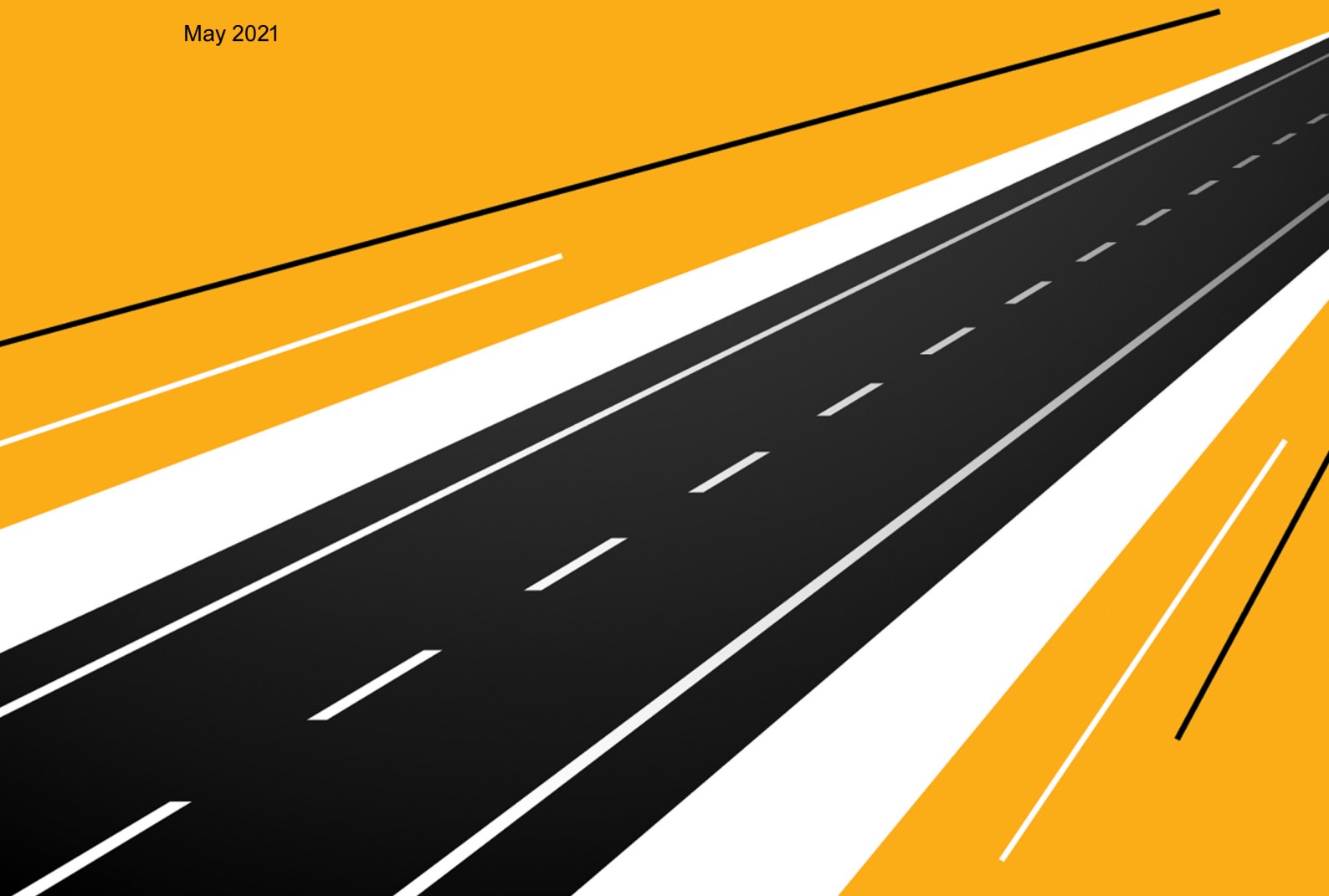
CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

VOLUME 2:
Technical Annexes for Section Mostar North-Mostar South

May 2021



CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

Environmental and Social Impact Assessment

Mostar North-Mostar South

ANNEX A: HABITATS, VEGETATION AND INVASIVE PLANT SPECIES

May 2021

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1 INTRODUCTION

1.1 Project background

During 2020 ENOVA was commissioned to undertake Environmental and Social Assessment relating to the Corridor Vc section Mostar North-Mostar South. The results of the previous gap analysis for biodiversity found that supplementary biodiversity information would be required, so that an informed assessment of sensitive habitats and biodiversity features could be undertaken. The supplementary information has been gathered through both field surveys and an up to date desk study. The following field surveys have been undertaken and will form an Annex to the final Environmental and Social Assessment study:

- **Annex A: Habitats, vegetation and invasive plant species**
- Annex B: Invertebrates[1]
- Annex C: Vertebrates
    - Annex C-1: Herpetofauna (amphibians and reptiles)
    - Annex C-2: Ornithofauna
    - Annex C-3: Mammals (bats)
    - Annex C-4: Large mammals.

