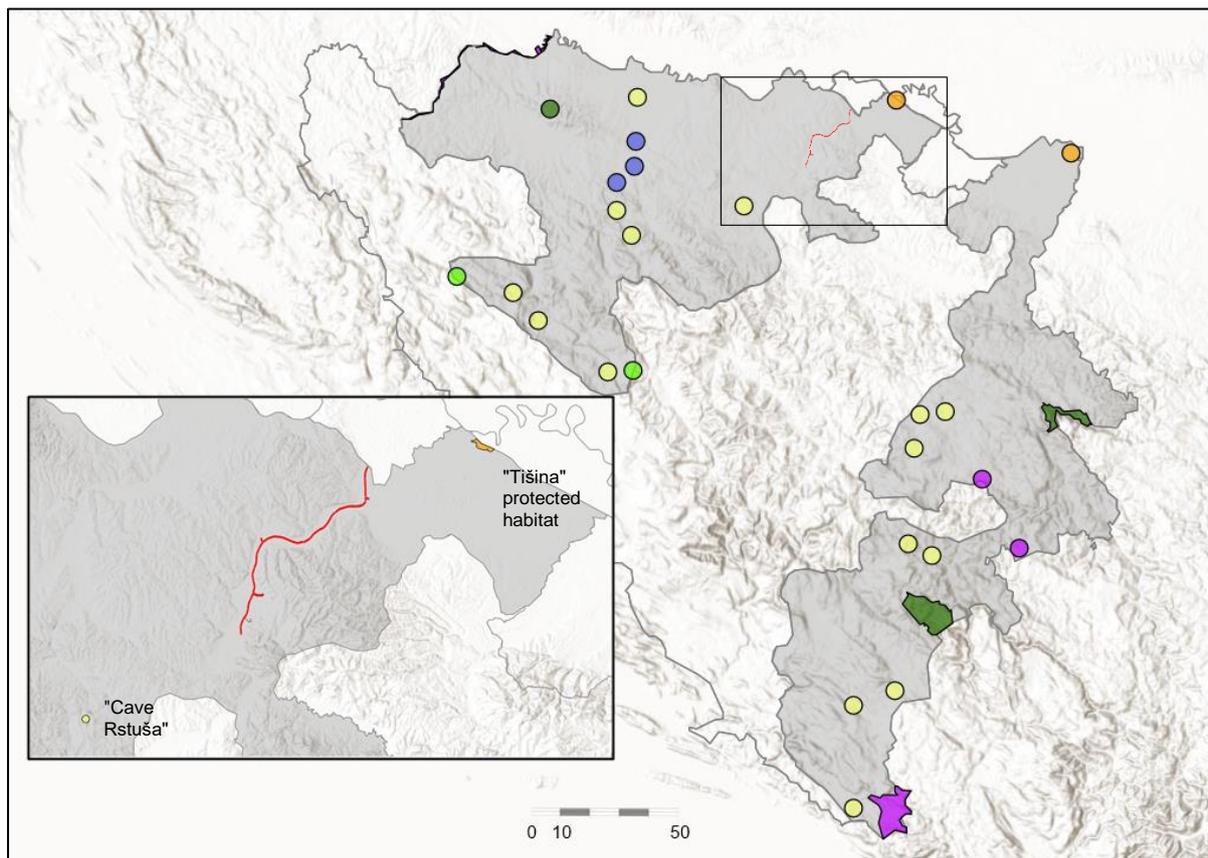


Figure 19 Map of national closest protected areas

Source: <http://e-priroda.rs.ba/en/protectedsites/>

Near the entity border, there are no declared protected areas under the regulations of the Federation of Bosnia and Herzegovina on which the highway would have a direct, indirect, cumulative, residual or other impact.

### 3.6.2 Planned Protected Areas on International and National Level

#### National level

In the Spatial Plan for Republika Srpska (RS) 2015 - 2025, the River Bosna is not planned for designation as a nature conservation area, and was not included as one of 130 sites 'proposed' for protection in the planning period (up until 2025). These sites were identified by biodiversity experts from RS. The Registry of Designated Nature Conservation Areas does not indicate presence of designated natural values along the project area.

Also the public forest management company in Modrica knows of no forest of the high protection value in the project area.

According to the collected data of proposals for protection of natural areas, it is obvious that in the municipalities of Modriča, Vukosavlje and Doboј there are five areas that have been proposed to be protected.

*Table 12 The list of areas planned to be protected in the plan period of the RS Spatial Plan according to IUCN classification*

ID no.	Site name	IUCN Category	Municipality	Coordinates
National park				
PNP005	National park Ozren	II	Doboј, Petrovo	44.620119, 18.251960
Habitat management area				
PUP037	Habitat management area Klokotnica	IV	Doboј, Petrovo	44.733015, 18.185516
Nature parks				
PPP009	Preslica Nature Park	V	Doboј	44.680778, 18.127489
PPP031	Nature Park Duge Njive, Trebava	V	Doboј, Modriča	44.858078, 18.223162
PPP029	Nature Park Vučijak	V	Brod, Modriča, Vukosavlje	45.033492, 16.846732

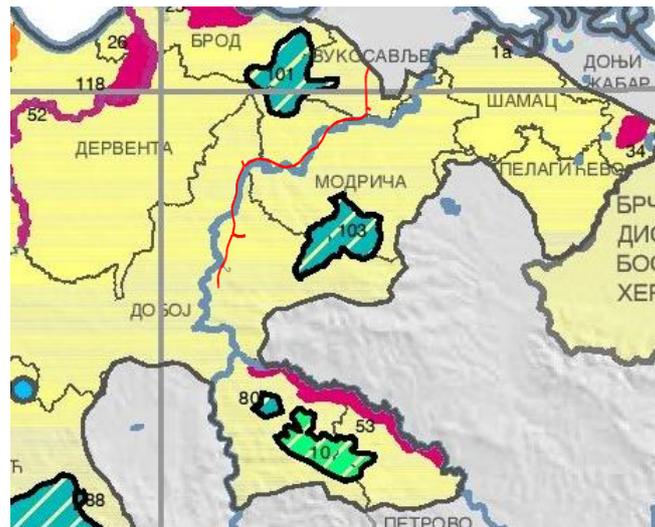


Figure 20 The map of spatial distribution of potential and real protected natural areas in the RS in relation to the project

(No. 103 – Nature Park Duga Njiva, Trebava; 101 - Nature park Vučijak; No. 80 – Nature Park Preslica; No. 10 – National Park Ozren; No. 53 – Klokotnica habitat management area)

Source: Spatial Plan of Republic Srpska 2015-2025

### International Level

The Bosna River is not an Emerald Site or Natura 2000 site. It has not been formally proposed as such by the authorities in either part of Bosnia. In 2008 Bosnia and Herzegovina ratified the Bern Convention. According to the updated list of officially nominated candidate Emerald sites, the state officially nominated 29 areas as candidate Emerald sites. None of the planned Emerald areas is within the project area. The River Bosna within the said project is not Emerald area or Natura 2000 area, and the government has not yet proposed it.

There are not officially proclaimed or nominated Natura 2000 areas in BiH for the country is not the member of EU, so the ecological network Natura 2000 has not yet been established in the RS. According to information from Institute for Cultural and Natural Heritage no activities related to the establishment of ecological network in Republika Srpska have been planned for 2022.

Ecological network of the Republika Srpska is determined by the decree of the RS Government, and the documents for its establishment are prepared by the Republic Institute for Protection of Cultural, Historical and Natural Heritage in cooperation with other professional and scientific institutions. This network will identify ecologically significant areas of the European Union in the territory of the Republika Srpska and it will become the part of the European ecological network Natura 2000. According to Article 25, paragraph 1 of the Law on Nature Protection (“Official Gazette of the Republika Srpska”, No. 20/14), ecological network contains ecologically significant areas, ecological corridors and protection zone.

Out of the proposed Natura 2000 habitats, according to the data from the project “Support to implementation of the Bird Directive and Habitat Directive in Bosnia and Herzegovina” (implemented by EU in BiH, the closest Natura 2000 habitats are in the north area of municipality of Modriča, downstream at the distance around 5 km. There is no impact on these areas provided that measures for prevention of watercourses pollution, solving of drainage, construction of adequate separators and accidents prevention are implemented.

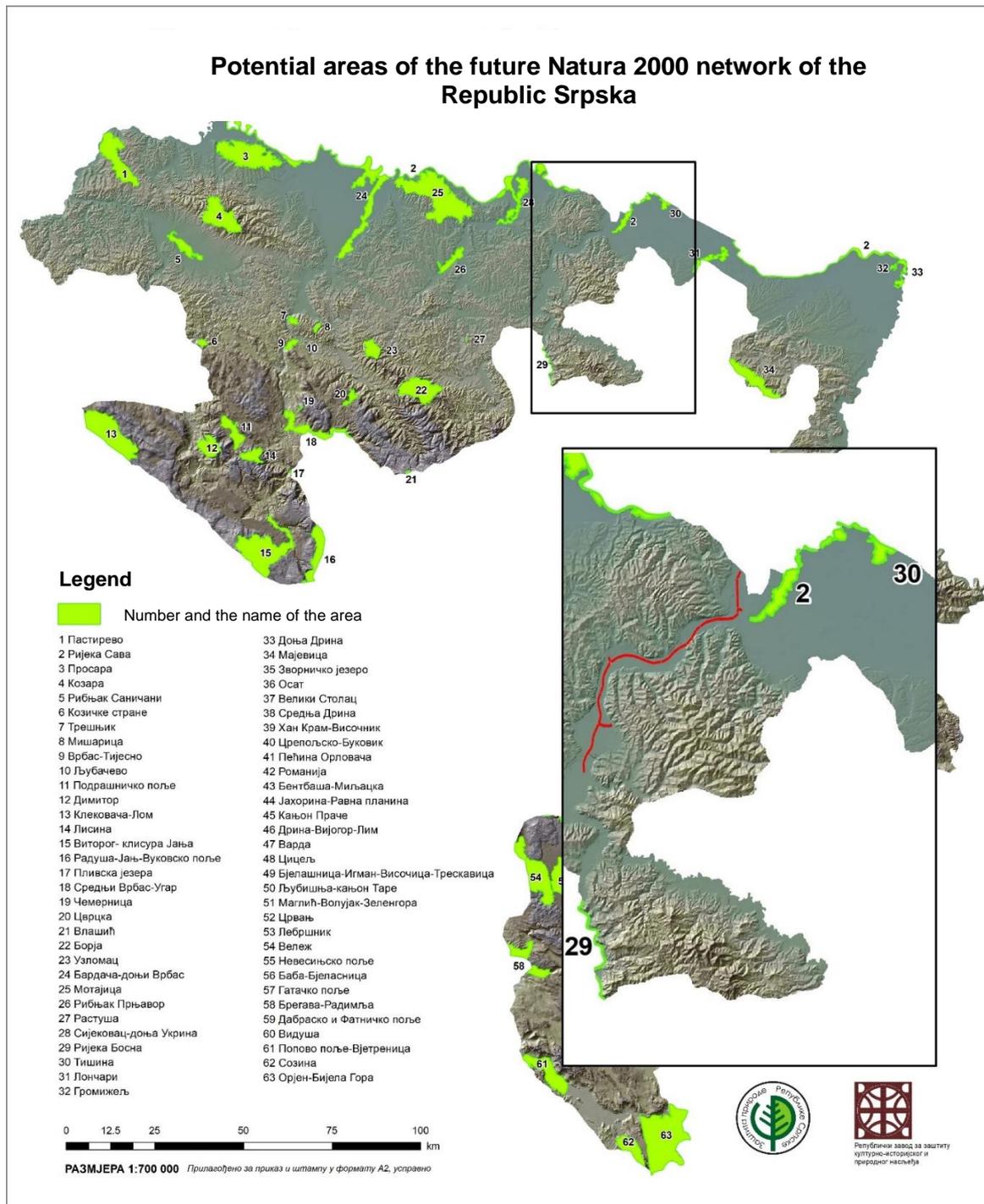


Figure 21 Potential Natura 2000 areas in the RS territory and their position in relation to the project (No. 2 – the River Sava; No. 29 – the River Bosna)

Source: Republic Institute for Protection of Cultural and Natural Heritage, Banja Luka

There are no other areas planned for protection which has to be considered according to the criteria of international agreements and conventions, in the area of influence of the planned route of the motorway.

### 3.7 Existing Impacts and Threats on Biodiversity

In the whole project area, the following factors that represent the threats for biodiversity, present habitat types and species and which exist independently of the motorway construction, have been identified:

- Large area covered with intensive agriculture (Podnovlje, Dugo Polje, Botajica, Tarevci, Vranjak, Koprivna, Majevec, Trnjani, Ritešić, Kožuhe),
- Large area of degraded forest (Kožuhe, Glogovica-Božinci, Podnovlje, Botajica, Tarevci),
- Presence of large number of illegal and legal borrow pits for soil and gravel (Kožuhe, Osječani, Majevec, Trnjani, Podnovlje, Vranjak Donji, Tarevci),
- Poaching, illegal fishing and unsustainable fishing (according to the data from local FA and local population),
- Lack of long-term research and monitoring of biodiversity or key habitats and species,
- Lack of adequate disposal of communal wastewater from households (Kostajnica, Grapska),
- Issue of illegal landfills of communal waste along the river (everywhere along the river),
- Alien invasive species encroachment (plants, fish),
- Noncompliance of strategic and spatial planning documentation of local communities with the aim of biodiversity management (e.g. there is no updated Spatial Plan Doboj, there is no Spatial Plan Modriča, Local Environmental Action Plans (LEAP) of Doboj and Modriča municipalities are incomplete, there is no Local Biodiversity Action Plans etc.)
- Low data quality on present species in updated hunting and fishing management bases and other documentation.



Figure 22 Illegal landfills of communal waste along the river



Figure 23 Illegal gravel extraction site



Figure 24 Unsustainable forestry practice in willow wood (Botajica)



Figure 25 Trash accumulation in willow-poplar shrub

## 4 Assessment of Risks and Impacts on Biodiversity and Ecosystems and Mitigation Measures

### 4.1 Terrestrial Vegetation/Habitats and Flora

#### 4.1.1 Pre-Construction and Construction

##### ***Terrestrial flora habitat loss, degradation and fragmentation:***

Regarding the terrestrial vegetation and habitats, the project footprint mostly overlaps with arable land, degraded areas of abandoned arable land (most under invasive plants), partially abandoned gravel pits with (mostly filled with water and municipal waste) and terrestrial and riverine scrubs (accacia, false indigo bush and willow scrubs). Other terrestrial habitats which are natural and near or in the project influence zone are forests.

Nineteen patches of forests and one part of a larger forest complex in the project area of influence were identified, as shown on Maps 2,3,4,5 (Annex 12). Fifteen forests patches are predominantly willow, five is dominated by oak, and one by alder.

Willow-poplar woods are represented by fourteen small patches near the River Bosna, Maps 2,3,4,5 (Annex 12). As already stated, this habitat is listed as a Priority Habitat on Annex I of the Habitats Directive (code: 91E0\*). These woods mostly don't overlap with project footprint and buffer. Willow-poplar forests in the project area are also very degraded by illegal logging, gravel extraction, invasive species and trash accumulation, see Figures 11 and 12. They also contain a number of invasive species such as *Acer negundo* which is abundant in understory layer of almost every surveyed stand, *Fraxinus pennsylvanica*, *Morus alba*, *Parthenocissus quinquefolia*, *Fallopia japonica*, *Echinocystis lobata* etc. The willow sites in the area of project influence can't be recognized as critical habitats, since they are relatively small, unconnected, degraded and not representative of the habitat type. In addition, these sites are mainly far from the motorway corridor, and lie on left and right floodplain, between the river and motorway, so there is no risk of significant habitat loss, degradation or fragmentation. Impacts to willow-poplar woods located within the project footprint, arising from habitat loss, fragmentation and degradation are expected to be **not significant**.

Alder woods are represented by one developed stand in project influence area in an old riverbed near the village of Kožuhe, as marked on Map 5 in Annex 12. See also Figure 13. A section of the road within the intersection "Trebava" in Kožuhe overlaps this alder forest. As already stated, this habitat is also listed as a Priority Habitat on Annex I of the Habitats Directive (code: 91E0\*), but this example is small and isolated. Although they are representative forest stands, part of the area under the alder forests in Kožuhe is planned to be under construction works of the "Trebava" interchange. The size of this isolated alder wood is about 17 ha, and about 2.5 ha (15%) of forest is planned for removal during the construction works. The interchange crosses the eastern part of this habitat and the rest of habitat remains in connection with the Bosna River, which is an advantage in terms of preserving the suitable condition of forest stands. In addition, the interchange and road route will not occupy the entire surface of this isolated habitat, but will "cut" the surface in two fragments. These type of habitat is also distributed in other zones outside the project area, i.e. along the valley of Bosna, out of project area. In this area, this habitat type is unconnected with other value habitats and is surrounded by plots with intensive agricultural production. The largest areas of same habitat type are located in zones that are planned as protected and are left to natural succession processes, and where logging and melioration are not carried out (mostly along the Sava River, planned for protection under Natura 2000 network in B&H; see Figure 21, symbol no. 2). It is possible to reduce risks and to mitigate threats by providing a stable groundwater level and adequate solution for surface water inflow from the coastal part, as well as monitoring measures during construction work and later during operation phase. In summary, impacts to this habitat located within the project footprint, arising from habitat loss, degradation and fragmentation are expected to be of **moderate** significance prior to mitigation.

The project footprint and the buffer zone of the motorway from Vukosavlje to Johovac **does not occupy or threat any other key terrestrial flora habitat or vegetation complex**. Impacts to habitats located within the project footprint, outside of alder and oak forests, arising from habitat loss and degradation are expected to be of **minor** significance.

##### ***Hydrological changes:***

A sufficient number of culverts and underpasses are planned, and the project does not include the regulation of the Bosna River or the control of flooding. According to the available project documentation

and field research, terrestrial vegetation/habitat that would remain cut off from the inflow of surface water was not registered. Since the motorway will be built mainly on the embankment with numerous underpasses and culverts, it does not threaten the existence of habitat that might be of importance for flora and vegetation/habitats that are supplied with water by flooding of the Bosna River directly or through underground water, so the motorway has **no negative impact on water regime changes in terrestrial vegetation/habitats.**

***Loss of Protected Vascular Plant Species:***

Based on the review of the list of plant species detected in field research and found in available references, it may be concluded that none of the found plant species in the subject area is of significance for protection at global or EU level. All found plant species of interest for protection at the national level, were recorded outside of the project influence zone. All these species are present in other floodplain forest habitats, especially in oxbow which remain out of project footprint, so their potential removal in construction sites **will not have a significant impact** on the population of these plants.

***Spreading of Invasive Alien Vascular Plant Species:***

Knowing that invasive allochthonous plant species have been recorded in all natural and semi-natural habitats in the valley of Bosna River, there is a risk of their additional spreading during the period of area landscaping (grass planting). Whilst alien invasive vascular plants (i.e. *Acer negundo*, *Parthenocissus quinquaefolia*, *Fallopia japonica*, *Helianthus tuberosus*, *Echinocystis lobata*, *Ambrosia artemisifolia*, *Asclepias syriaca* etc.) were identified within the zone of influence during the biodiversity survey, seeds or rhizomes of invasive species could potentially be transferred from affected areas into the project area by vectors e.g. workers and project vehicles. Impacts to terrestrial habitats and flora arising from invasive species are expected to be of **moderate** significance prior to mitigation. This impact requires monitoring and control of works during construction.

***Pollution:***

Fugitive dust emissions measured as particulate matter of varying particle size (e.g. PM10 and PM2.5) will be generated by land clearance and earthwork activities. Construction of the new sections road will expose a moderately sized surface area to wind erosion resulting in dust generation. Air quality impacts arising from fugitive dust emissions are expected to be relatively localised and occur within approximately 200 m of the unsealed access roads. Dust emissions generated by the construction of the proposed road alignment are likely to be wider reaching as the alignment is located on an exposed river valley. Depending on weather conditions during the pre- construction / construction phase, habitats located within could potentially be impacted. Impacts to the terrestrial vegetation and plants in these areas are expected to be of **minor** significance prior to mitigation.

There is also risk of accidental spills or seepage of hazardous substances (i.e. diesel fuel, oil, bitumen, concrete etc) and grey-water or septic systems (i.e. portaloos). This impact would most likely occur within the project footprint, the concrete mixing station and near the workers facilities. Impacts to habitats arising from accidental spills and leakages may be of Moderate significance, depending on substance type, volume and location of the accident.

**4.1.2 Operation**

Air pollution which occurs during the pre-construction / construction phase will continue in varying degrees and intensities into the operation phase. The regular air quality monitoring is planned, which will enable monitoring of the state of air quality regarding pollution. There is a small risk that culverts planned to conduct the surface water to the alder forest in Kožuhe become blocked or otherwise become dysfunctional and stop the inflow of surface water. During the operation phase, it is also possible that green areas are not adequate maintained and accelerate the spread of invasive and other non-native plant species.