This report provides the results of the habitats, vegetation and invasive species field survey. Fish species have not been considered in this project due to the fact the project area does not include permanent surface watercources, only occasional streams.

1.2 Site locations

The 14.2 km long section Mostar North-Mostar South begins 500 m before the Mostar North Interchange in the Kutilivac settlement, east of Vrapcici, and ends just before the Mostar South Interchange near the Mostar Airport. After the interchange, the alignment extends towards the settlement of Suhi Do, where the route is moved to the east (“up the hill”), in order to avoid houses.

After Suhi Do, the section enters the Tunnel Ostri Rat (L=3,380 m), turning towards the south and bypassing the City of Mostar. In the area east of Luke settlement, the alignment exits the tunnel and passes the slopes above the settlements and extends south towards the Buna valley. The section crosses the relatively uneven terrain between Ostri Rat and Gnojnice viaducts and tunnels. In Kocine settlement the alignment passes through a tunnel (L=2,600 m). After exiting this tunnel, the alignment descends towards the Mostar South Interchange.

The section ends at the Mostar South Interchange, which enables the connection between the motorway and main road M6.1 and it is located east of Mostar Airport. This location provides direct connection between the City of Mostar, the Airport and western Herzegovina via the planned southern bypass of the City to the motorway on Corridor Vc.

On this section the total length of the tunnels is 8,110 m, and the total length of the bridges is 940 m. The alignment passes mainly through hilly terrain with significant spatial limitations, so along the section, cuts and embankments with a larger number of buildings alternate.

1.3 Report aim and objectives

The main aim of this assignment is to provide a written report to inform the ESIA Disclosure Package and Biodiversity Management Plan. In order to achieve this aim, this report has been written to satisfy the following objectives:

[1] Only of conservation concern

- Provide the methodology and results of the field survey
- Evaluate project area and project area of influence for the likely presence of sensitive species/species of conservation concern
- Recommend preconstruction surveys, additional mitigation and/or monitoring only if required.

2 METHODOLOGY

2.1 Survey background

The survey was conducted by Nermina Sarajlic, MSc, PhD student of botany and plant ecology who currently works as an ecologist in Ornithological Society "Naše ptice". She participated in numerous projects and studies on plant ecology in Bosnia and Herzegovina, mostly for urban habitats, alien plant species as well as plant ecology in karst regions and wetlands.

The field investigation covered summer aspect of 2020.

2.2 Methodology

The vegetation surveys were undertaken on 27 sample points (shown on Figure 1). For each sample point, GPS coordinates were recorded by GPS coordinates (version 4.52) mobile application, where present plant species and the type of vegetation were identified. The species were identified in the field, or, if that was not possible, specimens were collected and/or photographed in detail, to be identified later using the relevant botanical literature.

The following publications were used for plant identification:

- Domac R. (1984): Mala flora Hrvatskeisusjednihpodrucja (Small Flora of Croatia and neighbouring regions). Skolskaknjiga, Zagreb.
- Hubbard C.E. (1959): Grasses. Pelican Book, Suffolk.
- Javorka, S., Csapody, V. (1979): Iconographia Florae Partis Austro-OrientalisEuropae Centralis. G. Fisher, Stuttgart.
- Rottensteiner W.K. (2014): ExkursionsflorafürIstrien (Excursion Flora for Istria). Naturwissenschaftlicher Verein für Kärnten, Klagenfurt
- Silic, C. (2005): Atlas dendroflore (drveceigrmlje) BosneiHercegovine (Atlas of dendroflora (trees and shrubs) of Bosnia and Herzegovina. Matica Hrvatska, Zagreb.

The following publications were used for reference:

- EUNIS Hierarchical View of Habitats. http://eunis.eea.europa.eu/habitats-code-browser.jsp (accessed 10th June 2020).
- European habitats Directive – WWW.eur-lex.europa.eu (accessed 10 October 2020)
- Federal Ministry of Environment and Tourism Red list of Endangered Wild Species and Subspecies of Plants, Animals and Mushrooms - Book 2 - Red List of Flora in FBiH (Published in Official Gazette FBiH, No. 7/14)
- Lubarda, B., Stupar, V., Milanovic, D., &Stevanovic, V. (2014). Chorological characterization and distribution of the Balkan endemic vascular flora in Bosnia and Herzegovina. Botanica Serbica, 38(1), 167–184
- Maslo S. (2014): The urban flora of the city of Mostar (Bosnia and Herzegovina). Natura Croatica 23(1):101-145
- Maslo, S. (2016): Preliminary list of invasive alien plant species (IAS) in Bosnia and Herzegovina. Herbologia 16 (1): 10.5644/Herb.16.1.01

- Environmental impact study for the corridor Vc motorway Mostar North – South border.InstitutgradevinarstvaHrvatsked.d. (Civil enginering institute of Croatia), 2006
- Study on Environmental Impact Assessment for Motorway LOT 5, 6: Section Mostar North - Mostar South – Pocitelj. Centre for economic, technological and environmental development – CETEOR d.o.o. Sarajevo, 2017
- Environmental and Social Impact Assessment for Sub-Section Mostar South Interchange to Tunnel Kvanj: Habitats, vegetation and invasive plant species. ENOVA, Sarajevo, 2020.

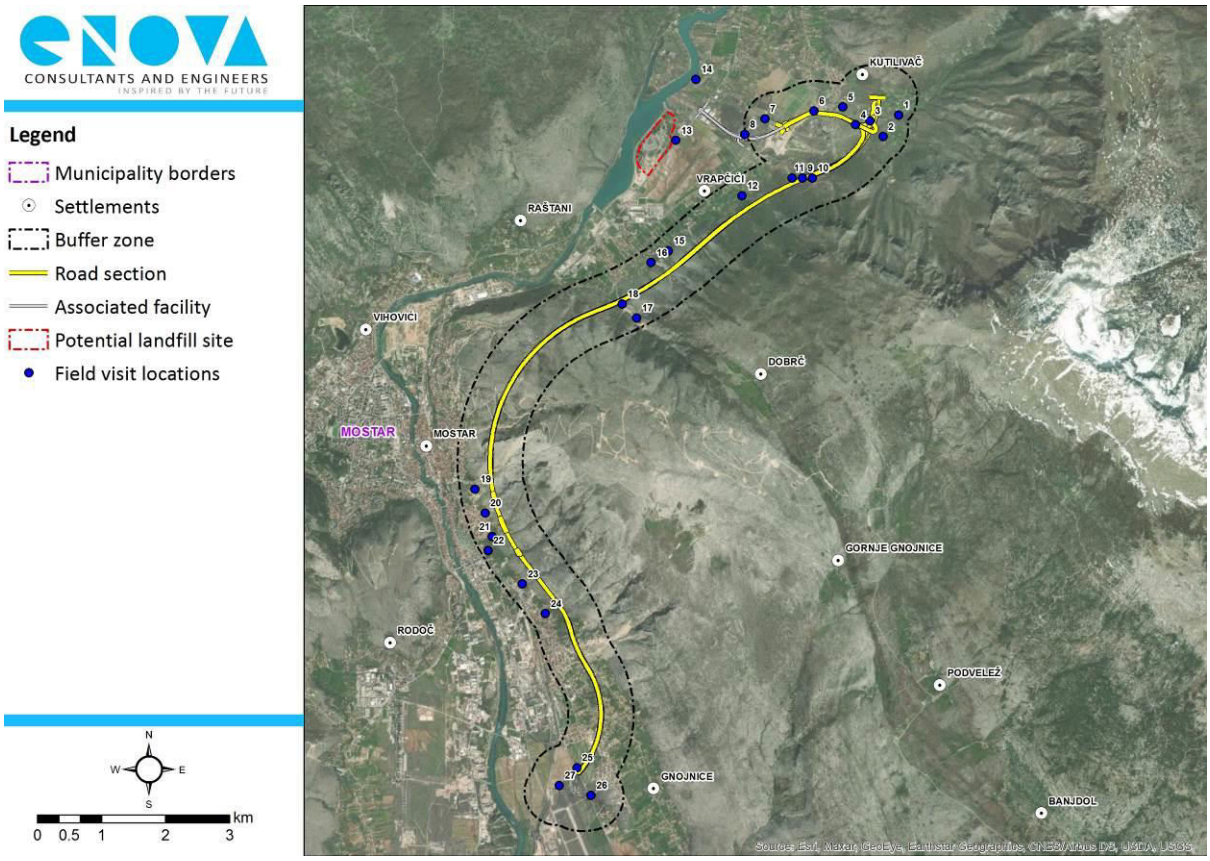

Figure 1: The map of surveyed sample points

The aerial imagery (ESRI DigitalGlobe) was used for development of basic maps showing polygons of different habitat types. This was then taken into the field for ground truthing. Following the field surveys, the habitat maps were refined, based on the information gathered at the sample points, and other general visual observations. EUNIS system was used for habitat mapping, as given in Chapter 5.1. GIS computer programme has been used for digitalisation of identified habitats of the project footprint zone and the buffer of 1000 m of area of influence (500 m each side).