## 4.2 Avoidance, Minimization / Mitigation and Restoration Measures

### 4.2.1 Pre-Construction and Construction

#### ***Limiting and control of construction works in areas with natural terrestrial vegetation***

Development and implementation of Construction Site Organization Plan (CSOP) for every subsection. The Plan will include measures for adequate organization of the construction site, implementation of the planned drainage of wastewater and stormwater (in order to avoid soil pollution). This measure will also prevent the degradation of surrounding vegetation.

Limitation of access for construction machines and vehicles to the space approved according to the Main Design, all with the aim of vegetation protection.

Careful and adequate planning of construction of temporary access roads, establishment of borrow pits and disposal sites avoiding, whenever possible, areas covered in dense vegetation like forests or other areas rich in plants.

Before construction, all areas from which the vegetation will be removed should be marked in order to prevent the unnecessary loss of vegetation in the area of construction impact.

Removal of trees along riverbanks has to be reduced as much as possible because of preservation of hydrological regime, diversity of habitats of hydrobionts, water temperature and prevention of bank erosion.

#### ***Measures to Minimise and Rehabilitate Damage to the Alder Copse at Kožuhe***

Considering that moving the planned route and subsequently approved interchange to the east is not possible, due to previous conducted investigations of the new interchange "Trebava" position, variation V-02 in Kožuhe (geology conditions, expropriation of additional land, households, cost estimate, etc.), it is in need to occupy one part of the alder forest in Kožuhe (approximately 2.5 ha). Occupying the area under the mentioned forest should be reduced to a minimum, and the remaining part of the alder wood should be protected, where its survival and natural development needs to be ensure and monitored.

Avoid removal, destruction or damage to the trees outside the construction zone. Such measures could include adding a section of vertical retaining wall for this intersection, rather than a sloped embankment, to reduce the aerial land take and avoid the copse.

Geotextiles needs to be used to stabilise slopes, instead of concrete and cover exposed areas of concrete/rocks and soil prior to the establishment of vegetation.

It is necessary to ensure that the location of alder copse is marked in the design documents, and its location and importance made known to the contractor. Add requirements to the tender documents to ensure the contractor avoids any unnecessary damage to this area (including of the surrounding soil, vegetation and water level).

Since the loop will be partially constructed as an overpass, the surface of the highway will not physically occupy the entire alder forest. The remaining part that will not be occupied needs to be fenced and the access to that surface has to be forbidden for workers and machinery.

During the clearing of the alder forest patch that needs to be removed due to construction, all young trees that can be dug up with sod around the roots need to be transferred to the expropriated part of the land around the alder forest (Fig. 26). This activity should be carried out in the period from November to mid-March. The afforested part should be approximately the same size as the part removed due to construction works and should be physically and ecologically connected to the remaining alder forest.

The remaining part of the alder copse, which will not be removed, depends on the stable water level. Due to the occasional flooding of Bosna River, the inflow of water will be enabled from the west side from the Bosna Riverbed. There is no regulation of the riverbed or the embankment between the forest stand and the river, so that the depression flooding, where the forest stand is developed, is enabled. In addition, it is necessary to enable the rainwater inflow from the eastern side of the Kožuhe village by building two culverts (as shown on the Figure 26 below).

Routine checks will be undertaken by the contractors Environmental Team to ensure vegetation clearance is confined to defined areas of disturbance and periodic checks will also be undertaken by a supervising engineer.

Include in the monitoring requirements for construction and operation, a requirement to monitor the health and status of the copse.

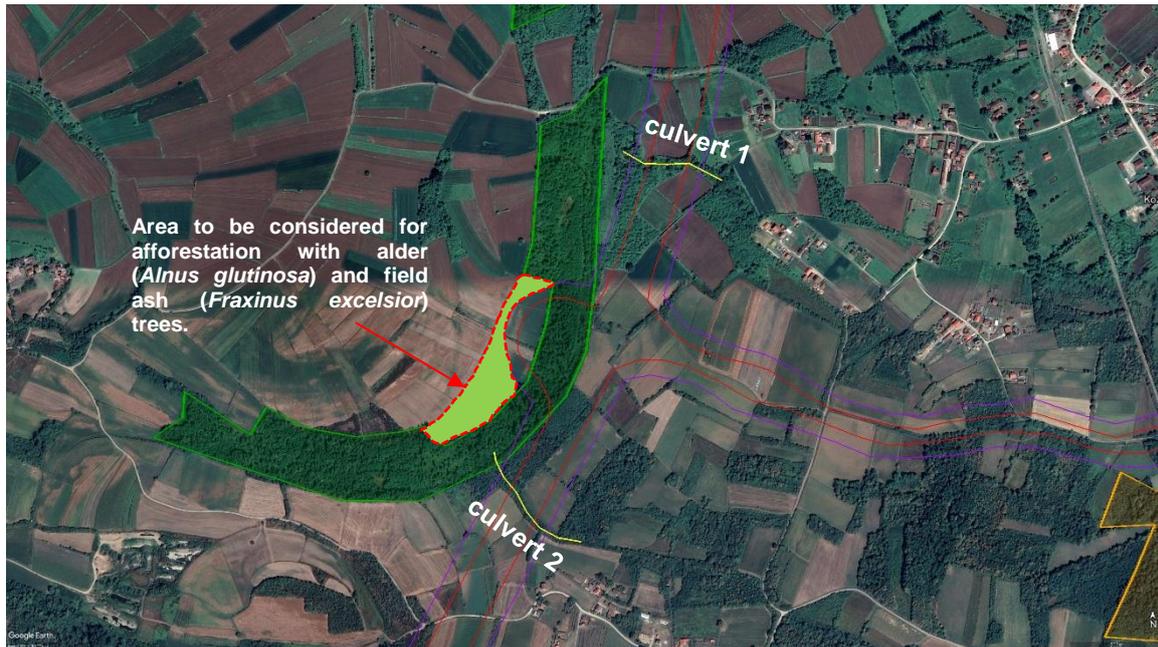


Figure 26 Enabling the rainwater inflow from the eastern side of the Kožuhe village by constructing two culverts to the alder wood

#### **Measures of management of borrow pits and disposal sites**

Removal of the topsoil and its temporary disposal for when it is again needed after the construction is completed to rehabilitate the degraded soil and to renew the vegetation. The surplus topsoil is to be transported to the temporary disposal site that is determined according to the Main Design or the request of the Engineer and proceed in accordance with valid environmental regulations.

All excavated material that will not be used has to be disposed of at designated locations, in accordance with CSOP, protected against erosion and outside zones with high risk of flooding. The location of the temporary disposal of material has to be brought back to its original state.

Several species of invasive foreign species to which special attention should be paid were recorded in the area in which the planned motorway route will be located: *Ambrosia artemisiifolia*, *Acer negundo*, *Parthenocissus quinquaefolia*, *Echinocystis lobata*, *Reynoutria japonica*, *Robinia pseudoacacia*, *Helianthus tuberosus*. Those and other invasive species need to be efficiently destroyed during construction works. The topsoil containing the listed species that is removed during construction will be stored separately and it shall not be taken outside the construction zone or used for backfilling, leveling, etc. This material may be used only for internal fill layers that will be covered by a thick layer of other material. Surplus excavated material is to be incorporated in the backfill layers on the bottom of borrowing pits and not to be used for leveling in order to reduce further spreading of weeds, invasive and neophyte species.

It is necessary to re-cultivate temporary borrow pits and disposal sites after construction is completed, including planting of adequate plants. This re-cultivating includes technical, agrotechnical and biological phases of works.

#### **Appropriate landscaping measures**

The planning of the green belt is obligatory, using only autochthonous species around motorway sections, after the construction is completed and in accordance with the Landscaping phase within the Main Design.

All areas should be covered in vegetation if possible (grass areas, trees and bushes, etc.), considering the ecological needs of other biodiversity groups, using only seeds and seedlings of autochthonous species that were produced in local agroecological conditions, in order to compensate for habitat

degradation and mitigate the impact to the landscape and occupation of natural and semi-natural habitats of wild species.

The following species are recommended to be used for landscaping of valleys and hilly terrains around the motorway route: English and sessile oak, narrow-leafed ash, black alder, black and white poplar, white and crack willow, European hornbeam, wild fruits, Cornelian cherry, smoketree, hawthorn, meadowsweets, common ivy, winter heath, anemone, primrose, etc. For grassing of embankments and other areas locally produced mixtures of autochthonous species are to be used.

***Measures to control and prevent pollution of terrestrial habitats during construction***

Staff and contractors will adhere to a Standard Operating Procedure for Emission and Dust Control, Erosion and Suspended Sediment Control to minimise impacts from fugitive dust emissions, erosion and suspended sediments on habitats and plants. This includes the use of dust control measures (i.e. watering, gravel application and wheel washes) on unsealed access tracks and exposed surfaces heavily trafficked by machinery and vehicles (i.e. entry / exit points, vehicle routes and loading and unloading areas) during the summer months when conditions are dry, when excessive dust generation is evident and during periods of high risk (e.g. dry and windy conditions).

Dust suppression water will be taken from suitable recycled water sources where possible.

Emergency spill management procedures will be in place and communicated to all relevant staff and contractors during their induction to minimise the impacts to habitats and plants in the event of an incident.

Emergency response procedures will be prepared for the Project which will include a protocol for responding to accidental spills and leakages of non-hazardous waste and hazardous compounds. Staff and contractors will receive training in spill events management.

**4.2.2 Operation**

***Measures for maintenance of green areas***

Renewal of vegetation is to be performed as soon as possible after the construction is completed.

The Green Spaces Management Plan is to be developed and implemented after planting, so corrective measures will be applied where trees were planted.

The road belt is to be regularly mowed according to the Green Spaces Management Plan without using chemical agents.

***Measures for controlling of invasive species***

If any increase in invasive species compared to the initial level is discovered, rehabilitation measures are to be applied like mechanical removal of allochthonous invasive species, wherever possible without the use of chemical agents. Removal of bushes and of high herbaceous plants is best performed in two phases: mechanical removal (mulching, root digging out, cutting above the soil level) of plants in April or May, and treatment of sprouts by arboricide.

Especially important is the obligation of removal of ragweed (*Ambrosia artemisiifolia*), as stipulated by the Decision on measures for suppression and destruction of weed species of ragweed – *Ambrosia artemisiifolia* L. (“Official Gazette of the Republika Srpska”, No. 81/07).

After invasive species are removed from the area, it is recommended to plant local (autochthonous) wild plants and/or cultures that will additionally prevent the growth of invasive species’ seeds that remained in the soil.

Areas that are cleared from invasive species should be monitored for at least three years, because the seeds remain in the soil.

## 4.3 Terrestrial Fauna and Their Habitats

### 4.3.1 Pre-Construction and Construction

#### **Terrestrial fauna habitat loss and degradation (including a loss of individuals of protected species):**

Data collected on invertebrates (dragonflies, butterflies) and on habitats of terrestrial invertebrates do not imply the special presence of species and their habitats that are of special interest for protection, except for sporadic findings of the species Large Copper Butterfly *Lycaena dispar* that is listed in Annex II of Habitat Directive and it's Near Threatened (NT) according to IUCN Global Red List. The assessment has concluded that it is insufficiently represented in the Study area for it to have a conservation significance. The expected impacts to other terrestrial invertebrate species arising from habitat clearance are considered to be of minor significance. The species are insufficiently present and not representative in the researched area to have specially defined avoidance or mitigation measures, and which were not already taken into account in defining of protection measures for habitats or for other fauna groups.

Recorded fauna of amphibians have neither composition nor numbers in the wider area of motorway route to be of significance for selection of special spots significant for protection of their population.

The only reptile species of interest that was recorded is *Emys orbicularis* (EN according to IUCN; Annex II of Habitat Directive; Strictly Protected by National Regulation of RS). The European pond turtle is found in a wide area around the Bosna River, in suitable slow flowing and stagnant water bodies and wet areas. Mostly all suitable habitats that are significant for European pond turtle remain connected together with the Bosna River, and that project neither occupies it nor separates it. The impact on this species and its habitats could be **moderate** with the construction of the motorway, but significantly reduced if a sufficient number of culverts are provided for watercourses that flows towards the Bosna River, along which most pond turtles are using for migration.

As stated earlier, some nesting bird species recorded in the area have a conservation interest.

These include: *Lanius collurio* (Annex I; IUCN - LC), *Lanius minor* (Annex I; IUCN - LC), *Streptopelia turtur* (IUCN - VU), *Alcedo atthis* (Annex I; IUCN - LC), *Haliaeetus albicilla* (Annex I of BD; IUCN - LC). All Strictly Protected under the Regulation on Strictly Protected and Protected Species of the Republic Srpska. In 2021. none of these species were found to be nesting within the zone of project footprint or in the buffer zone of the motorway. Removing limited areas of vegetation for construction of the Motorway will **not be significant threat** for their populations because they are far more widespread and far more numerous in other habitats in the surrounding area. Habitats that are outside of the direct impact zone (i.e. project footprint and buffer) of the motorway are sufficiently abundant and connected with the river to ensure normal daily and seasonal migrations and feeding of breeding birds. Except for bridges that are inevitable element of the route, the motorway neither separates nor occupies any significant bird habitat, i.e. it does not negatively affect the connectedness and quality of bird habitats.

The non-nesting species of conservation interest recorded in the area include:

- waterbirds: *Ciconia nigra*, *Ciconia ciconia*, *Platalea leucorodia*, *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardeola ralloides*, *Ardea purpurea*, *Ardea alba*, *Egretta garzetta* (all species are LC according the IUCN Global Red List and on Annex I of Bird Directive), *Vanellus vanellus* (IUCN - VU, Annex IIB of BD) and *Tringa glareola* (IUCN - LC, Annex I BD), are using the Bosna River valley during seasonal migrations (*Ciconia ciconia*, *Ciconia nigra*, *Platalea leucorodia*, *Ixobrychus minutus*, *Nycticorax nycticorax*, *Ardeola ralloides*, *Ardea purpurea*, *Ardea alba*, *Egretta garzetta*), visits the River Bosna during its daily searches for food (*Ciconia ciconia*, *Ciconia nigra*, *Nycticorax nycticorax*, *Ardea cinerea*), wintering around the river during December to February (*Ardea cinerea*, *Ardea alba*) and they all usually stay around the water or sometimes on agriculture land. *Grus grus* (IUCN - LC, Annex I of BD), passes over at higher altitudes (over 300 m) only during spring and autumn migration.

- birds of prey: *Circaetus gallicus* (IUCN - LC, Annex I of BD) and *Falco vespertinus* (IUCN - NT, Annex I of BD) fly over river valley during migration, and *Circus cyaneus* (IUCN - LC, Annex I of BD), is a common wintering species, uses the wider area of Bosna River and whole Posavina region during winter and the Bosna River valley is not registered as wintering ground for this significant population of species.

- woodpeckers: *Picus canus*, *Dryocopus martius*, *Leiopicus medius* (all on Annex I, IUCN - LC) are occasionally found in the valley of Bosna River on feeding in willow forests.

All also Strictly Protected under the Regulation on Strictly Protected and Protected Species of the Republika Srpska.

Migratory bird species migrate along the river channel and river banks or in the wider area of the Bosna River valley, so the construction work of motorway **will not disrupt bird migration routes** (mostly of passerines, waterfowl, raptors), but disturbance during sensitive periods (spring migration, autumn migration) will be present around habitats that are parallel with Bosna River (river flow, gallery forests and shrubs along the river).

By collecting data on bird species present along the planned route of motorway, it was clear that there are **no sites that contain significant populations of protected species** nor as individual nesting places that could be particularly endangered by the Motorway construction. Habitats which could have potential importance for birds include the river, riverbanks, river branches and the backwaters, however, these are scattered outside the inner zone of influence of the motorway. The expected impacts to breeding and migratory bird species arising from habitat clearance, degradation and fragmentation are considered to be of minor significance. Summarized, the collected data indicate the presence of protected bird species, so mitigation measures regarding protecting birds and their habitats birds will be recommended.

The direct or indirect zone of impact of the motorway **does not physically occupy any critical mammal habitat**. The zone of direct impacts from destruction of vegetation - does not threaten any of the clearly defined important habitats for mammals.

All presumed or registered small mammals are common species in this area, numerous and they do not require special protection measures.

Despite the recorded presence of vulnerable and near threatened bat species (*Myotis capaccinii* - Annex II, IV of HD, IUCN - VU; *Barbastella barbastellus* - Annex II, IV, IUCN - NT; *Miniopterus schreibersii* - Annex II, IV, IUCN - VU), there are **no founded significant roosting or foraging habitats** for bats in the project influence area. Any bats that do exist in the Study Area are most likely to roost in abandoned residential buildings and church towers, and in the wider area, in the mountainous areas on either side of the Bosna River Valley. None of these are within the Motorway corridor, and no bat roosts will be disturbed by the Project. The most likely flight paths for bats foraging in the area are the forests and the river channel, which are not physically intersected by the route of the Motorway. However, given that the presence of threatened and protected species has been sporadically registered, it is necessary to take mitigation measures to prevent unnecessary loss of bat individuals.

Mammal species that will probably use the watercourses are *Castor fiber* and *Lutra lutra*, recorded close to the River Bosna and also in smaller streams. These tributaries may be used by fish, amphibians and other small animals that move between upper parts of tributaries and the River Bosna. These tributaries are marked on maps. The project may affect their access to habitats during stream regulations, construction of culverts under the motorway and bridges. Except in area of bridges construction, the project does not include the removal of riverbanks or major regulation of watercourses, so the expected impacts to otter and beaver arising from habitat clearance and construction works are considered to be of **minor** significance prior to mitigation.

#### **Pollution, noise and vibrations:**

Fugitive dust emissions (e.g. PM10 and PM2.5) and combustion emissions air pollutants (i.e. SO<sub>2</sub>, CO, NO<sub>x</sub>, particulate matter and VOCs) will be generated during the pre- construction / construction phase which will be short term, localised and staged over two years. Air quality impacts arising from fugitive dust emissions are expected to be relatively localised and occur within approximately 200 m of the unsealed access roads. Dust depositions drop-out may also impact fauna habitats in areas near the source site in the dry weather conditions.

The predominant noise emissions generated during the pre-construction and construction phase will be generated by sources such as vehicle traffic, plant vehicles, pneumatic drills and jackhammers and machinery (i.e. drilling rigs, pile drivers, excavators / grader and vibratory rollers). Construction noise emissions will be relatively localised, temporary and generated over a 2-year period. The impact from noise generated by project construction could potentially be significant within 1 km of the construction site. Vibration impacts are expected to be perceptible within 200 m of the construction site.

All animals will mostly avoid the construction zone where the greatest impacts of air and noise pollution are expected. Some species may be able to habituate to consistent noise and vibration levels during construction while other species are unlikely to adjust. Therefore, impacts to priority fauna from fugitive

dust emissions, air pollutants and noise during the construction phase could be of minor significance prior to mitigation.

In Kožuhe village, "Dijelovi" area, in fragments of willow forest on about 400 m west (map) from the planned highway route, there is a nest of white-tailed eagle *Haliaeetus albicilla* (Annex I of BD; IUCN - LC; Strictly protected by National Regulation). This species is tolerant of the occasional human presence in this area and has been nesting for several years in area surrounded by agricultural land and in hunting area. Therefore, the species tolerates the active presence of agricultural machinery, foresters, hunters, fishermen and picnickers. Regardless, during the construction of the highway, it is possible that the disturbance of birds will increase in the nesting period (late winter – early summer), so mitigation and avoidance measures and monitoring are written for this species during the construction work.

Impacts to white tailed eagle from fugitive dust emissions, air pollutants, noise and vibrations during the construction phase could be of minor significance.

#### 4.3.2 Operation

##### ***Terrestrial fauna habitat fragmentation and collision with traffic:***

Generally, birds are avoiding the motorway routes due to light, noise, vibrations, etc. and, if necessary, they usually fly over in a medium-high flight. However, some species stay close to the motorway for various reasons, or they occasionally fly low over the motorway (e.g. small passerines, raptors, owls) and may occasionally collide with vehicles or with a noise barrier if it is made of transparent materials. The fact is that the environment around the some sections of motorway is composed of a different ecosystems and that many species of birds are registered there. Although there are no a lot of collected nor published data based on the field research, terrain configuration and line distribution of habitats (watercourse, underbrush and plot borders, fragments of flood forests) lead to an assumption that the Bosna valley represents a migratory corridor for birds fly over Bosnia and Herzegovina in spring and autumn during the migration and that rest and feed in habitats along the river. The collision with transparent noise barriers is possible. For that and other reasons, and due to unpredictable movements, attraction of prey birds and carnivorous species by dead or hit small animals, insects or road salt, occasional flyovers across the route, it is necessary to anticipate some mitigation measures for possibly negative effects on birds that might appear during motorway operational phase.