2.3 Assumptions and limitations

Habitat mapping and flora survey has been undertaken covering only summer aspect. Because of the climate of the area, most herbaceous plants were completely dry and difficult to identify. Also, the spring - and early summer-flowering species could not be found on site in this part of the year.

Some parts of the site (screes and garrigue) were not accessible due to impassable terrain, so the survey had to be done by observing the area with binoculars. In some cases, it was not possible to access private properties due to fencing, where only a part of the flora species visible from the local road could be identified. The access was also restricted at other locations, such as active quarries, landfillsand Mostar International Airport areas, for which binoculars have been used too.

Figures 2-3-4-5-6-7: ***Restricted access to parts of the surveyed area***

2.4 Project area of influence

The 500 m buffer zone at each side of the road route is assessed as sufficient with regard to the impact of planned works on flora and vegetation, as most natural habitats are already degraded. The habitats of the project footprint have been separately analysed from the remaining potential area of influence as given below in Chapter 3.1.

3 RESULTS

3.1 Habitats of the project area

Natural vegetation of the surveyed area consists of mixed deciduous and coniferous woodland of hop hornbeam, manna ash and black pine, and deciduous downy oak and oriental hornbeam woodland, developed under arid climate with dry summers. In most part of the area, the forest vegetation is degraded, so that terrain is covered with garrigue and dry rocky grasslands, developed under local climatic conditions and

anthropogenic influence. The hills in the surveyed area are mostly covered in different brushwood formations of *Paliurus spina-christi* and *Punica granatum* with *Juniperus oxycedrus*, typical for rocky terrains of the Sub-Mediterranean region. The steeper slopes of the hills in the surveyed area are characterized by bare rocks and screes with very sparse or no vegetative cover. The unmanaged parts of the grasslands and areas along the roadsides are overgrown with ruderal vegetation, mostly xerophytes and thermophile species.

During the survey, the following habitat types were identified in line with EUNIS classification of habitats (Annex 5.1):

Table 1: Habitat types identified in the surveyed area

EUNIS code	*Description*
E1	Dry grasslands
E1.6	Subnitrophilous annual grassland
F6.37	Illyrian [Paliurus spina-christi] garrigues
FB 4.2	Intensive vineyards
G1.7	Thermophilous deciduous woodland
G4	Mixed deciduous and coniferous woodland
H2	Screes
J1.2	Residential buildings of villages and urban peripheries
J1.4	Urban and suburban industrial and commercial sites still in active use
J2	Low density buildings
J2.3	Rural industrial and commercial sites still in active use
J3.2	Active opencast mineral extraction sites, including quarries
J3.3	Recently abandoned above-ground spaces of extractive industrial sites
J4.2	Road networks
J4.3	Rail networks
J4.4	Airport runways and aprons
J4.7	Constructed parts of cemeteries
J6.2	Household waste and landfill sites
X07	Intensively-farmed crops interspersed with strips of semi-natural vegetation

The spatial distribution of habitats is presented on maps (Annex 5.1).

The mixed deciduous and coniferous woodland (G4) is present in the northern part of the surveyed area, between the villages Kutilivac and Vrapcici, on higher elevations and steep slopes. The woodland is dominated by European hop-hornbeam (*Ostrya carpinifolia*), manna ash (*Fraxinus ornus*), downy oak (*Quercus pubescens*) and black pine (*Pinus nigra*), with dog rose (*Rosa canina*), prickly juniper (*Juniperus oxycedrus*), European cornel (*Cornus mas*), smoke tree (*Cotinus coggygria*) and waited spindle-tree (*Euonymus verrucosus*) in the shrub layer and autumn moor grass (*Sesleriaautumnalis*), false-brome (*Brachypodiumsylvaticum*), wood spurge (*Euphorbia amygdaloides*) and wild asparagus (*Asparagus acutifolius*) in the understory.

Figure 8: Mixed deciduous and coniferous woodland in Suhi do

The thermophilous deciduous woodland (G1.7) is dominated by Oriental hornbeam (*Carpinus orientalis*), manna ash (*Fraxinus ornus*), downy oak (*Quercus pubescens*) and Montpellier maple (*Acer monspessulanum*), with Jerusalem thorn (*Paliurus spina-christi*), smoke tree (*Cotinus coggygria*), prickly juniper (*Juniperus oxycedrus*), hawthorn (*Crataegus monogyna*) and elmleaf blackberry (*Rubus ulmifolius*) in shrub layer and black bindweed (*Dioscorea communis*), wild asparagus (*Asparagus acutifolius*), wall germander (*Teucrium chamaedrys*), autumn moor grass (*Sesleria autumnalis*) and butcher's-broom (*Ruscus aculeatus*) in the understory.

Figure 9: Thermophilous deciduous woodland typical for the surveyed area

The higher elevations of rocky hills with shallow and sparse soil are covered in garrigues (F6.37) of Jerusalem thorn (*Paliurus spina-christi*), with Mediterranean cypress (*Cupressus sempervirens*) and pomegranate (*Punica granatum*). The garrigue covers large areas in the surveyed area and in mosaic-like formations with dry rocky grasslands and screes, with sparse herbaceous heliophile plant species: common sage (*Salvia officinalis*), tunic flower (*Petrorhagia saxifraga*), hairy melic (*Melica ciliata*) and several stonecrop species (*Sedum spp*.).

Figure 10: Garrigue in the higher elevations of hills in the surveyed area

The degradation of garrigues led to the development of dry grasslands (E1). Most plants were dried and almost impossible to determine during the survey period, but the presence of yellow bluestem (*Dichanthium ischaemum*) mosquito grass (*Dasypyrum villosum*), love-in-a-mist (*Nigella damascena*), three-awn goat grass (*Aegilops neglecta*), felty germander (*Teucrium polium*), erect brome (*Bromus erectus*), hairy melic (*Melica ciliata*), European stonecrop (*Sedum ochroleucum*) tunic flower (*Petrorhagia saxifraga*), amethyst eryngo (*Eryngium amethystinum*) and hair grass (*Koeleria splendens*) was confirmed.

Both types of woodlands, garrigue and grasslands are also present in the habitat type X07 (intensively-farmed crops interspersed with strips of semi-natural vegetation), mostly in combination with planted grape vine (*Vitis vinifera*), lavender (*Lavandula angustifolia*), pomegranate (*Punica granatum*), cherry (*Prunus avium*), and peach (*Prunus persica*).

Figure 11: Dry grasslands in the surveyed area

The subnitrophilous annual grassland (E1.6) developed around the runway of the Mostar International Airport (J4.4) that could not be surveyed in detail because of restricted access, is dominated by common wild oat (*Avena fatua*), three-awn goat grass (*Aegilops neglecta*), white laceflower (*Orlaya grandiflora*), barren brome (*Bromus sterilis*), small burnet (*Sanguisorba minor*), Scutch grass (*Cynodon dactylon*), felty germander (*Teucrium polium*) and star clover (*Trifolium stellatum*). Similar composition was observed around the

constructed parts of cemeteries (J4.7). The access to the extractive industrial sites (J3) was restricted, but it was observed that nitrophiolus dry vegetation was developed there.

Screes (H2) are developed in the higher zones of the hills, on warm sunny rocks above the garrigues. They are characterized by mobile substrate and bare rocks, with very sparse vegetation, mostly chasmophytes that colonise the cracks and fissures of rocks. Most of these plants were already in the dormant phase when the survey was undertaken.

Figure 12: Screes in the surveyed area

Nitrophilous vegetation associated with frequent disturbance was observed around the urban and suburban industrial and commercial sites still in active use (J1.4), rural industrial and commercial sites still in active use (J2.3), active opencast mineral extraction sites (J3.2), recently abandoned above-ground spaces of extractive industrial sites (J3.3), low density buildings (J2), residential buildings of villages and urban peripheries (J1.2), household waste and landfill sites (J6.2), road (J4.2) and rail networks (J4.3) is dominated by wormwood - (*Artemisia absinthium*), rat's-tail fescue (*Vulpia ciliata*) black nightshade (*Solanum nigrum*), prickly lettuce - (*Lactuca serriola*), yellow bristle-grass (*Setaria pumila*), Barnyard grass (*Echinochloa crus-galli*), fat hen (*Chenopodium album*), creeping cinquefoil (*Potentilla reptans*) with a number of alien invasive plants: tree of heaven (*Ailanthus altissima*), paper mulberry (*Broussonetia papyrifera*), canadian horseweed (*Conyza canadensis*), common ragweed (*Ambrosia artemisiifolia*), Johnson grass (*Sorghum halepense*) and Indian goosegrass (*Eleusine indica*).

Figure 13: Ruderal communities developed in the surveyed area

The vineyards (FB 4.2) are intensively managed and have almost no natural vegetation preserved in the understory.

Figure 14: Intensive vineyards

The project footprint zone covers the area of 78.75 ha, most of which (20.08 ha) is under EUNIS habitat type F6.37 (Illyrian [Paliurus spina-christi] garrigues), followed by H2 (Screes) - 12.56 ha and X07 (Intensively-farmed crops interspersed with strips of semi-natural vegetation) - 12.19 ha.