The data collected on the medium and large mammals movements in the area suggest three zones of an increased presence of important species of hunting interest, most likely associated with a higher frequency of movement between the nearby forests on hills and the River Bosna. Animals likely to use these areas which have a protection status are: *Lepus europaeus*, *Vulpes vulpes*, *Canis aureus*, *Martes foina*, *Martes martes*, *Meles meles*, *Capreolus capreolus*, *Sus scrofa*. The zones in question are those mentioned at :

- Kožuhe, locality "Dijelovi"
- Dugo polje, locality "Kutlovac"
- Botajica locality, "Botajičke luke"

as mapped on Map 12, Annex 12. The presence of the new motorway in these areas will impinge upon animal movements to and from the river. Two of them are on Annex V of Habitat directive (*Canis aureus*, *Martes martes*), one is on Annex IV of HD (*Felis silvestris*). Four are on Annex III of Bern convention (*Martes martes*, *Martes foina*, *Meles meles*, *Capreolus capreolus*). Also, three are important species of hunting interest and have temporary protection in RS but are hunted during part of the year (*Lepus europaeus*, *Capreolus capreolus*, *Sus scrofa*). In case the motorway is not provided with a appropriate fence at some sections and not provided with appropriate passages, it is **possible for occasional collisions** of these species with vehicles, especially in the zones of their increased activity. The presence of the motorway in the project area may have a **moderate** impact on the movement of medium and large animals towards the river and from the river. Although not international or national strictly protected, as good practice, steps should therefore be taken where practical, to provide safe crossing points for animals at these areas, during operation.

There is always a risk that some animals will try to cross the road in places where the fence already exists. Some animals (e.g. badger, fox, wild cat, martens) probably will also use culvert, underpasses and other structures that are convenient for them to cross the motorway. Impacts of this type cannot be precisely determined before the motorway operation phase. Given these circumstances, it is necessary

to prescribe the measures for culvert construction, underpasses desing and fencing different parts of the motorway in accordance with the needs of animal protection.

## 4.4 Avoidance, Minimization, Restoration and Compensation Measures

### 4.4.1 Pre-construction, Construction

#### ***Measures for animal protection at the construction site***

The construction site is to be fenced in by the fence of the height of 2 m, as will be defined in the CSOP. This fence should also prevent night entries of mammals.

If fencing the site is not practical during construction, then all deep pits or other excavations need to be covered or fenced in order to prevent the entry of mammals like otter, beaver, wild boar, roe deer, etc.

During the construction period, construction sites are managed in such a way as not to provide adequate habitat for reptiles (shelter and hibernation). Those measures include avoiding stacking large piles of construction waste, and if reptiles are expected, transporting that waste when temperatures exceed 7°C, i.e. when reptiles are not in the hibernation phase.

The area under the bridge should not be used for storing construction equipment and machines, agricultural machines, or other vehicles, nor is it allowed to place fences or obstacles under the bridge that would prevent the passage of animals.

#### ***Measures preventing endangering of pond turtle***

During the work in the warm part of the year, close to wet flood areas on the ground, close to accumulations (former borrow pits filled with water), streams, canals, it is necessary to have the terrain searched by the qualified ecologist or herpetologist with the aim of finding individual pond turtles (*Emys orbicularis*).

All animals that are found are to be cautiously captured by landing nets and wire baskets upon consent from the RS Institute for Protection of Nature, and relocated outside the work zone, at the safe distance, and into similar surroundings like other existing accumulations or wetlands along the Bosna River, that satisfy the ecological needs of this species by the size and quality of the habitat.

#### ***Measures for prevention of endangering of birds during construction***

Habitat clearances need to be undertaken in a progressive and sensitive manner to enable birds and other fauna to move away from the area of works, disperse into surrounding habitats and to avoid fauna from being isolated in fragmented areas of habitat.

Wherever possible, removal of vegetation is to be performed after the nesting period (avoiding the period March-August, including August). Since this might turn out to be impossible, and to perform in accordance with the EU Birds Directive if the removal of vegetation has to be performed during the nesting period, then the qualified ornithologist should previously research the target vegetation for nesting birds.

Only the vegetation that has no obvious signs of nesting (active nest in which young birds are seen or heard, nest with eggs, adult birds that carry food into the nest, etc.) may be removed. If some of the works are performed from March to August, special attention should be paid during the field search before any works are performed to the following species: in the understory in the grass – fam. Phasianidae, fam. Alaudidae etc., in bushes and small trees – *Lanius collurio*, *Lanius minor*, *Streptopelia turtur*, in hollow trunks and in the treetop – all species of Order Piciformes (woodpeckers), sloping riverbanks, and soil excavations (former borrow pits) - *Alcedo atthis*, *Riparia riparia*.

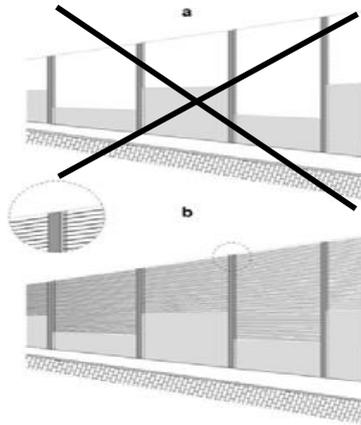
#### ***Measures for design and constructing the motorway equipment for protection of birds***

Planning of non-transparent noise barriers wherever possible. It is not allowed to use transparent glass/plastics or reflecting materials for noise barriers.

Different technical measures are to be applied in order to protect birds – measures that increase the visibility of fences and noise barriers, especially at locations where the motorway runs along the river or crosses it (Dobor, enclosed Map 11, Annex 12).

When increasing visibility of transparent noise barriers, the practice of placing silhouettes of birds of prey should be avoided for it turned out to be ineffective unless silhouettes are present in great numbers.

The use of adequate signs (vertical marks of light color on the outer side of the fence, away from the road– strips of the width of 2 cm at a distance of 10 cm or 1 cm-wide strip with a maximum spacing of 5 cm) may significantly reduce the number of bird collisions with the fence (e.g., one of the more successful systems is the PLEXIGLAS SOUNDSTOP® system containing 2 mm wide black horizontal strips at mutual distances of 28 mm).



*Figure 27 Noise barrier: a – transparent, and b – with strips for bird protection against a collision with the barrier*



*Figure 28 An example of noise barrier with strips that repel birds*

#### **Measures for constructing the motorway for preventing endangering bats**

There is a small possibility that bats will hibernate in objects and on older trunks in the project area. For that reason, all trees are to be checked for bat roost sites before cutting. It is not considered that bats would hibernate in such areas so cutting of trees or demolishing the structures is best done during the hibernation period from November until the end of February. Outside of this period, the listed locations are to be checked by a qualified ecologist/expert on mammals who will provide advice on acting in case of finding the roost site.

#### **Measures for construction of designated passage for mammals and other animals**

Precise determination of the crossing frequency and collection of quantitative and qualitative data on individual animals and populations that possibly cross the existing regional road R-465 (Doboj – Modriča) and freeway M-17 is necessary to be performed by using any of the standard methods for determination of wildlife crossing during construction, during a longer period and in adequate season. Since it has not been done so far, at this moment we must rely on available field data, data collected in the field during this report, visual examination of certain habitats, proofs of active corridors of wildlife across the existing roads (signs of animal activities and presence), data obtained from surveying local hunters (HA “Fazan” Doboj, HA “Majna” Modriča) and from other sources.

Besides the existing planned passages and underpasses for local and uncategorized roads, it is necessary to plan the location and construction of designated wildlife passage, mostly for large and medium-sized mammals. That structure should be located within the at all three existing mammal corridors (see Annex 12, map 12). Locations in areas where significant impact of humans could reduce the functionality of such crossing should be avoided.

Collected data on the fauna indicate three zones of higher diversity and activity of large animals (roe deer, wild boar, jackal, fox), the increased presence of species significant for hunting, and high frequency of animal migrations toward the River Bosna and away from it, and these are the zone around Kožuhe, Dugo polje and Botajica (enclosed Map 12 in Annex 12). These locations should be carefully considered as locations of passages for medium and large animals. Since the construction of the underpass is planned within the section through Kožuhe, Dugo polje and Botajica, with a sufficient number of pipe culverts of adequate dimensions, the passage designated for large and medium-size

animals should be made as wildlife underpass (under the level of the motorway) at at least one or every three proposed locations.

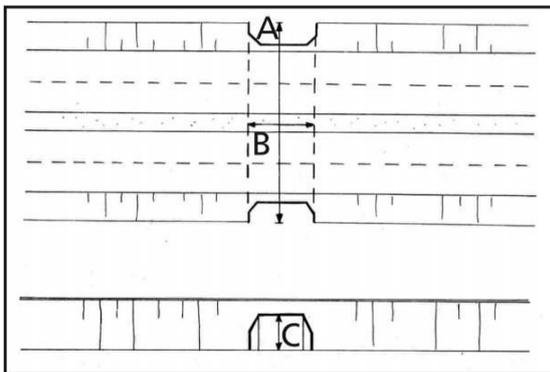
Since the designed width of the motorway is 30 m, the minimum width of the passage should be 15-20 m, the height not less than 3-4 m, in order to have the free space index (FSI) equal to or larger than 1.5 (according to the formula:  $FSI = W \times H/L$ , recommendations of local regulations and Cost 341), and in the case of the corridor, it is designated for less sensitive species (e.g. roe deer). In the case of larger passage length, the planned passage width increases with its length (ratio of width and length has to be larger than 0.8).

Protective fencing is to be installed on both sides of the passage. Along with the whole length of the passage the non-transparent closed fencing made of wood dowels or vertical wood battens (panels) or similar adequate material, of a minimum height of 1.4 m, that eliminates or reduces negative effects of noise and light beams coming from the road and prevents the fall of animals.

During construction of the stated underpass for the game, it is necessary to preserve the surrounding flora that would guide animals towards the passage.

Wildlife underpass should be marked by the information sign that is fabricated in accordance with special regulations, which would be placed near the road, at the passage itself, or at the distance of 300 m away from the passage.

Wildlife underpass is maintained in a way as to permanently ensure its purpose, unobstructed usage, and protection of migratory species, with adequate maintenance of vegetation within a radius of at least 300 m from the ecological passage.



*Figure 29 Drawing of the simple passage below the motorway level and main dimensions used in designing*



*Figure 30 An example of passage below the finished road level in Hungary, designated only for game animals*

(A – length of opening, B- width of opening, C – height of opening)

### **Measures of design and adjusting small culverts for passage of reptiles, amphibians and small mammals**

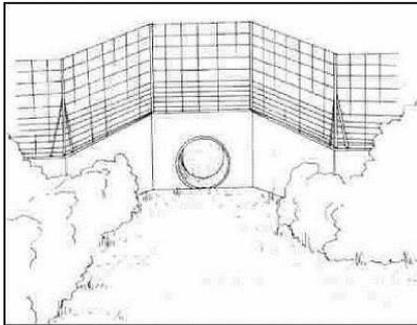
Culverts for drainage that were originally constructed for drainage purposes and for allowing the flow of water, may be adjusted so they represent the passage for small animals (martens, insectivores, rodents, reptiles, amphibians, etc.).

Small mammals (e.g., martens, hedgehogs, and other insectivores and rodents) and herpetofauna (amphibians and reptiles) may use the existing pipe culverts and bridges planned to be constructed and that need to be technically adjusted to serve as efficient passageways besides their drainage role. These culverts should be made as pipes or culverts of diameter, i.e. clear width of 0.4-2 m. In general, the passage of diameter of 1.5 m or with the side of 1-1.5 m is adequate for many animal species.

Passages may be of various shapes (rectangular, square, round, ellipsoid, round with level bottom, with one or more pipes) and they may be made of concrete or wood. The lower part of the culvert or pipe must be filled with adequate medium (soil, sand, or stone), so the surface for animal movements is formed.

Passages have to be executed with a minimum longitudinal inclination of 1% because of drainage. The inclined surface has to be rough. The bottom of the culvert or pipe must be above the water table. Entrance into the passage has to be free and without artificial lighting.

Animals should be directed to passages using the directional fences.



*Figure 31 Pipe culvert that is primarily used for drainage, adjusted also for passage of small animals, with fencing and planted bushes*



*Figure 32 Photograph as an example of adjusted box culvert below the road level, for small terrestrial animals*

### **Measures for repelling mammals away from the motorway**

The permanently acting eco-protective devices should be included in the equipment of the motorway, for repelling the game away from the motorway. The location of these devices should be planned outside the zones where animal passages are planned.

### **Measures for preventing mammals and other animals from crossing the traffic lanes**

The entire motorway should always be fenced on both sides.

It is recommended that the end of the fences near large structures (e.g. near buildings, bridges, etc.), for endpoints, are dangerous because animals may go around the fence and access the road.

When deciding about the location of the fence, it is necessary to take into account locations of existing and possible ecological passages, but the stated fences must not disturb entering the passages.

The fencing height and size of openings need to be adjusted to the local conditions and presence of certain species of mammals and birds. The height is measured on the side from which the animals come. If animals come from the side that is inclined, the fencing height should be adjusted accordingly (Figures 35 and 36). When determining the height of the fence, it is necessary to take into account the height of the snow in winter.

According to the collected data, the adequate height of the fence that would prevent animals in crossing the fence is the minimum recommended height of 1.6-1.8 m for roe deer and wild boar.

To prevent the passage of small mammals, like hares, through the lower part of the fence, the mesh has to be denser at the bottom. The denser mesh is recommended in the lower third of the fence. Distance between horizontal wires: lower part 50-150 mm, the upper part 150-200 mm, with the distance between vertical wires of 150 mm.

- The diameter of the wire should be at least 2.5 mm.
- The material has to be resistant to corrosion.
- It is necessary to ensure the adequate stability of the fence and good fixture to supports.

Lower parts of the fence should touch the ground and should be fixed to it. The fence has to touch the ground, which is to be leveled, without any holes or void spaces in order to prevent the animals from crawling through it.

Fence supports (poles) have to be of sufficient strength, made of metal (pole diameter larger than 5 cm). Medium poles may be of smaller dimensions. Poles have to be securely dug into the ground (to the depth of about 70 cm).

The distance between poles should not be larger than 4 m for wild boars.

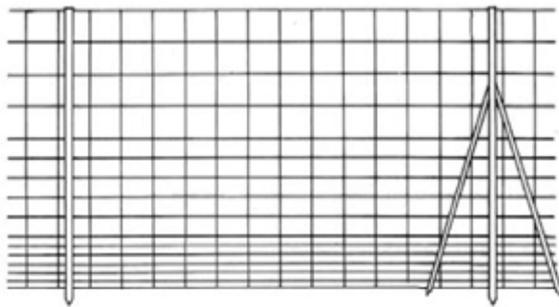


Figure 33 Fence as an example of various mesh openings in the lower third part of the mesh, where it is necessary

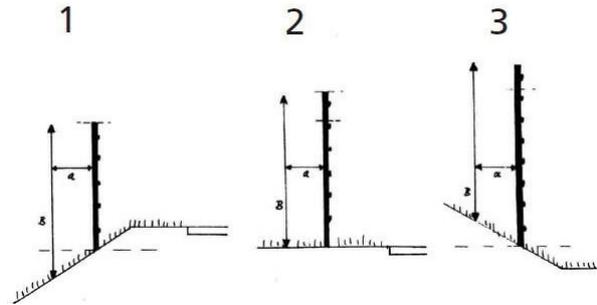


Figure 34 Determining the minimum height of the fence

**Measures to control and prevent pollution and noise in terrestrial fauna habitats during construction**

Measures to control and prevent pollution and noise in terrestrial fauna habitats during construction are the same as the already prescribed measures for terrestrial habitats and vegetation in previous chapter.

**4.4.2 Operation**

**Measures for control of animal protection equipment and objects for animal migration on the motorway**

The state and efficiency of the motorway equipment for bird protection should be controlled regularly.

In case of increased frequency of bird collisions with vehicles or structures at some road section, it is necessary to apply technical and technological measures to prevent further collisions. That includes repelling the birds from such spots, higher fences, etc.

If some locations prove to be spots of mass collisions of birds during motorway exploitation, installation of additional noise barriers should be considered, if not already installed. Such barriers may be used on both sides of the motorway on bridges, at the spot where the motorway is close the river, to prevent disturbing and possible collisions with vehicles and traffic accidents caused by low flying birds.

Mammal passages should be checked annually to ensure there are no blockages, and maintenance is planned for the lifetime of the motorway.

It is necessary to examine motorway fence once a year, within the regular maintenance of the road, and even more frequently during the first year. Particular attention should be paid to any openings (it is necessary to close them immediately), connections with poles, fixing to the ground, paths, and voids that imply the regular passage of animals below the fence.

In case of fence damage caused by a traffic accident or lighting, it should be repaired immediately.

Key performance parameters for this measure will have to be determined in relation to the data on the present number of animal casualties on roads in that area. Although there is no concrete performance parameter for the use of proposed underpasses, it would be beneficial to determine as the information for further projects, if possible, whether animals use those underpasses and which animals do so.

To monitor the efficiency of the constructed animal passage and of adjusted ones, some standard methods are to be used like photo-traps, infrared (IR) sensors, or control sand strips.

If the common measures for reduction of the negative impact of the motorway on wildlife turn out to be insufficient or inefficient, it is necessary to apply additional measures like installing the items that repel the wildlife – prismatic mirrors, electric shepherds in front of the motorway fence, higher fences or dug-in fences.

If during the motorway exploitation it is determined that some zones present the locations of the increased presence of animals or zones of their crossing the motorway, or that for any reason there is

potential for collision with vehicles, which will be determined by monitoring, it is necessary to mark those locations with good traffic signs by the Law on Traffic Safety.

Culverts under the motorway should be checked regularly to ensure their passibility.

#### **Measures to control and prevent pollution of terrestrial fauna habitats during operation**

Measures to control and prevent pollution of terrestrial fauna habitats during operation are the same as the already prescribed pollution control measures for terrestrial vegetation/habitats and environment in operational phase.

## 4.5 Riverine Habitats and Species

### 4.5.1 Pre-Construction and Construction

#### **Aquatic and riparian habitat loss, degradation, fragmentation and hydrological changes:**

Except for touching the Bosna River in the area of Dobor (Jakeš) and the bridge areas, the motorway **route does not overlaps nor cross the river**. Except for the phase of bridges construction on strictly limited surfaces, there are no direct interventions on the river channel. According to the data from the design, the changes to the hydrological regime of the Bosna River channel during the construction of bridges and the motorway will have **local and temporary character**.

Protected fish species in the Bosna River (*Gobio obtusirostris*, *Romanogobio uranoscopus*, *Romanogobio kesslerii*, *Alburnus sarmaticus*, *Rhodeus amarus*, *Misgurnus fossilis*, *Cobitis elongata*) or fishing species of interest (*Cyprinus carpio*) may be endangered in case of degrading natural sediment or creating an insurmountable barrier in the riverbed of Bosna River. Since there are no designed regulations of the River Bosna, and that intersections of the route are solved by bridges and culverts, and that the data on fish species are collected for the whole Bosna River through Doboj and Modriča (without information on spatial distribution and their presence in different habitats) it might be considered that construction of planned bridges will have **no significant impact on fish** of the River Bosna.

The motorway route crosses a few small and medium creeks riverbranches/backwaters (see Annex 12, map 10), so regulations of smaller or larger extent are planned in those areas. At the project area, the regulations of following creeks and channels are planned:

- Lovnica creek in Majevac,
- Ljuteš creek in Trnjani,
- Glogovica creek in Božinci,
- Bosnica cutoff channel in Dugo Polje,
- Ljubioča creek in Dugo Polje,
- Rljeka creek, in Vranjak
- Savići creek, in Brijestovo (Vranjak)
- unnamed cuttof channel in Botajica etc.

These mostly small ephemeral creeks, that transect the Project footprint and are active during the raining season will be diverted using culverts. The construction of the proposed project will not entail the direct loss of any major tributaries or creeks located within the footprint of the proposed road alignment in the river Bosna floodplain.

The species of protected mammals that are likely to use these small tributaries, riverbranches and cut off channels are: *Castor fiber* and *Lutra lutra*, which are recorded near the Bosna River and also in small tributaries. The pond turtle (*Emys orbicularis*) was also found in or near these habitats. These tributaries are marked on the Maps 2,3,4,5 (Annex 12), and are known to the designers of the motorway project. In the period of high water flow (autumn, winter, early spring), fish species such as *Leucaspius delineatus*, *Squalius cephalus*, *Chondrostoma nasus* and also protected species *Gobio obtusirostris* (Annex II of Habitat Directive), *Romanogobio uranoscopus* (Annex II HD), *Romanogobio kesslerii* (Annex II HD) and some others fish species are believed to use these small small tributaries, riverbranches and cut off channels (e.g. Ljuteš, Lovnica, Glogovica, Ljubioča, Bosnica etc.). Some of of these watercourss will be intersected by the Motorway. Provided that adequately sized culverts are constructed in the places where the Motorway intersects these streams/tributaries and other

watercourses to maintain the flow and connectivity between these streams and the River, and that the natural state of sediments is maintained in all these tributaries, negative impacts that could affect the natural movement of fish between the mentioned watercourses and Bosna river is considered to be **minor**. Accordingly, certain mitigation measures are given.