The construction of the motorway will also directly affect 9.61 ha of Mixed deciduous and coniferous woodland (G4) and 7.85 ha of Thermophilous deciduous woodland (G1.7), which are the most valuable and best-preserved vegetation types in the area.

An additional area of 1,690.45 ha will be indirectly affected, and possibly prone to the invasion of alien plant species as a consequence of the disturbance caused by construction works and later use of the motorway.

Table 2: Area under specific habitat types directly and indirectly affected by the project

EUNIS code	*Direct*	*Indirect*	*Total*
E1	1.88	9.84	11.72
E1.6	3.18	35.44	37.32
F6.37	20.08	416.55	419.73
FB 4.2	2.86	82.21	102.29
G1.7	7.85	165.29	173.14
G4	9.61	147.86	157.47
H2	12.56	251.81	264.37
J1.2	1.80	248.75	250.56
J1.4	0.00	8.53	8.53
J2	1.01	35.17	36.18
J2.3	0.00	12.80	12.80
J3.2	0.44	6.06	6.50
J3.3	3.28	13.24	16.52
J4.2	1.76	9.11	10.87
J4.3	0.00	2.81	2.81
J4.4	0.00	5.87	5.87
J4.7	0.00	3.23	3.23
J6.2	0.25	8.87	9.12
X07	12.19	227.01	239.20

TOTAL	**78.75**	**1690.45**	**1768.22**

The potential landfill site, located near Neretva River, is now completely covered with EUNIS J3.3 habitat type (Recently abandoned above-ground spaces of extractive industrial sites). The affected area will cover 29.7 ha.

Table 3: Area under specific habitat types directly affected by the project - potential landfill site

EUNIS code	*Direct*
J3.3	29.7
TOTAL	**29.7**

3.2 Flora of the project area

The Environmental impact study for the Corridor Vc motorway Mostar North-South border (Civil enginering institute of Croatia, 2006) mentions the possible presence of Balkan subendemic species *Sedum orientale* in Neretva river canyon, endangered *Dianthus liburnicus* (in karst forests), *D. sanguineus* (dry meadows and rocky pastures), *Silene reichenbachii* (karst rocks and rocky pastures), *Helleborus hercegovinus* (karst areas of the Mediterranean), *Cardamine maritima* (rock cracks in degraded forests and shrubs of the Oriental Oak), *Matthiolafruticulosa* (rocks of the Neretva Valley), *Rhamnus orbiculatus* (dry meadows and rocky pastures of the Mediterranean), *Astragalus illyricus* (dry meadows, rocky pastures), *Genista dalmatica* (limestone and dolomite rocks and pastures), *Seseli globiferum* (rock cracks), *Portenschlagiella ramosissima* (limestone rock cracks), *Moltkia petraea* (limestone rock cracks), *Onosma stellulata* (rock cracks and rocks), *Teucrium arduinii* (rock cracks), *Micromeria croatica* (bottom of canyons and rocks), *Prospero elisae* (dry meadows), *Hyacinthella dalmatica* (rocky parts), *Galanthus nivalis* (along the Neretva River in the Oriental Oak zone), *Gladiolus illyricus* (rocky pastures), *Orchis tridentata* (limestone rock parts along the forest edges), and *Anacamptys pyramidalis* (pastures, light forests, shrubs), *Anthericumliliago* subsp. *balcanicum* (rock and limestone in the Mid Neretva River course canyons), *Centaurea pannonica* subsp. *substitute* Neretva River valley and karst Herzegovina fields), *Ceterach javor keanum* (sunny canyon rocks), *Cymbalaria pallida* (warm and shady canyon rocks along the Mid Neretva River course), *Dryopteris submontana* (sub Mediterranean water sources of the Herzegovina canyons along the Neretva River). Most of these species can not be found late in the vegetative season, because of dormancy period imposed by high summer temperatures.

According to the Study on Environmental Impact Assessment for Motorway LOT 5, 6: Section Mostar North - Mostar South - Pocitelj developed by Centre for economic, technological and environmental development – CETEOR d.o.o. Sarajevo (2017), the rare and endemic species in the area of Mostar include *Seseli hercegovinum* (in rock crevices and on the rocks on Prenj, Cvrsnica, around Neretva and mouth of Diva Grabovica), *Moltkea petraea* (in rock crevices on Prenj and Cvrsnica in the Neretva canyon and Diva Grabovica). *Campanula herzegovina* (Prenj, Cvrsnica, cabulja), *Edraianthus hercegovinus* (Cvrsnica), *Sibirea croatica* (Prenj and Cvrsnica), *Leontopodium alpinum* (Prenj and Cvrsnica), *Alyssum moellendorfianum* (slopes of Prenj), *Minuartia handelii* (Cvrsnica), *Dianthus freynii* (Prenj, Cvrsnica), *Oxytropis prenja* (Prenj, Cvrsnica, Vran). The mentioned species cannot be completely scoped out from the project area.

The most detailed work on the flora of the surveyed area, but focused on the urban flora, was done by Maslo (2014). That survey included railway station and private gardens, where numerous ornamental and short-life adventive species were present, and listed a total of 965 taxa (species and subspecies), including 27 endemic taxa, none of which were found during this survey.

However, since the survey was undertaken in summer aspect, and considering the fact that three endemic species (*Edraianthus tenuifolius, Petteria ramentacea* and *Tanacetum cinerariifolium*) were found during the field surveys for the Sub-Section Mostar South Interchange to Tunnel Kvanj of Corridor Vc, it is very likely that these species are present in the surveyed area as well have entered the period of dormancy or could not be

positively identified due to lack of certain organs needed for identification. Therefore, it is recommended to perform additional field survey to cover early spring and early summer seasons, preferably in April and May, which will be focused on the habitat types where the presence of endemic, rare and endangered plant species is expected (forests, dry grasslands, and screes).

During the survey, a **total of 244 plant species were recorded**. The results of the flora survey, with list of species registered at every observation point are given in the Annex of this report per sample points. Due to the fact that the floristically richest habitats were almost completely dry (dry grasslands, garrigues and screes), it is likely that the number of the plant species present in this area is larger. It is therefore necessary to undertake additional surveys as mentioned above.

4 DISCUSSION AND RECOMMENDATIONS

4.1 Summary of main findings

4.1.1 Sensitive Habitats

During the survey, **no sensitive or Annex I habitats from Habitat Directive or *priority habitats from Habitat Directive were found**. Based on available literature data, no previous studies have been done with regard to habitats of the project area. According to the results of the Support to implementation of the Birds and Habitats directives in Bosnia and Herzegovina project, done by Prospect Consulting Services for EU Delegation to Bosnia and Herzegovina, the following habitat types may be found in this area:

- 62A0 Eastern sub-mediteranean dry grasslands (*Scorzoneratalia villosae*)
- 8140 Eastern Mediterranean screes
- 8210 Calcareous rocky slopes with chasmophytic vegetation
- 8310 Caves not open to the public.

Of these, only dry grasslands, calcareous rocky slopes with chasmophytic vegetation and screes were observed. It is necessary to undertake more detailed surveys of these areas, preferably in late spring, when most diagnostic species can be found in optimal development stage.

4.1.2 Endangered and/or endemic flora species

During the survey, *Ruscus aculeatus* (VU) according to the Red List of Flora in FBiH (Published in Official Gazette FBiH, No. 7/14), was found in the understory of thermophilous oriental hornbeam and manna ash woodland, where it was very numerous and well-developed. This species is also listed on Annex V of the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora), as the species whose taking from the wild can be restricted by European law.

Figures 15-16: Butcher's-broom (Ruscus aculeatus) in thermophilous deciduous woodland in the surveyed area

According to the Environmental impact study for the Corridor Vc motorway Mostar North – South border (2006), the sensitive species *Celtis tournefortii*, *Cyclamen neapolitanum*, *Cyclamen repandum*, *Acanthus spinossisimus*, *Galanthus nivalis*, *Orchis simia* and *Orchis spitzelii* can be found in the area of proposed motorway route. Maslo (2014) mentions the presence of endangered species *Thymus striatus*, *Stenbergia lutea*, *Spiranthes spiralis*, *Salvia bertolonii*, *Scutellaria orientalis* subsp. *pinnatifida*, *Onosma visianii*, *Opopanax chironium*, *Orchis purpurea*, *Origanum heracleoticum, Micromeria thymifolia, Linaria pelisseriana, Limodorum abortivum, Gladiolus illyricus, Centaurea fritschii, Erythronium dens-canis, Ephedra major* subsp. *major, Cyclamen hederifolium, Clypeolajonthlaspi, Dianthus sylvestris. subsp. tergestinus, Cynoglossum columnae, Dittrichia graveolens, D. viscosa, Cephalanthera longifolia, C. rubra, Asphodelus fistulosus, Aristolochia rotunda, Acanthus spinosissimus, Alkanna tinctoria, Cardamine graeca, Galanthus nivalis, Hermodactylus tuberosus, Legousia hybrida* and *Verbascum orientale,* and endemic *Edraianthus tenuifolius*, *Tanacetum cinerarifolium, Petteria ramentacea* (which were confirmed in the area during the flora survey of the Sub-Section Mostar South Interchange to Tunnel Kvanj of Corridor Vc), but also *Teucrium arduini, Peltaria alliacea, Rhamnus intermedius, Onosma echioides, O. stellulata, Micromeria croatica, M. kerneri, Moltkia petraea, Anthyllis vulneraria* subsp*. praepropera, Erysimum linariifolium, Arum nigrum, Genista sylvestris subsp. dalmatica, Cerastium grandiflorum, Chaerophyllum coloratum, Cerinthe minor* subsp. *auriculata, Centaurea glaberrima* subsp. *divergens, Centaurea rupestris* subsp. *ceratophylla, Asperula scutellaris, Astragalus monspessulanus* subsp. *illyricus, Cardamine maritima, Melampyrum fimbriatum, Trifolium dalmaticum, Carduus micropterus* and *Linaria microsepala.*