River banks with vegetation of alliance *Bidention* (Natura 2000 code: 3270) and amphibious vegetation on the mud of alliance *Nanocyperion* (Natura 2000 code: 3130) which are listed on the EU Habitat Directive, and are not habitats of priority, are widespread in the downstream part of Bosna River. Some temporary damage to the river banks will be unavoidable at the five relative short sections of river bank where the bridge and embankment constructions will occur. Although this habitat type is not yet confirmed at these locations, steps should be taken to confine the construction works to the area where work is strictly necessary.

**Water pollution:**

Bosna River and its surrounding water bodies are already turbid due to sediment, and they are polluted due to the discharge of wastewater without treatment. The most found fish species and macroinvertebrates in the River Bosna in the area of Dobož and Modriča are usual for lowland rivers and stagnant waters, and they are mainly species tolerant to existing water pollution. During the planned machinery work in the riverbed there will be a **minor** impact in water quality (mostly water turbidity and increase in suspended matters) which will have a **limited and short-term impact**. Any changes of the water quality and hydrology characteristics of the Bosna river during the construction of the bridges and the embankment in the area of Dobor tunnel will have a local and short-term character. Since there will be no long term, permanent changes to the hydraulic performance of the river (apart from possibly during short term flood events), **no negative effects on water quality, are expected**.

However, there is **risk of surface and groundwater contamination through accidental spills** or seepages of hazardous substances (i.e. diesel fuel, oil, bitumen etc) and grey-water or septic systems (i.e. portaloo) during construction could contaminate receiving aquatic habitats and pose a risk to downstream water quality and aquatic biodiversity. This would be detrimental to the health of fauna and may result in the loss of aquatic habitats. Water bodies located in close proximity to the road alignment are most vulnerable. Impacts to aquatic habitats and species arising from accidental spills and leakages may be of major significance, depending on substance type, volume and location of the accident.

**Introduction or spread of invasive alien species;**

The allochthonous and invasive fish species that have been confirmed in the waters of River Bosna are: *Carassius gibelio*, *Pseudorasbora parva*, *Amiurus nebulosus*, *Lepomis gibbosus*. Considering the planned construction works in and around the river, the impacts for the spread of invasive aquatic species are **negligible**.

**4.5.2 Operation**

Obstruction of culverts and prevention of migration of aquatic and semi-aquatic species are possible. Occasional traffic accidents are possible, in which dangerous and polluting substances can flow into water bodies. The danger of these influences is estimated to be **minimal**. The measures that are prescribed corresponds to the measures of environmental protection – water protection. They will be covered by an environmental permit.

**4.6 Avoidance, Minimization, Restoration and Compensation Measures**

**4.6.1 Pre-construction, Construction**

**Measures for limiting and controlling construction works close to water**

It is necessary to take steps of limiting the construction works spatially to areas where such works are strictly necessary.

Wherever possible, riverbanks and waterspecies near bridges should remain undisturbed, except if really unavoidable. Damages to riverbanks should be avoided or minimized wherever possible.

Within the design documentation, it is necessary to mark the area of riverbanks planned for works, and the Contractor's access to the remaining riverbanks should be prohibited.

Construction of structures across watercourses and in the riverbed should be planned for the year in which it would cause the slightest consequences for water wildlife (low water levels should be avoided).

Ensure that a full reinstatement of the river banks is performed once the works are complete. Since distribution of muddy river bank habitats depend on hydromorphological processes that are unpredictable and changeable in the lower course of Bosna River, it is necessary to take certain precautions before and during construction works in the costal river zone

#### ***Measures for protection of fish and other aquatic species***

It is necessary to provide the natural passage for fish during construction (e.g., during construction of bridges).

Any fish trapped within temporary cofferdam are to be transferred into the flow-through part of the watercourse, under the supervision of representatives of the FA. All activities at the site that include interaction with fish populations are to be performed in coordination with qualified ecologists and local FA.

Project staff and contractors will be banned from fishing and the collection of aquatic natural resources in the vicinity of the project to minimise impacts to fish and aquatic species. Environmental education and awareness programmes will be conducted for project staff and contractors (e.g. through staff inductions) to emphasise the importance of conserving biodiversity for wildlife and communities.

#### ***Measures for prevention of water pollution during construction***

Emergency spill management procedures will be in place to minimise the risk of impacts to receiving aquatic habitats and species. This will be communicated to all relevant staff and contractors during their induction.

The system for controlled drainage of stormwater from the pavement using the flow-through separators at the edge of the carriageway or retentions and separators before release into the recipient should be constructed.

Oil leaks are to be prevented to prevent water pollution and harmful effects on water species.

It is necessary to install the container for adsorbent (wood chips, sand, extruded polystyrene) at the construction site for the case of leaking oil and oil derivatives. The waste created by the absorption of oil and oil derivatives is to be stored separately and treated and hazardous waste, in agreement with the authorized company.

It is strictly prohibited to store construction and other solid waste in the riverbed or on the banks.

All solid communal waste and similar waste that is generated during construction is to be collected into designated containers located on the hard surface. The waste should be secured against scattering and disposed of by the authorized company.

The system for the collection of sanitary wastewater should be made after the opening of the construction site in order to prevent the uncontrolled release of such water. It is also possible to install mobile ecological toilets for workers.

Measures for pollution control will be applied, as described in detail within the Main Design and CSOP.

#### ***Measures of adjusting the planned culverts and dry passages under the bridges for wildlife passage***

Some culverts the purpose of which is drainage are to be planned and executed in accordance with guidelines given in this report, so they may also serve as efficient ecological corridors, i.e., passages for small animals (medium and small mammals, reptiles, amphibians, etc.). The same principle is applied to bridges.

It is necessary to construct all pipe and other culverts that are planned at locations of the intersection of the motorway and existing watercourses, but they should be of adequate dimensions (enclosed Map 10 in Annex 12). Culverts for small mammals are pipe or box culverts. The diameter of pipes or the width of box culverts is 1.5 m, which is adequate for most mammal species.

Water flow and passage of animals through culverts have to be maintained during construction, and special requirements in designing have to be taken into account for the safe passage of otters in all circumstances, including high water (during floods).

If the culvert or the space under the bridge is often covered in water, it is necessary to adjust it so the part of it may be kept dry in all hydrological conditions. That may be achieved by creating lateral inclination, installing of side structures or ledges above the water level (Figures 35, 36, 37 and 38). Box culverts and tunnels should be partly dry on the inside or have the protruding edge like otter walk or catwalk and the berm for badgers and an otters.

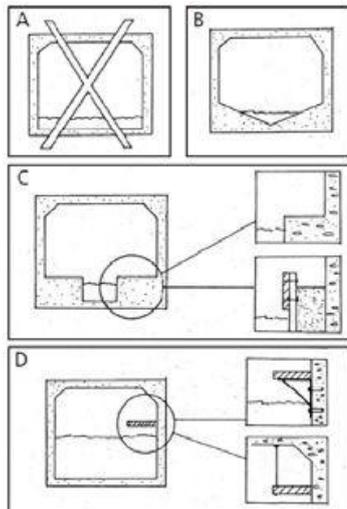


Figure 35 Different types of adjusting the culvert for animal passage

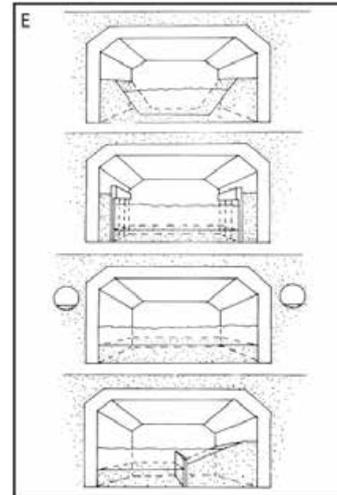


Figure 36 Different types of adjusting the area under the bridge for animal passage

(A - Not adequate for terrestrial animals for water covers the whole bottom of the culvert or the zone under the bridge; B and C – Examples of the catwalk constructed under the water level; D – wooden plank fixed to the sidewall as a barrier for water; E - Different types of adjusting the area under the bridge)

Culverts that need such adjusting are given in Map 10 in Annex 12 enclosed to this report.

Areas under bridges need to have land passage (Figures 37 and 38) over the river Bosna and small watercourses where they will be planned by the main design (enclosures: Map 10, Annex 12).



Figure 37 An example of the surface under the bridge with the dry passage for mammals and other terrestrial animals



Figure 38 Photograph as an example of box culvert with the dry part of the passage for mammals and other terrestrial animals

Protective fencing needs to be combined with culverts. The length depends on the area in question, but it is recommended to install the fence of a length of 20 m on each side of the culvert.

### ***Measures for regulation and revitalizing of small watercourses and riverbanks***

The bottom of the regulated riverbed is to be designed in such a way as to be like the unregulated one as much as possible.

The Design documentation should plan for restoration of riverbanks that were possibly disturbed by construction works, with compliance with measures from the Main Design – Landscaping Phase with adequate vegetation that might be used in bank restoration.

If routes of small watercourses were changed or redirected, it is necessary to return them to their original state with hydro-construction works in order to revert the effects of works that caused ecological degradation (Figure 40).



*Figure 39 Example of undesirable solution of watercourse regulation*



*Figure 40 Example of a more favorable variant of watercourse regulation*

During the stated restoration of watercourses, it is very important not to force the riverbed geometry that is not supported by the river in hydraulic, hydro-morphological, and ecological sense.

In the case of restoration of small watercourses or riverbanks of the River Bosna, it is desirable to maintain the diversity of hydraulic and morphological elements of the river flow that is present in natural watercourses (meandering, changing the longitudinal inclination of the bottom, cross-profiles of various shapes, alternating shallow and deep zones, banks covered in vegetation where necessary etc.).

It is necessary to maintain the natural state of sediments in all watercourses with the aim of maintaining continuity and connectedness of populations of those watercourses with the River Bosna, i.e., migration of fish and zoobentos.

#### **4.6.2 Operation**

##### ***Measures for prevention of water pollution during motorway exploitation***

Regular checks of the system for controlled drainage of stormwater by checking and maintaining separators and related drainage installation.

Road belt is to be maintained regularly by mowing without the use of chemical agents on channels grown in vegetation or close to watercourses.

##### ***Measures for maintenance of culverts and passages under bridges***

Culverts and passages under bridges need to be checked annually to ensure that there are no blockages, and maintenance should last for the life of the motorway.

## **4.7 Protected Areas**

### **4.7.1 Pre-construction, Construction and Operation**

Considering the distance and purpose of the project area, there is no negative impact of the motorway on the closest presently protected areas on national level.

Distance to the potentially national protected areas is over 10 km for each area, so considering the type and size of the project, existing environmental conditions and the geographic position, there is **no significant negative impact on potentially protected areas** at the entity level.

There is **no impact on planned Natura 2000 areas** provided that measures for prevention of watercourses pollution, solving of adequate drainage of potential waste water, construction of adequate separators and accidents prevention are implemented.

The planned section of the motorway will have **no direct, indirect or cumulative negative impact on any of international protected sites (IBA, Ramsar)** since its distance from those areas is larger than 50 km.

#### 4.8 Summary of the most important impacts and mitigation measures

A detailed breakdown of the project-related impacts to flora, vegetation, fauna and their habitats, recommended measures to avoid, restore / rehabilitate and minimise impacts is presented as following:.

Table 13 A summary of the most significant impacts and mitigation measures

Biodiversity Feature	Characterisation	State of the feature in the project area	Project Effect	Impact	Mitigation measures
Willow-poplar woods	Annex I of the Habitats Directive (code 91E0*); No critical habitat qualifying features.	Fourteen small patches near the river. Relatively small, unconnected, degraded and not representative habitat type.	Woods don't overlap with project footprint and buffer.	not significant	Limiting and control of construction works.
Alder woods in Kožuhe	Annex I of the Habitats Directive (code 91E0*); No critical habitat qualifying features.	Developed stand with characteristic species. Small and isolated, surrounded by plots with intensive agricultural production. Not unique for the project area.	Intersection "Trebava" in Kožuhe overlaps one small part of this alder wood (2,5 ha or 15%).	moderate	Avoid removal, destruction or damage to the trees outside the construction zone. Fence the part of the forest that will not be removed and prohibit access to vehicles and workers. Providing a stable groundwater level and adequate solution for surface water inflow from the east, as well as monitoring measures during construction work and later during operation phase. Young trees in the part that will be cleared can be safely plant out with the presence of supervision engineer and an botanist expert, and the area around the forest should be

					afforested with those trees.
Muddy and gravel river banks	Annex I of the Habitats Directive (code 3270, 3130); No critical habitat qualifying features.	Widespread in the downstream part of Bosna River. The distribution depends on hydromorphological processes that are unpredictable and changeable in the lower course of Bosna River.	Not confirmed at project footprint locations in the bridge construction zones.	minor	Avoidance of river bank areas, except for limited extent necessary to create bridge crossings. Ensure that a reinstatement of the river banks is performed once the works are complete.
Natural vegetation	All registered natural and semi-natural vegetation/habitats in the direct project influence zone.	Mostly willow-poplar and alder forests and river banks (in the zone of bridges) near the project footprint.	Risk of additional spreading of invasive species during the construction works and landscaping.	moderate	Proper management and recultivation of borrow pits and disposal sites. Appropriate horticultural landscaping by using only autochthonous species.  Removal of allochthonous invasive species during maintenance of green areas.
Protected Vascular Plant Species	8 species protected and 2 strictly protected by national regulations. No presence of globally or EU endangered species.	Mostly present in forest habitats, especially in oxbow outside of the project influence zone.	Recorded mostly in willow forests which remain out of project footprint.	not significant	Limiting and control of construction works in areas with natural terrestrial vegetation.
Large Copper Butterfly	<i>Lycaena dispar</i> (IUCN - NT, Annexes II and IV of the Habitats Directive)	Sufficiently represented in the Study area for it to be considered of conservation significance.	Project doesn't overlap with significant habitats of this species.	not significant	Precaution, vegetation removal will only occur as necessary.
European pond turtle	<i>Emys orbicularis</i> (EN according to IUCN; Annex II of Habitat Directive; Strictly Protected by	Could be found sporadically in suitable slow flowing and stagnant water	Not found in the project footprint. The project could fragment water habitats if culverts are not provided.	moderate	Terrain search and relocation of possible found animals out of the construction works zone. Eight watercourses

	National Regulation)	bodies around the Bosna River.			identified to be preserved by culverts designed and adequate hydro regulation works to allow passage. During construction works near the habitat of the pond turtle, the presence of an expert biologist is required. Monitoring of pond turtle population during the post-construction phase is strongly recommended.
Protected breeding birds	5 species: <i>Lanius collurio</i> (Annex I; IUCN - LC), <i>Lanius minor</i> (Annex I; IUCN - LC), <i>Streptopelia turtur</i> (IUCN - VU), <i>Alcedo atthis</i> (Annex I; IUCN - LC), <i>Haliaeetus albicilla</i> (Annex I of BD; IUCN - LC). All Strictly Protected under the national regulations.	Small populations in project area (< 5 breeding pairs). Widespread and far more numerous in other habitats in the surrounding area.	None of these species were found to be nesting within the project footprint or in the buffer zone; Project neither separates nor occupies directly any breeding birds important habitat. Possible disturbance during construction. Possible collision with transparent noise barriers.	minor	Removal of vegetation is to be performed out of the nesting period.  Search the target vegetation for nesting birds before construction. Planning of non-transparent noise barriers (vertical marks of light color on the outer side of the fence).
Non-nesting protected bird species (migratory, wintering and vagrant species)	17 species: waterbirds, birds of prey and woodpeckers; All in Annex I Bird Directive. All Strictly Protected under the national regulations.	Could be found sporadically, mostly near the river, riverbanks, oxbow and cutoff channels, scattered outside the zone of project influence. No sites that contain significant populations of protected species (<5 individuals).	Project will not disrupt bird migration routes. Possible collision with transparent noise barriers.	minor	Limiting and control of construction works.  Planning of non-transparent noise barriers (vertical marks of light color on the outer side of the fence).
Protected bat species	3 species: <i>Myotis capaccinii</i> - Annex II, IV of HD, IUCN - VU; <i>Barbastella barbastellus</i> - Annex II, IV, IUCN - NT; <i>Miniopterus schreibersii</i> - Annex II, IV, IUCN - VU	Sporadically registered; can be found during migration and feeding, no significant roosting or foraging habitats of bats in the project area.	No sites that contain significant populations of protected species, project will not disrupt bat migration routes.	not significant	Precautionary measures due the lack of field data. Checking for bat roost sites in old trunks before cutting.

Otter and beaver	<i>Lutra lutra</i> (Annexes II and IV of the EU Habitats Directive); <i>Castor fiber</i> (Annex II and IV of HD)	Signs of presence near the river and small watercourses. No nests observed.	Disturbance to watercourse habitats during construction and disruption of access during operation.	minor	Eight watercourses identified to be preserved by culverts designed to allow passage. Construct all pipe and other culverts that are planned at locations of the intersection of the motorway and existing watercourses, but they should be of adequate dimensions. Provide land passages under bridges.
Protected and important medium and large mammals	10 species: <i>Vulpes vulpes</i> , <i>Canis aureus</i> (Annex V of HD), <i>Martes foina</i> , <i>Martes martes</i> (Annex V of HD), <i>Meles meles</i> (Annex III of Bern convention), <i>Felis silvestris</i> (Annex IV of HD), <i>Lepus europaeus</i> , <i>Capreolus capreolus</i> , <i>Sus scrofa</i> , all species, species significant for hunting.	Three zones of an increased presence of these species: 1. Kožuhe, locality "Dijelovi" 2. Dugo polje, locality "Kutlovac" 3. Botajica locality, "Botajičke luke"	Disruption of access to river during construction and operation. Occasional collisions with vehicles are possible in case the motorway is not provided with a appropriate fence and appropriate passages, especially in the zones of species increased activity.	moderate	Animal protection at the construction site.  Construct a wildlife underpass (under the level of the motorway) at all three proposed locations.  Box culverts and tunnels should be partly dry on the inside or have the protruding edge like otter walk or catwalk and the berm for badgers and an otters. Provide land passages under bridges.  Eco-protective devices should be included in the equipment of the motorway, for repelling the game away.
Protected fish species and other aquatic and semi-aquatic species	8 species: <i>Gobio obtusirostris</i> , <i>Romanogobio uranoscopus</i> , <i>Romanogobio kesslerii</i> , <i>Rhodeus amarus</i> , <i>Misgurnus fossilis</i> , <i>Cobitis elongata</i> , (all on Annex II of Habitat Directive) <i>Alburnus sarmaticus</i>	Common for the whole length of the River Bosna, from Dobož to Modriča. River Bosna does not represent a unique habitat, nor does it support a significant population of any of these species. Some of the species use a small watercourses in the floodplain.	Changes to the hydrological regime of the Bosna River channel during the construction of bridges and the motorway will have local and temporary character. The motorway route crosses eight small and medium ephemeral creeks and cutoff channels.	minor	Provide the natural passage for fish during construction. Provide that adequately sized culverts are constructed in the places where the Motorway intersects creeks/tributaries and other watercourses to maintain the flow and connectivity between these streams and the River.

	(IUCN - EN) and <i>Cyprinus carpio</i> (IUCN - VU).				<p>The bottom of the regulated riverbed is to be designed in such a way as to be like the unregulated one as much as possible.</p> <p>Prevention and control of water pollution during construction and operation.</p>
International or National Protected areas	No protected area qualifying features (Ramsar, IBA, Natura 2000, Emerald, Nationally Protected Areas)	There is no existing, proposed nor planned protected areas in the project area.	-	negligible	-

## 5 Monitoring

### 5.1 Monitoring plan

The Project has committed to establishing an Environmental Monitoring Plan. This will incorporate a Biodiversity Monitoring and Evaluation Programme to assess the efficacy of the avoidance and mitigation measures and to inform the requirement for adaptive management. A range of biodiversity monitoring actions have been developed based on the avoidance and mitigation measures designed for the Project.

A set of monitoring actions has been developed based on the avoidance and mitigation measures designed for the Project.

Monitoring is of key importance during the construction of roads because it represents the mechanism that enables the designers to check the efficiency of applied measures with the aim of mitigating the impact of roads and traffic on existing ecosystems.

The goals of monitoring are the following:

- To determine faults in implementation, establishment, or maintaining of measures;
- To determine the efficiency of measures considering their purpose;
- To determine if measures reduce impacts on species and habitats in a long term.

Table 13: Summary of recommended monitoring measures

Monitoring subject/Parameter	Location	Time	Note on method, purpose, indicators etc.	Responsibility and Staff
Phase: Pre-construction and Construction				
Alder forest (Natura 2000 code: 91E0*)	Kožuhe, Dijelovi locality	During construction	Check that there is no unnecessary damage to the remaining part of the wood.	Contractor, Botanist, Supervising Engineer
Natural vegetation renewal	Complete route (along the buffer zone and associated ecosystems in project influence zone). Soil and gravel temporary excavation pit.	During construction it is necessary to monitor the vegetation twice a year.	Field determination of degree of renewal of original vegetation. Control of presence and spreading of invasive species during works.	Contractor, Botanist, Supervising Engineer
River banks, muddy shores with amphibious vegetation (Natura 2000 codes: 3270 and 3130)	At the riverbed locations where construction work is planned (Ritešić, Dugo polje and Vranjak bridges, and under the Dobor hill in Jakeš).	Before construction (summer, autumn).	Visual inspection. Presence of indicator species and protected plant species. To determine whether Natura 2000 habitats have been formed in localities where construction work was planned in the water bodies, in order to take measures for the protection of species and habitats (construction work adaptation, relocation of plants, etc.).	Contractor, Botanist, Supervising Engineer
European pond turtle	Along the river, around habitats, cut off channels	Late spring and summer period: April - September	Traps/netting method. To determine the presence of animals in water or	Contractor, Biodiversity expert,

	and creeks (see maps 6, 7).		close to water to have them relocated safely.	Supervising Engineer
Breeding bird species	Complete route (footprint and buffer zone).	Spring, summer (March-August)	Free method. Check for presence of active nesting sites. Determination of locations and animals that possibly nest in the zone of planned construction works with the aim of safe relocation or change of work schedule.	Contractor, Ornithologist, Supervising Engineer
White-tailed see eagle	Nest near Kožuhe (willow scope, Dijelovi locality)	January-March. Before and during construction works.	Visual inspection of nest site without disturbing the nest and birds. To determine the presence of nesting signs to ensure minimum disturbance.	Contractor, Ornithologist, Supervising Engineer
Bat roosting sites	Complete route (footprint and buffer zone)	Before construction works.	Check for presence of potential roosting sites (old trunks).	Contractor, Biodiversity expert, Supervising Engineer
Medium and Large mammals	Kožuhe, Dugo polje, Botajica	One year before construction, during the whole year.	Camera trap method. To determine the species types and frequency of wildlife crossing the proposed Motorway alignment.	Contractor, Biodiversity expert, Supervising Engineer
Phase: Operation				
Alder forest (Natura 2000 code: 91E0*)	Kožuhe, Dijelovi locality	Floristic-vegetation parameters - every three years. Environmental parameters - every year.	Determine the species diversity, environmental parameters and health status of forest stand in order to take certain protection measures. Detailed measures are given later in this chapter.	Investor, Botanist
Natural vegetation renewal (mostly alluvial willow-poplar forests)	Complete route (along the buffer zone and associated ecosystems in project influence zone). Soil and gravel temporary excavation pit.	Twice a year (first three months after landscaping).	Determining the renewal degree, coverage and composition of desired species.	Investor, Botanist
Invasive plant species	Complete route	Annual monitoring during the first three years.	Determination of presence of allochthonous invasive species along the route and planning their removal.	Investor

European pond turtle, other reptile and amphibian species	Along the river, around wet habitats, cut off channels and creeks (see maps 6,7).	Annual monitoring during the first three years. Warm period of the year (spring, summer) March-June, first three years, once per year	To determine if European pond turtle uses culverts as established migratory routes or the species is not present at the target habitat where it was determined before the beginning of motorway construction work in order to take the necessary protecting measures. To record numbers and species of amphibians and reptiles that get killed by the collisions with vehicles on the motorway and to eventually determine critical zones.	Investor, Biodiversity expert
Primarily birds of prey, owls, waterbirds, small passerines	Along the whole route, especially bridges and Dobor hill and fortress.	First two years of operation phase. Two times per year in two different months, during the reproduction period and autumn migration (March-October).	Monitoring along the route by foot or slow car ride. To record number and species killed by traffic along the motorway and to determine critical points.	Investor, Ornithologist
White-tailed see eagle	Nest near Kožuhe (willow scope, Dijelovi locality)	January-March, first two years, once per year	Visual inspection of nest site without disturbing the nest and birds. To determine the presence of nesting signs.	Contractor, Ornithologist
Medium and large mammals	Along the whole route, especially underpasses and designated animal passage	During the first three years of designated animal passage	Keeping minutes on animal casualties on the motorway (species and precise locations). It is necessary to drive very slowly along the whole motorway or to walk (if that is safe).	Investor, Biodiversity expert
Otter and beaver	At locations of intersection of the motorway with watercourses	Spring and summer, first three years	To determine the frequency of usage of pipe culverts and spaces under the bridge and possible need for more frequent maintenance or adjustments. Record possible collisions with vehicles, fence crossing, presence of traces along the Bosna River and population size.	Investor, Biodiversity expert

## 5.2 Other monitoring requirements

All previously mentioned activities of monitoring will continue for the first three years after construction. After that, it is planned to consider the efficiency of monitoring and the need to monitor each of the

recommended species/groups. The future monitoring program will be developed to cover the period from 4 to 10 years after construction and it will be implemented accordingly.

The Contractor is obliged to deliver the data on monitoring for his phase (construction phase) to the Engineer and the Investor.

The Investor is obliged to deliver the results of monitoring after construction to the ministry in charge of environmental protection and to the ministry in charge of hunting.

Biodiversity expert engagement includes those types of monitoring where professional knowledge and objectivity is important for species identification. Other types of monitoring may be performed by workers who are not biodiversity experts, with previous quick training in

1. identification of target species to be monitored (easily recognizable species that are difficult to mix up), and
2. methodology and protocol of data gathering in the field, data processing and timely delivery to relevant institutions.

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## ANNEX 1. GPS Coordinates of Flora and Vegetation Survey Sites

Site ID	Site name	Coordinates (X, Y)	
8	Kožuhe, Dijelovi, šuma	44.861449°	18.097293°
9	Kožuhe, Jabučik, šuma 1	44.859227°	18.096062°
10	Kožuhe, Jabučik, šuma 2	44.855942°	18.096487°
11	Kožuhe, Jabučik, šuma 3	44.859928°	18.096772°
12	Kožuhe, Jabučik, šuma 4	44.858534°	18.096200°
13	Kožuhe, Jabučik, šuma 5	44.856878°	18.096590°
14	Kožuhe, Jabučik, šuma 6	44.856680°	18.096665°
15	Ritešić, Ritešičko polje, šuma	44.879600°	18.098033°
16	Trnjani, Majevačko polje, starača kopovi 1	44.895266°	18.099896°
17	Trnjani, Majevačko polje, starača kopovi 2	44.896005°	18.098846°
18	Božinci Donji, Trnjansko polje, šuma uz rijeku 1	44.914254°	18.110289°
19	Božinci Donji, Trnjansko polje, šuma uz rijeku 2	44.913642°	18.109744°
20	Glogovica, Rastoka, šuma uz rijeku	44.919046°	18.114403°
21	Dugo Polje, Kutlovac, šuma starača 1	44.934755°	18.142244°
22	Dugo Polje, Kutlovac, šuma starača 2	44.934726°	18.143321°
23	Dugo Polje, Bus-staklenik, šljunkara 1	44.925950°	18.170699°
24	Dugo Polje, Bus-staklenik, šljunkara 2	44.924467°	18.169415°
25	Vranjak Donji, Brijestovo, poplavna livada	44.945538°	18.216841°
26	Tarevci, Daulije, poplavna šuma	44.960230°	18.230679°
27	Tarevci, Daulije, šljunkara 1	44.961030°	18.234669°
28	Tarevci, Daulije, šljunkara 2	44.960996°	18.238660°
29	Botajica, Botajičke luke, sprud	44.965132°	18.256982°

## ANNEX 2. GPS Coordinates of Fauna detailed Survey Sites

Site ID	Site name	Coordinates (X, Y)	
6	Kožuhe, starača	44.8567111°	18.0962000°
7	Ritešić, most	44.8776361°	18.0987750°
8	Trnjani, starača	44.8964222°	18.0981972°
9	Glogovica/Božinci Donji, rukavac i kopovi	44.9171028°	18.1131750°
10	Podnovlje, šljunkara Narić, sprudovi	44.9283889°	18.1342250°
11	Dugo Polje, Kutlovac, rukavac-vrbak uz Bosnu	44.9308722°	18.1444778°
12	Dugo Polje, Kutlovac, starača-vrbak uz cestu	44.9342639°	18.1410722°
13	Dugo Polje, Bosnica, vrbak	44.927716°	18.158659°
14	Dugo Polje, Bus-staklenik, sprud	44.925214°	18.170230°
15	Dugo Polje, Vranjacko polje, polja ka skeli	44.927092°	18.192561°
16	Vranjak Donji, kod pumpe, kanal i polja	44.939595°	18.216230°
17	Vranjak Donji, sprud i vrbak-starača	44.944747°	18.213536°
18	Vranjak Donji, Brvno, starača-plavna livada	44.948511°	18.226775°
19	Tarevci, Tarevacko polje, sljunkara i poplavna suma	44.961117°	18.237767°
20	Botajica, Botajičke luke, polja i rukavac	44.965711°	18.250655°
21	Botajica, ada, poplavna šuma i sprud	44.965212°	18.256663°
22	Jakeš, odmaralište, vrbaci	44.970214°	18.263417°
23	Jakeš, magistrala, polja	44.974416°	18.291418°
24	Srnava, polja i kanal	45.018345°	18.290496°

### ANNEX 3. Habitats

EUNIS code	Habitat name	Natura 2000 code	Note	Critical habitat
C	Inland surface water habitats			
C1	Surface standing waters			
C1.32	Free-floating vegetation of eutrophic water bodies	3150 'Natural eutrophic lakes with Magnopotamion or Hydrocharition'	natural	No
C1.34	Rooted floating vegetation of eutrophic water bodies	3150 'Natural eutrophic lakes with Magnopotamion or Hydrocharition'	natural	No
C1.35	Plankton communities of eutrophic standing waters	-	natural	No
C1.63	Eutrophic temporary waters	-	natural	No
C2	Surface running waters			No
C2.34	Eutrophic vegetation of slow-flowing rivers	-	natural	No
C3	Littoral zone of inland surface water bodies			
C3.211	Flooded [Phragmites] beds	-	natural	No
C3.22	Common clubrush ([Scirpus]) beds	-	natural	No
C3.26	Reed canary-grass ([Phalaris]) beds	-	semi-natural	No
C3.29	Water-fringing large sedge communities	-	semi-natural	No
C3.431	Ponto-Pannonic riverbank dwarf sedge communities	3130 'Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoeto-Nanojuncetea'	natural	No
C3.5132	Small galingale swards	3130 'Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoeto-Nanojuncetea'	natural	No
C3.52	[Bidens] communities (of lake and pond shores)	3270 'Rivers with muddy banks with Chenopodium rubri p.p. and Bidention p.p. vegetation'	natural	No
C3.53	Euro-Siberian annual river mud communities	3270 'Rivers with muddy banks with Chenopodium rubri p.p. and Bidention p.p. vegetation'	natural	No
C3.62	Unvegetated river gravel banks	-	natural	No
C3.63	Unvegetated river mud banks	-	natural	No
C3.65	Exposed unvegetated freshwater lake muds	-	natural	No
E	Grassland and tall forb habitats			
E2	Mesic grasslands			
E2.222	Hygromesophile medio-European lowland hay meadows	6510 'Lowland hay meadows (Alopecurus	semi-natural	No

		pratensis, Sanguisorba officinalis'		
E2.61	Dry or moist agriculturally-improved grassland	-	urban	No
E2.7	Unmanaged mesic grassland	-	semi-natural	No
E3	Seasonally wet and wet grasslands			
E3.43	Subcontinental riverine meadows	6510 'Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis'	semi-natural	No
E3.442	Flood swards	-	semi-natural	No
E3.463	Illyrio-Pannonic riverine and humid meadows	6510 'Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis'	semi-natural	No
E5	Woodland fringes and clearings and tall forb habitats			
E5.1	Anthropogenic herb stands	-	urban	No
E5.43	Shady woodland edge fringes	-	semi-natural	No
F	Heathland, scrub and tundra habitats			
F3	Temperate and mediterranean-montane scrub habitats			
F3.131	Bramble thickets	-	urban	No
F9	Riverine and fen scrubs			
F9.121	Almond willow-osier scrub	-	semi-natural	No
F9.35	Riparian stands of invasive shrubs	-	urban	No
G	Woodland and forest habitats and other wooded land			
G1	Broadleaved deciduous woodland			
G1.1112	Eastern European poplar-willow forests	*91E0 'Alluvial forests with Alnus glutinosa and Fraxinus excelsior'	natural	No
G1.1141	Pannonic willow and poplar-willow galleries	*91E0 'Alluvial forests with Alnus glutinosa and Fraxinus excelsior'	natural	No
G1.4141	Pannonic swamp alder-ash woods	*91F0 'Alluvial forests with Alnus glutinosa and Fraxinus excelsior'	natural	No
G1.A1A1	Illyrian sessile oak-hornbeam forests	91L0 'Oak-hornbeam forests of the illyrian area'		No
G1.C1	Poplar plantations	-	urban	No
I	Regularly or recently cultivated agricultural, horticultural and domestic habitats	-	urban	
J	Constructed, industrial and other artificial habitats	-	urban	

**ANNEX 4. List of plant species**

No.	Species	IUCN Global Red List	Annex HD	Nationa Regulation	Status
1	<i>Acer campestre</i>				
2	<i>Acer dasycarpum</i>				NEO
3	<i>Acer negundo</i>				INV
4	<i>Acer tataricum</i>				
5	<i>Achillea millefolium</i>				
6	<i>Aegopodium podagraria</i>				
7	<i>Agrimonia eupatoria</i>				
8	<i>Agropyron repens</i>				
9	<i>Agrostis stolonifera</i>				
10	<i>Ajuga reptans</i>				
11	<i>Alisma plantago-aquatica</i>				
12	<i>Alliaria petiolata</i>				
13	<i>Allium carinatum</i>				
14	<i>Allium scorodoprasum</i>				
15	<i>Allium vineale</i>				
16	<i>Alnus rohlenae</i>				
18	<i>Amaranthus graecizans</i>				NEO
19	<i>Amaranthus hybridus</i>				NEO
20	<i>Amaranthus retroflexus</i>				INV
21	<i>Ambrosia artemisifolia</i>				INV
22	<i>Amorpha fruticosa</i>				INV
23	<i>Anchusa officinalis</i>				
24	<i>Angelica sylvestris</i>				
25	<i>Anthoxanthum odoratum</i>				
26	<i>Arabidopsis thaliana</i>				
27	<i>Arctium lappa</i>				
28	<i>Aristolochia clematitis</i>				
29	<i>Arrhenatherum elatius</i>				
30	<i>Artemisia verlotiorum</i>				INV
31	<i>Artemisia vulgaris</i>				
32	<i>Arum maculatum</i>				
33	<i>Asclepias syriaca</i>				INV
34	<i>Athyrium filix-femina</i>				
35	<i>Bellis perennis</i>				
36	<i>Berula erecta</i>				
37	<i>Bidens frondosa</i>				INV
38	<i>Bidens tripartitus</i>				
39	<i>Brachypodium sylvaticum</i>				
40	<i>Bromus hordeaceus</i>				
41	<i>Bromus sterilis</i>				
43	<i>Calamagrostis epigejos</i>				
44	<i>Caltha palustris</i>				
45	<i>Calystegia sepium</i>				

46	<i>Calystegia sylvatica</i>				
47	<i>Capsella bursa-pastoris</i>				
48	<i>Cardamine hirsuta</i>				
49	<i>Cardamine pratensis</i>				
50	<i>Carex acuta</i>				
51	<i>Carex brizoides</i>				
52	<i>Carex distans</i>				
53	<i>Carex hirta</i>				
54	<i>Carex otrubae</i>				
55	<i>Carex pendula</i>				
56	<i>Carex remota</i>				
57	<i>Carex riparia</i>				
58	<i>Carex spicata</i>				
59	<i>Carex strigosa</i>			SP	
60	<i>Carex vesicaria</i>			P	
61	<i>Carex vulpina</i>				
62	<i>Centaurea jacea</i>				
63	<i>Cerastium brachypetalum</i>				
64	<i>Cerastium glomeratum</i>				
65	<i>Cerastium sylvaticum</i>				
66	<i>Chaerophyllum bulbosum</i>				
67	<i>Chenopodium album</i>				
68	<i>Chenopodium ambrosioides</i>				INV
69	<i>Chelidonium majus</i>				
70	<i>Chenopodium polyspermum</i>				
72	<i>Callitriche cophocarpa</i>				
73	<i>Circaea lutetiana</i>				
74	<i>Cirsium arvense</i>				
75	<i>Clematis vitalba</i>				
76	<i>Clinopodium vulgare</i>				
77	<i>Conium maculatum</i>				
78	<i>Convolvulus arvensis</i>				
79	<i>Corylus avellana</i>				
80	<i>Cornus sanguinea</i>				
81	<i>Crataegus monogyna</i>				
82	<i>Crepis biennis</i>				
83	<i>Cruciata laevipes</i>				
84	<i>Cynodon dactylon</i>				
85	<i>Cyperus fuscus</i>			P	
86	<i>Cyperus glomeratus</i>			P	
88	<i>Dactylis glomerata</i>				
89	<i>Daucus carota</i>				
90	<i>Deschampsia cespitosa</i>				
91	<i>Digitaria sanguinalis</i>				
92	<i>Dryopteris filix-mas</i>				
93	<i>Echinochloa crus-galli</i>				

94	<i>Echinocystis lobata</i>				INV
95	<i>Eleocharis palustris</i>				
96	<i>Eleusine indica</i>				INV
97	<i>Elytrigia repens</i>				
98	<i>Equisetum arvense</i>				
99	<i>Equisetum palustre</i>				
100	<i>Eragrostis minor</i>				
101	<i>Erigeron annuus</i>				INV
102	<i>Erigeron giganteus</i>				INV
103	<i>Eryngium amethystinum</i>				
104	<i>Euonymus europaeus</i>				
105	<i>Eupatorium cannabinum</i>				
106	<i>Euphorbia cyparissias</i>				
107	<i>Euphorbia esula</i>				
108	<i>Euphorbia helioscopia</i>				
109	<i>Festuca arundinacea</i>				
110	<i>Festuca pratensis</i>				
111	<i>Ficaria verna</i>				
112	<i>Filipendula ulmaria</i>				
113	<i>Frangula alnus</i>				
114	<i>Fraxinus pensylvanica</i>				NEO
115	<i>Fraxinus angustifolia</i>				
116	<i>Galeopsis speciosa</i>				
117	<i>Galinsoga parviflora</i>				INV
118	<i>Galium aparine</i>				
119	<i>Galium elongatum</i>				
120	<i>Galium mollugo</i>				
121	<i>Galium palustre</i>				
122	<i>Galium uliginosum</i>			P	
123	<i>Geranium dissectum</i>				
124	<i>Geum urbanum</i>				
125	<i>Glechoma hederacea</i>				
126	<i>Glyceria fluitans</i>				
127	<i>Hedera helix</i>				
128	<i>Helianthus tuberosus</i>				INV
129	<i>Heracleum sphondylium</i>				
130	<i>Holcus lanatus</i>				
131	<i>Humulus lupulus</i>				
132	<i>Inuly conyzae</i>				
133	<i>Iris pseudacorus</i>				
134	<i>Juncus articulatus</i>				
135	<i>Juncus effusus</i>				
136	<i>Kickxia elatine</i>				
137	<i>Lamium album</i>				
138	<i>Lamium purpureum</i>				
139	<i>Lavatera thuringiaca</i>				

140	<i>Lemna minor</i>				
141	<i>Leucanthemum vulgare</i>				
142	<i>Ligustrum vulgare</i>				
143	<i>Lotus corniculatus</i>				
144	<i>Lychnis flos-cuculi</i>				
145	<i>Lycopus europaeus</i>				
146	<i>Lysimachia nummularia</i>				
147	<i>Lysimachia vulgaris</i>				
148	<i>Lythrum salicaria</i>				
149	<i>Malva sylvestris</i>				
150	<i>Medicago arabica</i>				
151	<i>Medicago sativa</i>				
152	<i>Mentha aquatica</i>				
153	<i>Molinia caerulea</i>				
154	<i>Morus alba</i>				
155	<i>Myosotis arvensis</i>				
158	<i>Oenanthe banatica</i>				
159	<i>Oenanthe fistulosa</i>				
160	<i>Oenanthe silaifolia</i>				
161	<i>Oenothera biennis</i>				INV
162	<i>Ornithogalum umbellatum</i>				
163	<i>Papaver rhoeas</i>				
164	<i>Panicum capillare</i>				INV
165	<i>Panicum dichotomiflorum</i>				INV
166	<i>Panicum riparium</i>				NEO
167	<i>Parthenocissus quinquaefolia</i>				INV
168	<i>Pastinaca sativa</i>				
169	<i>Polygonum amphibium</i>			SP	
170	<i>Petasites hybridus</i>				
171	<i>Peucedanum aegopodioides</i>			P	
172	<i>Phalaris arundinacea</i>			P	
173	<i>Phragmites australis</i>				
174	<i>Picris hieracioides</i>				
175	<i>Plantago lanceolata</i>				
176	<i>Plantago major</i>				
177	<i>Poa pratensis</i>				
178	<i>Poa trivialis</i>				
179	<i>Polygonum hydropiper</i>				
180	<i>Polygonum aviculare</i>				
181	<i>Polygonum hydropiper</i>				
182	<i>Polygonum lapathifolium</i>				
183	<i>Polygonum mite</i>				
184	<i>Polygonum persicaria</i>				
185	<i>Polystichum setiferum</i>				
186	<i>Populus alba</i>				
187	<i>Populus canescens</i>				

188	<i>Populus nigra</i>				
189	<i>Portulaca oleracea</i>				NAT
191	<i>Potentilla reptans</i>				
192	<i>Prunus spinosa</i>				
193	<i>Pulmonaria officinalis</i>				
194	<i>Quercus robur</i>				
195	<i>Ranunculus bulbosus</i>				
196	<i>Ranunculus polyanthemos</i>				
197	<i>Ranunculus repens</i>				
198	<i>Reseda lutea</i>				
199	<i>Reynoutria japonica</i>				INV
200	<i>Rhinanthus rumelicus</i>				
201	<i>Robinia pseudoacacia</i>				INV
203	<i>Rorippa austriaca</i>				
204	<i>Rorippa sylvestris</i>				
205	<i>Rosa arvensis</i>				
206	<i>Rubus caesius</i>				
207	<i>Rubus idaeus</i>				
208	<i>Rumex acetosa</i>				
209	<i>Rumex crispus</i>				
210	<i>Rumex obtusifolius</i>				
212	<i>Rumex sanguineus</i>				
213	<i>Salix alba</i>				
214	<i>Salix fragilis</i>				
215	<i>Salix purpurea</i>				
216	<i>Salix triandra</i>				
218	<i>Sambucus nigra</i>				
219	<i>Schoenoplectus lacustris</i>				
220	<i>Scirpus sylvaticus</i>				
222	<i>Scutellaria altissima</i>				
223	<i>Scutellaria hastifolia</i>				
224	<i>Setaria viridis</i>				NEO
225	<i>Silene alba</i>				
226	<i>Silene vulgaris</i>				
227	<i>Sinapis alba</i>				
228	<i>Solanum dulcamara</i>				
229	<i>Solanum lycopersicum</i>				NEO
230	<i>Solanum nigrum</i>				
231	<i>Solidago gigantea</i>				INV
232	<i>Sonchus oleraceus</i>				
233	<i>Sorghum hallepense</i>				INV
234	<i>Sparganium erectum</i>				
235	<i>Spirodela polyrhiza</i>				
236	<i>Stachys palustris</i>				
237	<i>Stellaria media</i>				
238	<i>Succisa pratensis</i>				

239	<i>Symphytum officinale</i>				
240	<i>Taraxacum officinale</i>				
241	<i>Taraxacum paludosum</i>			P	
242	<i>Thalictrum flavum</i>			P	
243	<i>Thalictrum lucidum</i>				
244	<i>Thlaspi alliaceum</i>				
246	<i>Trifolium pratense</i>				
247	<i>Trifolium repens</i>				
248	<i>Tussilago farfara</i>				
249	<i>Ulmus laevis</i>				
250	<i>Ulmus minor</i>				
251	<i>Urtica dioica</i>				
252	<i>Verbena officinalis</i>				
253	<i>Verbascum sp.</i>				
254	<i>Veronica arvensis</i>				
255	<i>Veronica chamaedrys</i>				
256	<i>Veronica persica</i>				INV
257	<i>Viburnum opulus</i>				
258	<i>Vicia cracca</i>				
259	<i>Vicia hirsuta</i>				
260	<i>Vicia sativa</i>				
261	<i>Viola alba</i>				
262	<i>Vulpia myuros</i>				
263	<i>Xanthium italicum</i>				INV

NEO: Neophyte; INV: Invasive; SP - national strictly protected; P - national protected

## ANNEX 5. List of butterflies

No.	Species	Sites ID no.(2017)	Sites ID no. (2021)	Annex HD	IUCN Global Red List	IUCN Europe Red List
1	<i>Pyrgus malvae</i>	8			LC	LC
2	<i>Carterocephalus palemon</i>		14			
3	<i>Ochlodes sylvanus</i>	6,8,9,12			LC	LC
4	<i>Pieris sp.</i>		21			LC
5	<i>Pieris rapae</i>	8,10,	14		LC	LC
6	<i>Colias crocea</i>		11, 16		LC	LC
7	<i>Lycaena dispar</i>	9		II, IV	NT	LC
8	<i>Cupido argiades</i>		18		LC	
9	<i>Celastrina argiolus</i>		20			
10	<i>Polyommatus icarus</i>	6	9, 16		LC	LC
11	<i>Melanargia galathea</i>		14			
12	<i>Brenthis daphnae</i>		6		LC	LC
13	<i>Vanessa atalanta</i>		20			
14	<i>Aglais io</i>		6			
15	<i>Polygonia c-album</i>		20, 21			
16	<i>Arashnia levana</i>		6, 17		LC	
17	<i>Melitaea athalia</i>	8,9,10			LC	LC
18	<i>Melitaea phoebe</i>	6			LC	LC
19	<i>Limenitis sp.</i>		20			
20	<i>Apatura iris</i>	6			LC	LC
21	<i>Pararge aegeria</i>	8			LC	LC
22	<i>Coenonympha rhodopensis</i>	7			LC	LC
23	<i>Coenonympha pamphilus</i>		20, 16, 18		LC	LC
24	<i>Coenonympha glycerion</i>		16		LC	LC
25	<i>Maniola jurtina</i>		6, 16		LC	LC
26	<i>Minois dryas</i>		9		LC	

HD – II: Listed in Habitats Directive Annex II

Sites: Refers to Survey Sites ID in Annex 2. Marked on Map 1.

## ANNEX 6. List of dragonflies

No.	Species	Habitat-based assumption	Sites ID no. ( 2017 )	Sites ID no. (2021)	Annex HD	IUCN Global Red List	IUCN Europe Red List
1	<i>Calopteryx splendens</i>		7,8,10,11,12	21		LC	
2	<i>Lestes virens</i>		18			LC	LC
3	<i>Ischnura elegans</i>		9,11			LC	
4	<i>Enallagma cyathigerum</i>		11			LC	
5	<i>Coenagrion puella</i>		11	14		LC	
6	<i>Erythromma najas</i>		9			LC	LC
7	<i>Erythromma viridulum</i>		9,11			LC	
8	<i>Erythromma lindenii</i>		18	20		LC	LC
9	<i>Platycnemis pennipes</i>		18	21, 10, 12, 9, 20		LC	LC
10	<i>Aeshna mixta</i>	x				LC	LC
11	<i>Aeshna affinis</i>	x				LC	LC
12	<i>Aeshna cyanea</i>		18			LC	LC
13	<i>Anax imperator</i>		6			LC	
14	<i>Anax parthenope</i>	x					LC
15	<i>Gomphus vulgatissimus</i>		9			LC	LC
16	<i>Onychogomphus forcipatus</i>			21		LC	
17	<i>Libellula depressa</i>		8,12	21, 17,		LC	LC
18	<i>Orthetrum cancellatum</i>		6	21, 14, 10, 12, 13, 9, 19?,		LC	LC
19	<i>Orthetrum albistylum</i>			20		LC	LC
20	<i>Orthetrum brunneum</i>			21, 19?,		LC	LC
21	<i>Sympetrum sanguineum</i>			6		LC	LC
22	<i>Sympetrum fonscolombii</i>	x	7			LC	
23	<i>Sympetrum striolatum</i>	x	7			LC	LC
24	<i>Sympetrum meridionale</i>	x				LC	LC
25	<i>Crocothemis erythraea</i>			9, 14		LC	

HD – II: Listed in Habitats Directive Annex II

Sites: Refers to Survey Sites ID in Annex 2. Marked on Map 1.

**ANNEX 7. List of fish species**

No.	Species	Surveying the local fishermens	Confirmed during the water monitoring 2019, 2020	Annex of HD	Global Red List	Europe Red List	National Regulation
1	<i>Esox lucius</i>	x					
2	<i>Rutilus virgo</i>	x	Johovac, Modriča	II, V	LC	LC	Z
3	<i>Rutilus rutilus</i>		Modriča				
4	<i>Leucaspius delineatus</i>	x			LC	LC	SZ
5	<i>Squalius cephalus</i>	x	Johovac, Modriča				
6	<i>Chondrostoma nasus</i>	x	Johovac, Modriča				
7	<i>Leuciscus aspius</i>		Modriča	II, V	LC	LC	Z
8	<i>Leuciscus idus</i>	x			LC	LC	Z
9	<i>Tinca tinca</i>	x			LC	LC	SZ
10	<i>Gobio obtusirostris</i>		Johovac, Modriča	II	LC	LC	Z
11	<i>Romanogobio uranoscopus</i>		Johovac	II	LC	LC	SZ
12	<i>Romanogobio kesslerii</i>		Modriča	II	LC	LC	SZ
13	<i>Barbus barbus</i>	x	Johovac, Modriča	V			
14	<i>Barbus balcanicus</i>	x	Johovac, Modriča	II, V	LC	LC	Z
15	<i>Alburnus alburnus</i>	x	Modriča				
16	<i>Alburnus sarmaticus</i>	x	Johovac	II	EN	EN	SZ
17	<i>Alburnoides bipunctatus</i>		Johovac		LC	LC	Z
18	<i>Ballerus ballerus</i>	x					
19	<i>Ballerus sapa</i>	x			LC	LC	Z
20	<i>Vimba vimba</i>	x	Johovac, Modriča		LC	LC	Z
21	<i>Abramis brama</i>	x					
22	<i>Carassius carassius</i>	x			LC	LC	SZ
23	<i>Carassius gibelio</i>	x					
24	<i>Cyprinus carpio</i>	x			VU	VU	SZ
25	<i>Rhodeus amarus</i>		Johovac, Modriča	II	LC	LC	Z
26	<i>Ctenopharyngodon idella</i>	x					
27	<i>Pseudorasbora parva</i>	x	Modriča				
28	<i>Misgurnus fossilis</i>	x		II	LC	LC	Z
29	<i>Cobitis elongata</i>		Johovac	II	LC	LC	Z
30	<i>Siluris glanis</i>	x	Modriča				
31	<i>Amiurus nebulosus</i>	x					
32	<i>Lota lota</i>	x			LC	LC	Z

33	<i>Gymnocephalus baloni</i>	x	Modriča	II, IV	LC	LC	SZ
34	<i>Zingel zingel</i>			V	LC	LC	SZ
35	<i>Sander volgensis</i>	x	Modriča		LC	LC	Z
36	<i>Lucioperca lucioperca</i>	x	Modriča				
37	<i>Perca fluviatilis</i>	x	Johovac, Modriča				
38	<i>Lepomis gibbosus</i>	x	Modriča				
39	<i>Neogobius fluviatilis</i>		Johovac				

**ANNEX 8. List of Amphibians**

No.	Species	Sites	IUCN Global Red List	Annex of HD
1	<i>Salamandra salamandra</i>		LC	
2	<i>Lissotriton vulgaris</i>		LC	
3	<i>Bufo bufo</i>		LC	
4	<i>Bufo viridis</i>		LC	IV
5	<i>Hyla arborea</i>		LC	IV
6	<i>Pelophylax kl. esculentus</i>		LC	V
7	<i>Rana dalmatina</i>		LC	IV

**ANNEX 9. List of Reptiles**

No.	Species	Sites	IUCN Global Red List	Annex of HD	National Regulation
1	<i>Emys orbicularis</i>	maps 6,7,8,9	NT	II, IV	SP
2	<i>Podarcis muralis</i>		LC	IV	
3	<i>Lacerta viridis</i>		LC	IV	
4	<i>Anguis fragilis</i>		LC		
5	<i>Natrix natrix</i>		LC		
6	<i>Natrix tessellata</i>		LC	IV	
7	<i>Coronella austriaca</i>		LC	IV	
8	<i>Zamenis longissimus</i>		LC	IV	
9	<i>Vipera ammodytes</i>		LC	IV	

## ANNEX 10. List of Birds

### General informations of findings

No.	Species	Literature and surveying the local hunters	Confirmed during the field survey	Breeding confirmed	Migration	Wintering	Other (feeding, vagrant etc)
1	<i>Coturnix coturnix</i>	x	x	No	Yes		
2	<i>Phasianus colchicus</i>	X	x	Yes			
3	<i>Perdix perdix</i>	x		No			
4	<i>Cygnus olor</i>	x		No		Yes	
5	<i>Anser anser</i>	x		No	Yes		
6	<i>Anser albifrons</i>	x		No	Yes		
7	<i>Mergus merganser</i>	x		No	Yes		
8	<i>Tadorna tadorna</i>	x		no	yes		
9	<i>Aix galericulata</i>	x		no			yes
10	<i>Mareca penelope</i>	x		no	yes		
11	<i>Anas platyrhynchos</i>	x	x	yes		yes	
12	<i>Anas acuta</i>	x		no	yes	yes	
13	<i>Anas crecca</i>	x		no	Yes	Yes	
14	<i>Tachybaptus ruficollis</i>	x	x	yes	yes	yes	
15	<i>Podiceps cristatus</i>	x		no	yes		yes
16	<i>Columba livia</i>	x	x	Yes		yes	
17	<i>Columba palumbus</i>	x	x	Yes		Yes	
18	<i>Streptopelia turtur</i>	x	x	Yes	Yes		
19	<i>Streptopelia decaocto</i>	x	x	Yes		Yes	
20	<i>Cuculus canorus</i>	x	x	Yes			
21	<i>Rallus aquaticus</i>						
22	<i>Gallinula chloropus</i>	x	x	Yes			
23	<i>Fulica atra</i>	x	x			yes	
24	<i>Grus grus</i>	x		No	Yes		
25	<i>Ciconia nigra</i>	x	x	No	Yes		yes
26	<i>Ciconia ciconia</i>	x	x	No	Yes		yes
27	<i>Platalea leucorodia</i>	x		No	Yes		yes
28	<i>Ixobrychus minutus</i>	x	x	No	Yes		
29	<i>Nycticorax nycticorax</i>	x	x	No	Yes		yes
30	<i>Ardeola ralloides</i>	x		No	Yes		yes
31	<i>Ardea cinerea</i>	x	x	No		Yes	yes
32	<i>Ardea purpurea</i>	x		No	Yes		yes
33	<i>Ardea alba</i>	x	x	No	Yes	Yes	yes
34	<i>Egretta garzetta</i>	x	x	No	Yes		yes
35	<i>Phalacrocorax carbo</i>	x	x	No		Yes	yes
36	<i>Vanellus vanellus</i>	x		No	Yes		
37	<i>Scolopax rusticola</i>	x					
38	<i>Gallinago gallinago</i>	x		no	yes		
39	<i>Actitis hypoleucos</i>	x	x	Yes	Yes		
40	<i>Tringa ochropus</i>	x	x	No	Yes	Yes	

41	<i>Tringa nebularia</i>	x	x	No	Yes	Yes	
42	<i>Tringa glareola</i>	x		No	Yes		
43	<i>Larus ridibundus</i>	x	x	No		Yes	yes
44	<i>Larus michahellis</i>	x		No		Yes	yes
45	<i>Sternula albifrons</i>	x	x	No	Yes		yes
46	<i>Sterna hirundo</i>	x	x	No	Yes		yes
47	<i>Tyto alba</i>	x		Yes		Yes	
48	<i>Athene noctua</i>	x		No			yes
49	<i>Otus scops</i>	x		No	Yes		
50	<i>Asio otus</i>	x	x	Yes			
51	<i>Strix aluco</i>	x	x				yes
52	<i>Circaetus gallicus</i>	x		No	Yes		
53	<i>Circus cyaneus</i>	x		No		yes	
54	<i>Accipiter nisus</i>	x	x	No			yes
55	<i>Accipiter gentilis</i>	x	x	No			yes
56	<i>Haliaeetus albicilla</i>		x	yes		yes	yes
57	<i>Buteo buteo</i>	x	x	yes		yes	yes
58	<i>Merops apiaster</i>	x	x	yes	yes		
59	<i>Alcedo atthis</i>	x	x	yes		yes	
60	<i>Jynx torquilla</i>	x		yes			
61	<i>Picus canus</i>						yes
62	<i>Picus viridis</i>	x	x			yes	yes
63	<i>Dryocopus martius</i>	x	x	No		yes	yes
64	<i>Dryobates minor</i>	x	x	Yes		yes	yes
65	<i>Leiopicus medius</i>		x	No			yes
66	<i>Dendrocopos major</i>	x	x	Yes		yes	yes
67	<i>Falco tinnunculus</i>	x	x	Yes			yes
68	<i>Falco vespertinus</i>	x		No	Yes		
69	<i>Falco subbuteo</i>	x	x	No	Yes		yes
70	<i>Oriolus oriolus</i>	x	x	Yes			
71	<i>Lanius collurio</i>	x	x	Yes	Yes		
72	<i>Lanius minor</i>	x		Yes			
73	<i>Lanius excubitor</i>	x		No		yes	
74	<i>Garrulus glandarius</i>	x	x	No			yes
75	<i>Pica pica</i>	x	x	Yes		yes	
76	<i>Corvus frugilegus</i>	x	x	No		yes	yes
77	<i>Corvus corax</i>	x	x	Yes		yes	yes
78	<i>Corvus cornix</i>	x	x	Yes		yes	
79	<i>Poecile palustris</i>	x	x	Yes		yes	
80	<i>Cyanistes caeruleus</i>	x	x	Yes		yes	
81	<i>Parus major</i>	x	x	Yes		yes	
82	<i>Alauda arvensis</i>	x		No	Yes		
83	<i>Hippolais icterina</i>	x		Yes			
84	<i>Acrocephalus schoenobaenus</i>	x		No	Yes		
85	<i>Acrocephalus palustris</i>	x	x	Yes	Yes		

86	<i>Acrocephalus arundinaceus</i>	x		No	Yes		
87	<i>Delichon urbicum</i>	x		No	Yes		
88	<i>Hirundo rustica</i>	x	x	Yes	Yes		
89	<i>Riparia riparia</i>	x	x	Yes	Yes		
90	<i>Phylloscopus sibilatrix</i>	x		No	Yes		
91	<i>Phylloscopus trochilus</i>	x		No	Yes		
92	<i>Phylloscopus collybita</i>	x	x	Yes	Yes		
93	<i>Aegithalos caudatus</i>	x	x	Yes		Yes	
94	<i>Sylvia atricapilla</i>	x	x	Yes	Yes		
95	<i>Sylvia borin</i>		x	Yes	Yes		
96	<i>Sylvia communis</i>	x	x	Yes	Yes		
97	<i>Certhia brachydactyla</i>	x		Yes		Yes	
98	<i>Sitta europaea</i>	x	x	Yes		Yes	
99	<i>Troglodytes troglodytes</i>	x	x	Yes		Yes	
100	<i>Sturnus vulgaris</i>	x	x	Yes	Yes		
101	<i>Turdus philomelos</i>	x	x	Yes			
102	<i>Turdus merula</i>	x	x	Yes		yes	
103	<i>Turdus pilaris</i>	x				yes	
104	<i>Muscicapa striata</i>	x	x	No	Yes		
105	<i>Erithacus rubecula</i>	x	x	Yes		Yes	
106	<i>Luscinia megarhynchos</i>	x	x	Yes	Yes		
107	<i>Phoenicurus ochruros</i>	x	x	Yes			
108	<i>Saxicola torquatus</i>	x	x	Yes	Yes		
109	<i>Oenanthe oenanthe</i>	x		No	Yes		
110	<i>Passer domesticus</i>	x	x	Yes		Yes	
111	<i>Passer montanus</i>	x	x	Yes		Yes	
112	<i>Anthus trivialis</i>		x	No	Yes		
113	<i>Anthus spinoletta</i>	x				Yes	
114	<i>Motacilla flava</i>	x	x	Yes	Yes		
115	<i>Motacilla alba</i>	x	x	Yes		Yes	
116	<i>Fringilla coelebs</i>	x	x	Yes		Yes	
117	<i>Fringilla montifringilla</i>	x				Yes	
118	<i>Coccothraustes coccothraustes</i>	x		yes		yes	
119	<i>Pyrrhula pyrrhula</i>	x				Yes	
120	<i>Chloris chloris</i>	x	x	Yes		Yes	
121	<i>Linaria cannabina</i>	x		No		Yes	
122	<i>Carduelis carduelis</i>	x	x	Yes		Yes	
123	<i>Serinus serinus</i>	x	x	Yes			
124	<i>Emberiza citrinella</i>	x	x	Yes			

Protected status of bird species

No.	Species	EU Bird Directive	Bern	Bon	AEWA	CITES	Global Red List	European Red List	SPECs 2017.	National Regulation
1	<i>Coturnix coturnix</i>	IIB	III				LC	LC	3 b	P (L)
2	<i>Phasianus colchicus</i>	IIA; IIIA	III				LC	LC		P (L)
3	<i>Perdix perdix</i>	IIA; IIIA	III				LC	LC	2 b	P
4	<i>Cygnus olor</i>	IIB	III	II	Y		LC	LC		P
5	<i>Anser anser</i>	IIA; IIIB	III	II	Y		LC	LC		SP
6	<i>Anser albifrons</i>		III	II	Y		LC	LC		P (L)
7	<i>Mergus merganser</i>	IIB	III	II	Y		LC	LC		SP
8	<i>Tadorna tadorna</i>		II	II	Y		LC	LC		SP
9	<i>Aix galericulata</i>		III	II			LC			P
10	<i>Mareca penelope</i>	IIA; IIIB	III	II	Y		LC	LC		SP
11	<i>Anas platyrhynchos</i>	IIA; IIIA	III	II	Y		LC	LC		P (L)
12	<i>Anas acuta</i>	IIA; IIIB	III	II	Y		LC	LC	3 w	SP
13	<i>Anas crecca</i>	IIA; IIIB	III	II	Y		LC	LC		P (L)
14	<i>Tachybaptus ruficollis</i>		II		Y		LC	LC		SP
15	<i>Podiceps cristatus</i>		III		Y		LC	LC		SP
16	<i>Columba livia</i>	IIA	III				LC	LC		P (L)
17	<i>Columba palumbus</i>	IIA; IIIA					LC	LC		P (L)
18	<i>Streptopelia turtur</i>	IIB	III	II*			VU	VU	1 b	SP
19	<i>Streptopelia decaocto</i>	IIB	III				LC	LC		P
20	<i>Cuculus canorus</i>		III				LC	LC		SP
21	<i>Rallus aquaticus</i>	IIB	III		Y		LC	LC		SP
22	<i>Gallinula chloropus</i>	IIB	III		Y		LC	LC		P
23	<i>Fulica atra</i>	IIA; IIIB	III	II*	Y		LC	NT	3 b,w	P (L)
24	<i>Grus grus</i>	I	II	II	Y	II	LC	LC		SP
25	<i>Ciconia nigra</i>	I	II	II	Y	II	LC	LC		SP
26	<i>Ciconia ciconia</i>	I	II	II	Y		LC	LC		SP
27	<i>Platalea leucorodia</i>	I	II	II	Y	II	LC	LC		SP
28	<i>Ixobrychus minutus</i>	I	II	II*	Y		LC	LC	3 b	SP
29	<i>Nycticorax nycticorax</i>	I	II		Y		LC	LC	3 b	SP
30	<i>Ardeola ralloides</i>	I	II		Y		LC	LC	3 b	SP
31	<i>Ardea cinerea</i>		III		Y		LC	LC		P (L)
32	<i>Ardea purpurea</i>	I	II	II*	Y		LC	LC	3 b	SZ
33	<i>Ardea alba</i>	I	II	II*	Y		LC	LC		SZ
34	<i>Egretta garzetta</i>	I	II		Y		LC	LC		SZ
35	<i>Phalacrocorax carbo</i>		III		Y		LC	LC		

36	<i>Vanellus vanellus</i>	IIB	III	II	Y		NT	VU	1 b,w	SP
37	<i>Scolopax rusticola</i>	IIA; IIIB	III		Y		LC	LC		P (L)
38	<i>Gallinago gallinago</i>	IIA; IIIB	III	II	Y		LC	LC	3 b,w	P (L)
39	<i>Actitis hypoleucos</i>		II	II	Y		LC	LC	3 b	SP
40	<i>Tringa ochropus</i>		II	II			LC	LC		SP
41	<i>Tringa nebularia</i>	IIB	III	II	Y		LC	LC		SP
42	<i>Tringa glareola</i>	I	II	II	Y		LC	LC		SP
43	<i>Larus ridibundus</i>	IIB	III		Y		LC	LC		SP
44	<i>Larus michahellis</i>		III				LC	LC		SP
45	<i>Sternula albifrons</i>	I	II	II	Y		LC	LC	3 b	SP
46	<i>Sterna hirundo</i>	I	II	II*	Y		LC	LC		SP
47	<i>Tyto alba</i>		II			II	LC	LC	3 b	SP
48	<i>Athene noctua</i>		II			II	LC	LC	3 b	SP
49	<i>Otus scops</i>		II			II	LC	LC	2 b	SP
50	<i>Asio otus</i>		II			II	LC	LC		SP
51	<i>Strix aluco</i>		II			II	LC	LC		SP
52	<i>Circaetus gallicus</i>	I	III	II		II	LC	LC		SP
53	<i>Circus cyaneus</i>	I	III	II		II	LC	NT	3 w	SP
54	<i>Accipiter nisus</i>		III	II		II	LC	LC		SP
55	<i>Accipiter gentilis</i>		III	II		II	LC	LC		SP
56	<i>Haliaeetus albicilla</i>	I	III	I; II		I	LC	LC		SP
57	<i>Buteo buteo</i>		III	II		II	LC	LC		SP
58	<i>Merops apiaster</i>		II	II			LC	LC		SP
59	<i>Alcedo atthis</i>	I	II				LC	VU	3 b	SP
60	<i>Jynx torquilla</i>		II				LC	LC	3 b	SP
61	<i>Picus canus</i>	I	II				LC	LC		SP
62	<i>Picus viridis</i>		II				LC	LC		SP
63	<i>Dryocopus martius</i>	I	II				LC	LC		SP
64	<i>Dryobates minor</i>		II				LC	LC		SP
65	<i>Leipicus medius</i>	I	II				LC	LC		SP
66	<i>Dendrocopos major</i>		II				LC	LC		SP
67	<i>Falco tinnunculus</i>		II	II		II	LC	LC	3 b	SP
68	<i>Falco vespertinus</i>	I	II	I; II		II	NT	NT		SP
69	<i>Falco subbuteo</i>		II	II		II	LC	LC		SP
70	<i>Oriolus oriolus</i>		II				LC	LC		SP
71	<i>Lanius collurio</i>	I	II				LC	LC	2 b	SP
72	<i>Lanius minor</i>	I	II				LC	LC	2 b	SP
73	<i>Lanius excubitor</i>		II				LC	VU		SP

74	<i>Garrulus glandarius</i>	IIB					LC	LC		P
75	<i>Pica pica</i>	IIB					LC	LC		P
76	<i>Corvus frugilegus</i>	IIB					LC	LC		P
77	<i>Corvus corax</i>		III				LC	LC		P
78	<i>Corvus cornix</i>	IIB					LC	LC		P (L)
79	<i>Poecile palustris</i>		II				LC	LC		SP
80	<i>Cyanistes caeruleus</i>		II				LC	LC		SP
81	<i>Parus major</i>		II				LC	LC		SP
82	<i>Alauda arvensis</i>	IIB	III				LC	LC	3 b	SP
83	<i>Hippolais icterina</i>		II	II			LC	LC		SP
84	<i>Acrocephalus schoenobaenus</i>		II	II			LC	LC		SP
85	<i>Acrocephalus palustris</i>		II	II			LC	LC		SP
86	<i>Acrocephalus arundinaceus</i>		II	II			LC	LC		SP
87	<i>Delichon urbicum</i>		II				LC	LC	2 b	SP
88	<i>Hirundo rustica</i>		II				LC	LC	3 b	SP
89	<i>Riparia riparia</i>		II				LC	LC	3 b	SP
90	<i>Phylloscopus sibilatrix</i>		II	II			LC	LC		SP
91	<i>Phylloscopus trochilus</i>		II	II			LC	LC		SP
92	<i>Phylloscopus collybita</i>		II	II			LC	LC		SP
93	<i>Aegithalos caudatus</i>		III				LC	LC		SP
94	<i>Sylvia atricapilla</i>		II	II			LC	LC		P
95	<i>Sylvia borin</i>		II	II			LC	LC		SP
96	<i>Sylvia communis</i>		II	II			LC	LC		SP
97	<i>Certhia brachydactyla</i>		II				LC	LC		SP
98	<i>Sitta europaea</i>		II				LC	LC		SP
99	<i>Troglodytes troglodytes</i>		II				LC	LC		SP
100	<i>Sturnus vulgaris</i>	IIB					LC	LC	3 b	P
101	<i>Turdus philomelos</i>	IIB	III				LC	LC		SP
102	<i>Turdus merula</i>	IIB	III				LC	LC		P
103	<i>Turdus pilaris</i>	IIB	III				LC	LC		SP
104	<i>Muscicapa striata</i>		II	II			LC	LC	2 b	SP
105	<i>Erithacus rubecula</i>		II	II			LC	LC		SP
106	<i>Luscinia megarhynchos</i>		II	II			LC	LC		SP
107	<i>Phoenicurus ochruros</i>		II	II			LC	LC		SP
108	<i>Saxicola torquatus</i>		II	II			LC	LC		SP

109	<i>Oenanthe oenanthe</i>		II	II			LC	LC	3 b	SP
110	<i>Passer domesticus</i>						LC	LC	3 b	P
111	<i>Passer montanus</i>		III				LC	LC	3 b	P
112	<i>Anthus trivialis</i>		II				LC	LC		SP
113	<i>Anthus spinoletta</i>		II				LC	LC		SP
114	<i>Motacilla flava</i>		II				LC	LC	3 b	SP
115	<i>Motacilla alba</i>		II				LC	LC		SP
116	<i>Fringilla coelebs</i>		III				LC	LC		P
117	<i>Fringilla montifringilla</i>		III				LC	LC		SP
118	<i>Coccothraustes coccothraustes</i>		II				LC	LC		SP
119	<i>Pyrrhula pyrrhula</i>		III				LC	LC		SP
120	<i>Chloris chloris</i>		II				LC	LC		SP
121	<i>Linaria cannabina</i>		III				LC	LC	2 b	SP
122	<i>Carduelis carduelis</i>		II				LC	LC		SP
123	<i>Serinus serinus</i>		II				LC	LC	2 b	SP
124	<i>Emberiza citrinella</i>		II				LC	LC	2 b	SP

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SP (L) - strictly protected by Regulation on Strictly protected and protected wild species of Republic Srpska but also on Low on Hunting of RS

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**ANNEX 11. List of Mammals**

No.	Species	Literature and surveying the local hunters	Confirmed during the field survey	Only assumption based on suitable habitat and distribution maps	Annex of Bern c.	Annex of HD	Bonn convention	Global Red List	EU Red List	National Regulation
1	<i>Erinaceus roumanicus</i>	x	yes		III			LC	LC	
2	<i>Sorex minutus</i>		no	x	III			LC	LC	P
3	<i>Sorex araneus</i>		no	x	III			LC	LC	P
4	<i>Neomys fodiens</i>		no	x	III			LC	LC	SP
5	<i>Neomys anomalus</i>		no	x	III			LC	LC	SP
6	<i>Crocidura suaveolens</i>		no	x	III	III		LC	LC	P
7	<i>Crocidura leucodon</i>		no	x	III			LC	LC	P
8	<i>Talpa europea</i>	x	yes					LC	LC	P
9	<i>Myotis capaccinii</i>		yes		II	II, IV	II	VU	VU	SP
10	<i>Myotis daubentonii</i>		yes		II	IV	II	LC		SP
11	<i>Pipistrellus pipistrellus</i>		yes		III	IV	II	LC		SP
12	<i>Pipistrellus pygmaeus</i>		yes		II	IV	II	LC	LC	SP
13	<i>Pipistrellus kuhlii</i>		yes		II	IV	II	LC	LC	SP
14	<i>Pipistrellus nathusii</i>		yes		II	IV	II	LC	LC	SP
15	<i>Hypsugo savii</i>	x	yes		II	IV	II	LC	LC	SP
16	<i>Eptesicus serotinus</i>		yes		II	IV	II	LC		SP
17	<i>Nyctalus leisleri</i>		yes		II	IV	II	LC	LC	SP
18	<i>Nyctalus noctula</i>		yes		II	IV	II	LC	LC	SP
19	<i>Vespertilio murinus</i>	x	yes		II	IV	II	LC	LC	SP
20	<i>Barbastella barbastellus</i>		yes		II	II, IV	II	NT	VU	SP
21	<i>Miniopterus schreibersii</i>		yes		II	II, IV	II	VU		SP
22	<i>Lepus europaeus</i>	x	yes					LC	LC	P (*L)
23	<i>Sciurus vulgaris</i>	x	yes		III			LC	LC	SP (*L)
24	<i>Myodes glareolus</i>		no	x				LC	LC	P
25	<i>Ondatra zibethicus</i>	x	yes					LC		
26	<i>Arvicola terrestris</i>		no	x				LC	LC	P
27	<i>Microtus subterraneus</i>		no	x				LC	LC	P
28	<i>Microtus arvalis</i>		yes					LC	LC	P
29	<i>Microtus agrestis</i>		no	x				LC	LC	P
30	<i>Apodemus flavicollis</i>		yes					LC	LC	
31	<i>Apodemus sylvaticus</i>		yes					LC	LC	
32	<i>Apodemus agrarius</i>		yes					LC	LC	

33	<i>Rattus norvegicus</i>	x	yes					LC		
34	<i>Mus musculus</i>	x	yes					LC	LC	
35	<i>Mus spicilegus</i>		no	x				LC	LC	
36	<i>Micromys minutus</i>		no	x				LC	LC	P
37	<i>Glis glis</i>	x	yes		III			LC	LC	P (*L)
38	<i>Muscardinus avellanarius</i>		no	x	III	IV		LC	LC	P (*L)
39	<i>Castor fiber</i>	x	yes		III	II, IV, V		LC	LC	SP (*L)
40	<i>Canis aureus</i>	x	yes			V		LC	LC	
41	<i>Vulpes vulpes</i>	x	yes					LC	LC	
42	<i>Mustela nivalis</i>	x	yes		III			LC		
43	<i>Mustela putorius</i>	x	no	x	III	V		LC	LC	
44	<i>Martes martes</i>	x	no	x	III	V		LC	LC	
45	<i>Martes foina</i>	x	yes		III			LC	LC	
46	<i>Meles meles</i>	x	yes		III			LC	LC	
47	<i>Lutra lutra</i>	x	no	x	II	II, IV		NT	NT	SP (*L)
48	<i>Felis silvestris</i>	x	no	x	II	IV		LC	LC	
49	<i>Sus scrofa</i>	x	yes	x				LC	LC	
50	<i>Capreolus capreolus</i>	x	yes	x	III			LC	LC	P (*L)

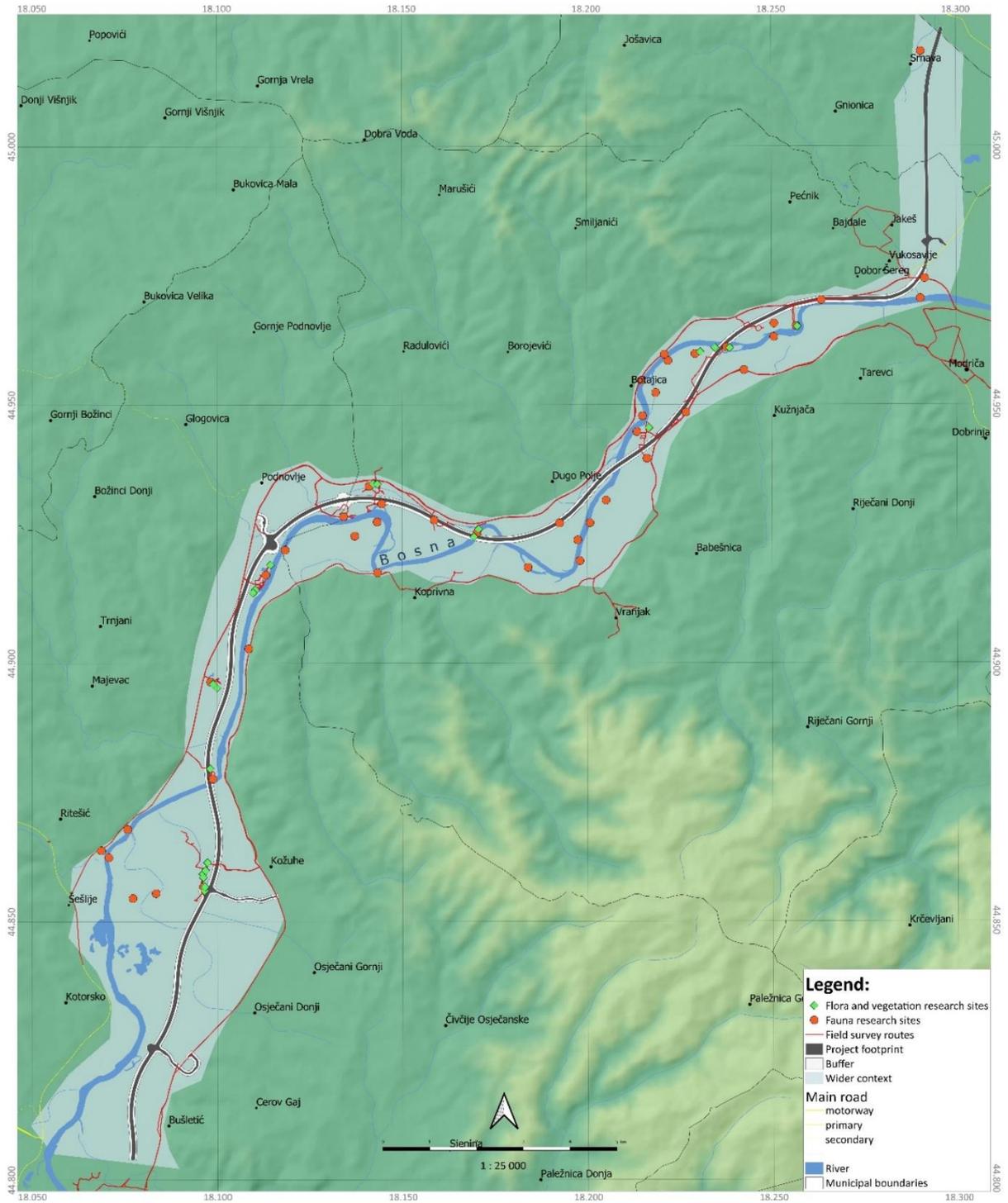
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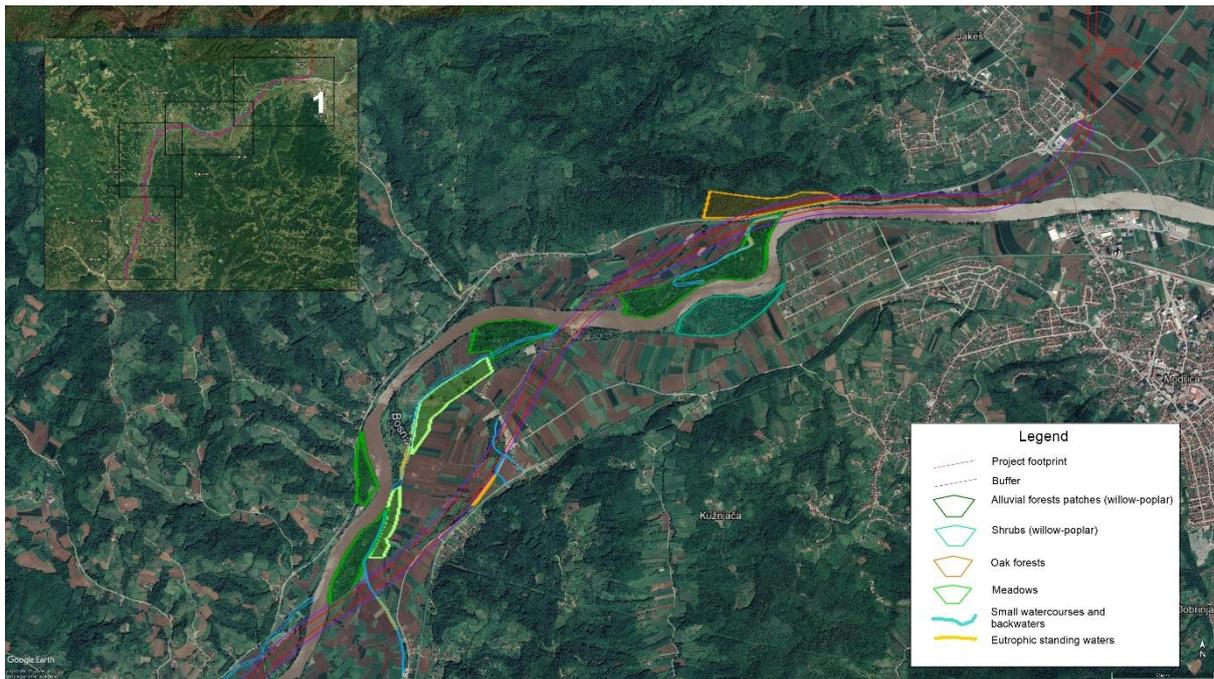
P (L) - protected by Regulation on Strictly protected and protected wild species of Republic Srpska but also Low on Hunting of RS

**ANNEX 12. Maps**

**Map 1 Study Area and Area of Analysis, Survey routes and Research sites and points**



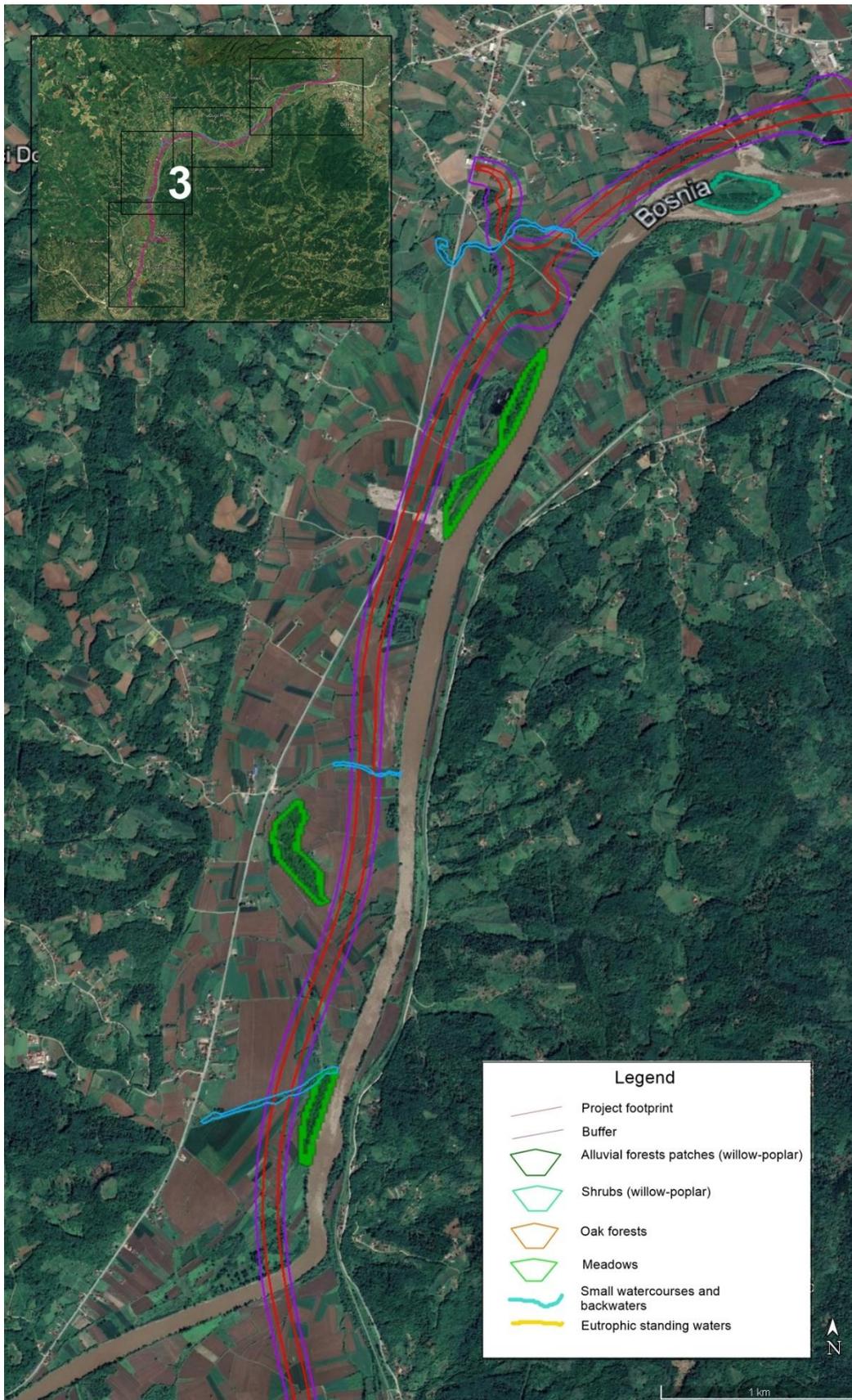
Map 2. Natural and semi-natural vegetation and habitats in subsection 1



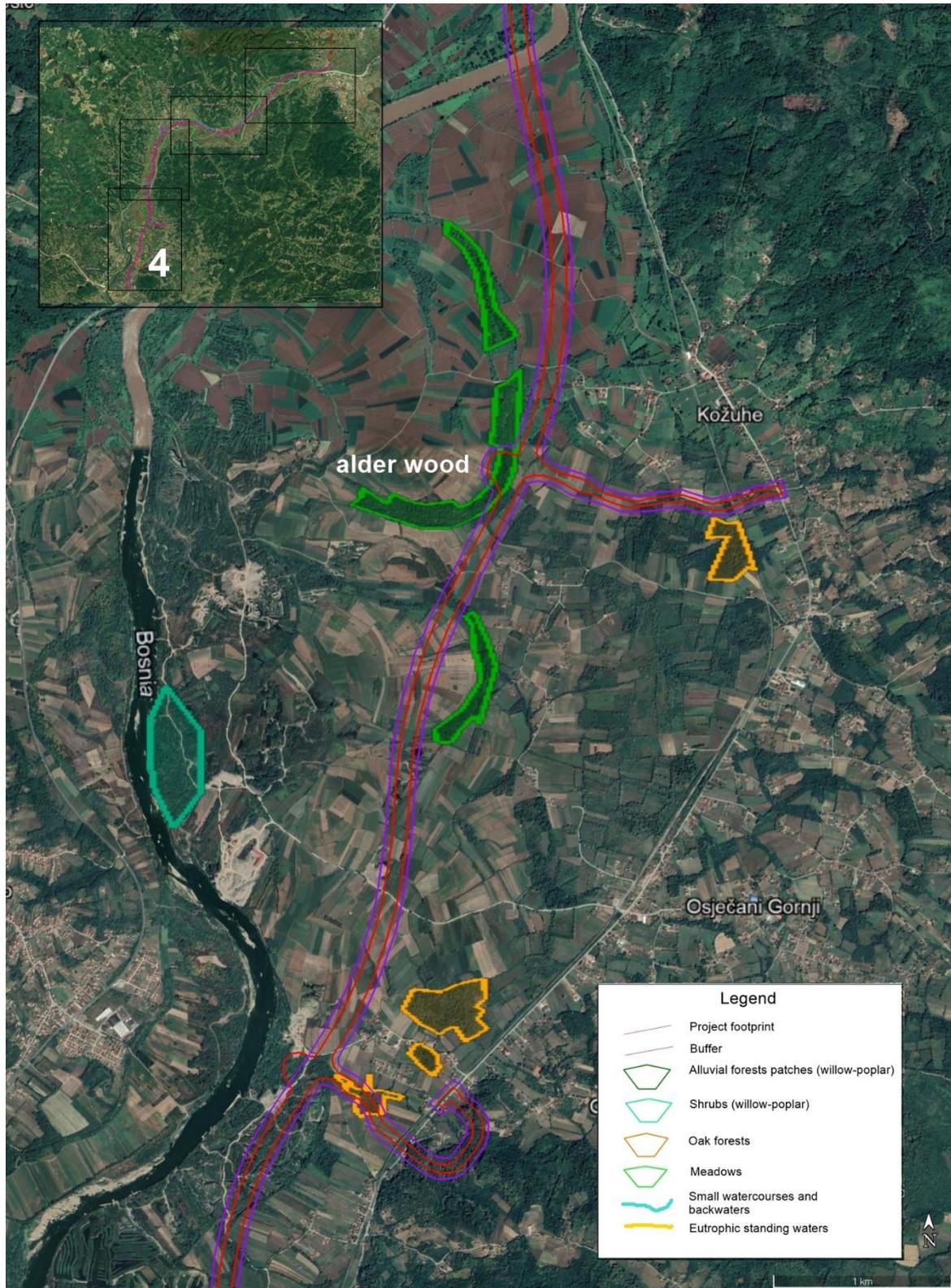
Map 3. Natural and semi-natural vegetation and habitats in subsection 2



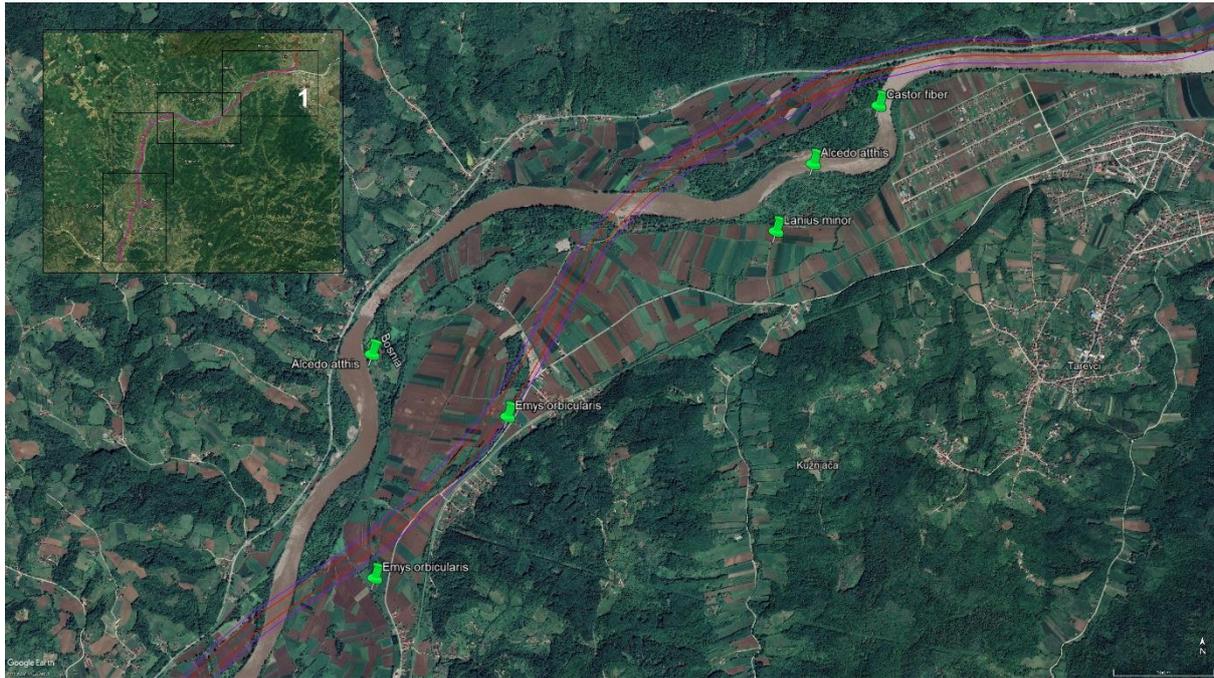
Map 4. Natural and semi-natural vegetation and habitats in subsection 3



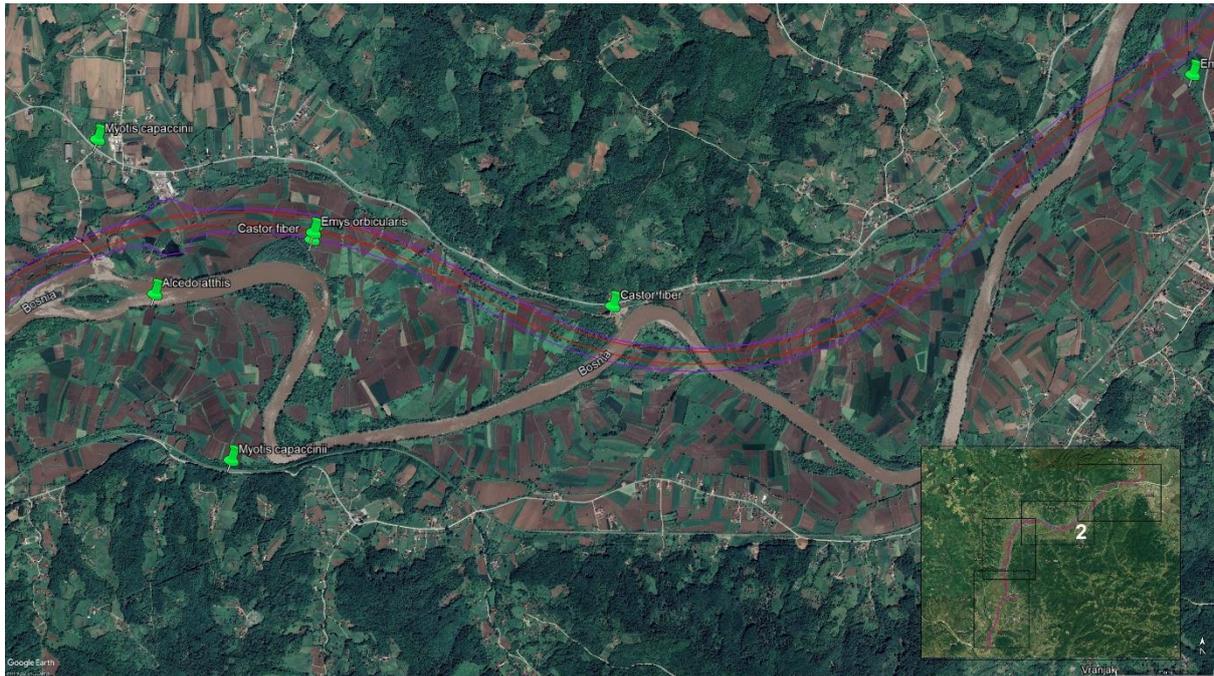
Map 5. Natural and semi-natural vegetation and habitats in subsection 4



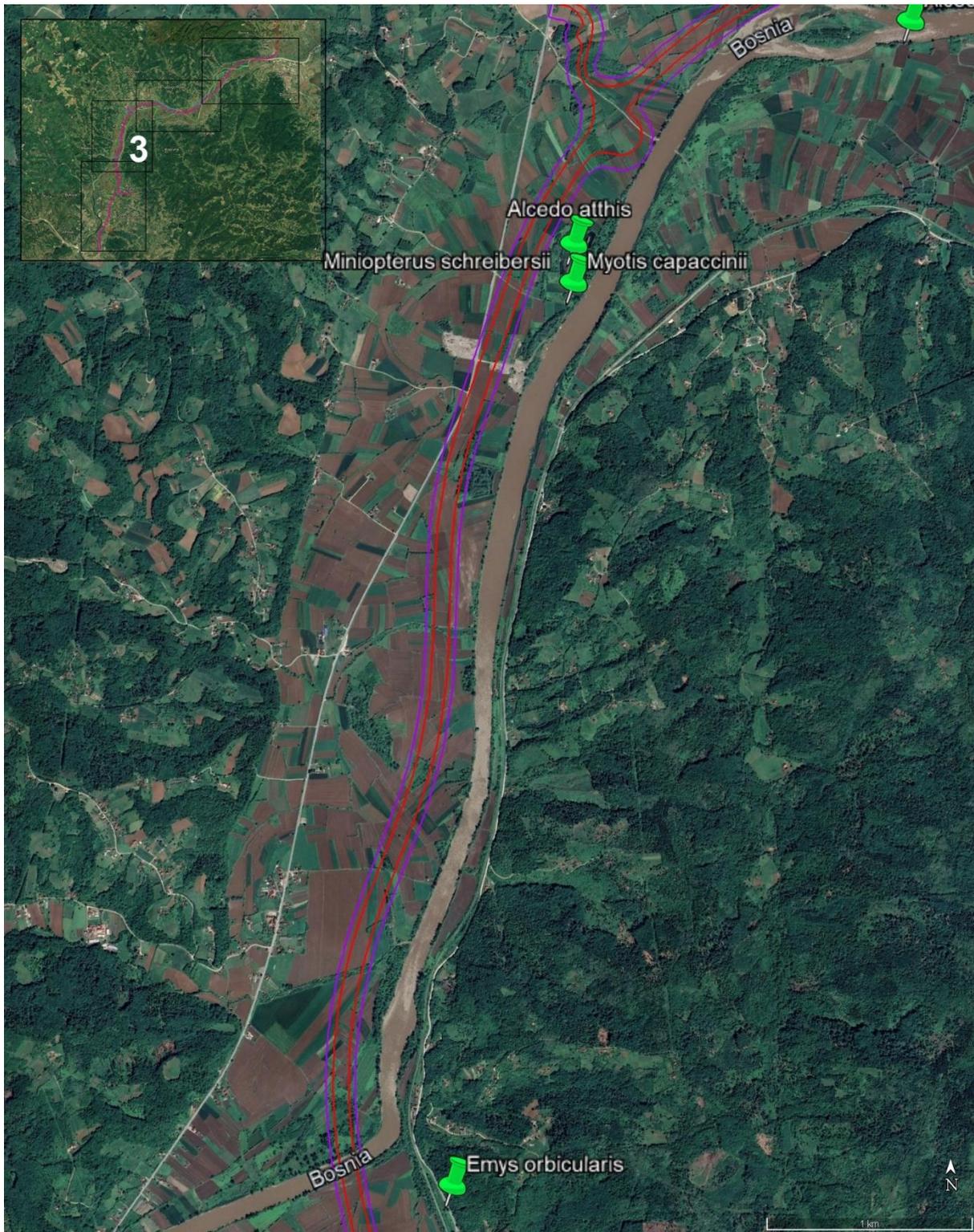
Map 6. Points of some of the protected animal species in subsection 1



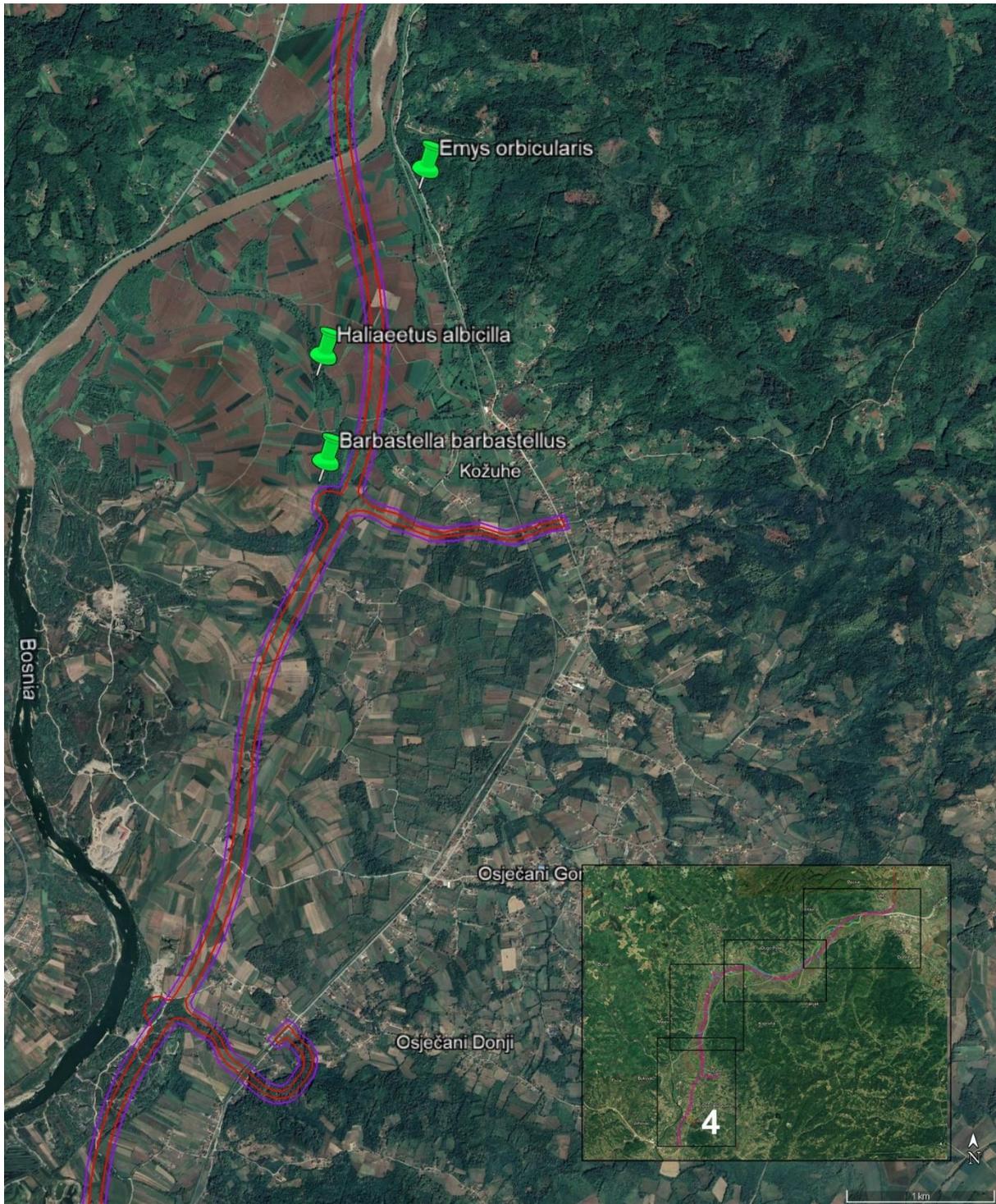
Map 7. Points of some of the protected animal species in subsection 2



Map 8. Points of some of the protected animal species in subsection 3



Map 9. Points of some of the protected animal species in subsection 4



Map 10. Locations of small watercourses where it is necessary to maintain water flow by construction of adequate culverts (red arrow) and regulate creeks in accordance with the needs of animal migrations (yellow arrow)



Map 11. Zones where is important to plan non-transparent noise barriers (yellow arrow) and locations of bridges under which it is necessary to leave a dry land passage (red arrow)



Map 12. Three zones of an increased presence of medium and large mammal species (high frequency of movement between the nearby forests on hills and the River)