Those species can possibly be found in the surveyed area as well, so it is necessary to check the presence of the species before the beginning of the construction phase, preferably in late spring.

4.1.3 Invasive species

Invasive species have been observed at many locations of the project footprint area and surrounding potential area of influence. During the survey, the following invasive plant species (according to Maslo, 2016) were found:

- *Ailanthus altissima* (Tree of heaven)
- *Robiniapseudoacacia* (Black locust)
- *Broussonetiapapyrifera* (Paper mulberry)
- *Ambrosia artemisiifolia* (Common ragweed)
- *Conyza canadensis* (Canadian horseweed)
- *Erigeron annuus* (Annual fleabane)
- *Sorghum halepense* (Johnson grass).
- *Veronica persica* (Persian speedwell)
- *Xanthium spinosum* (Spiny cocklebur)
- *Abutilon theophrasti* (Velvetleaf)
- *Amaranthus retroflexus* (Redroot pigweed)
- *Datura stramonium* (Jimsonweed)
- *Euphorbia prostrata* (Prostrate spurge)
- *Eleusine indica* (Indian goosegrass).

The above listed species were mostly observed on waste and other disturbed sites, along roadsides, where they form relatively large stands. *Ailanthus altissima* was recorded to be most frequent invasive species and observed at neglected dry grasslands, along the existing local roads edges of degraded natural forest.

Figure 17: *Abutilon theophrasti (Velvet leaf)*

Figure 18: ***Xanthium spinosum (Spiny cocklebur)***

Figure 19: ***Euphorbia prostrata (Prostrate spurge)***

Figure 20: *Ambrosia artemisiifolia (Common ragweed)*

Figure 21: *Sorghum halepense (Johnson grass)*

Figure 22:Eleusine indica (Indian goosegrass)

Figure 23: Ailanthus altissima (Tree of heaven) and Broussonetiapapyrifera (Paper mulberry)

4.2 Mitigation measures

4.2.1 Preconstruction phase

It is necessary to undertake additional flora and vegetation survey prior to the construction activities to cover rare, endangered and endemic species mentioned by other authors. The survey needs to be performed from **early spring to mid-summer**, in order to record presence of early-flowering geophytes.

4.2.2 Construction phase

During the vegetation clearance and earthworks, the disposal of the material is to be well managed, in order to prevent the degradation of natural vegetation and invasion of non-native species into the natural habitats.

The excess construction waste must be re-used to level the road route and the remaining material shall be disposed at designated landfill, in order to prevent degradation of other natural vegetation and no temporary landfills are to be formed elsewhere, as these act as focal points for dispersion of invasive species.

The movements of heavy machinery need to be restricted to the existing road network and planned access roads, in order to minimize the damages to the natural vegetation in the area.

4.2.3 Operation phase

Mitigation measures during operation period involve monitoring and timely removal of invasive plant species, with focus on Thee of heaven (*Ailanthus altissima*), which is very aggressive plant able to colonize large areas, supressing the development of native vegetation, and Common ragweed (*Ambrosia artemisiifolia*), whose pollen is one of the strongest allergens It is advisable to develop an Invasive species management plan for these species, with regular monitoring performed at least once a year, and physically remove the existing specimens in order to prevent the further spread.

4.3 Monitoring measures

4.3.1 Preconstruction phase

Upon completion of the additional spring field surveys, habitat mapping is to be updated before the commencementof the construction activities.

4.3.2 Construction phase

During the construction phase, the status and any changes in potential sensitive habitats and sensitive species are to be monitored. Special focus should be given to the invasion of alien species into the natural sensitive habitats.

4.3.3 Operation phase

The monitoring of status of sensitive habitats and species, and invasive alien species is to be continued and regularly performed during the operational phase.

5 ANNEXES

5.1 Maps

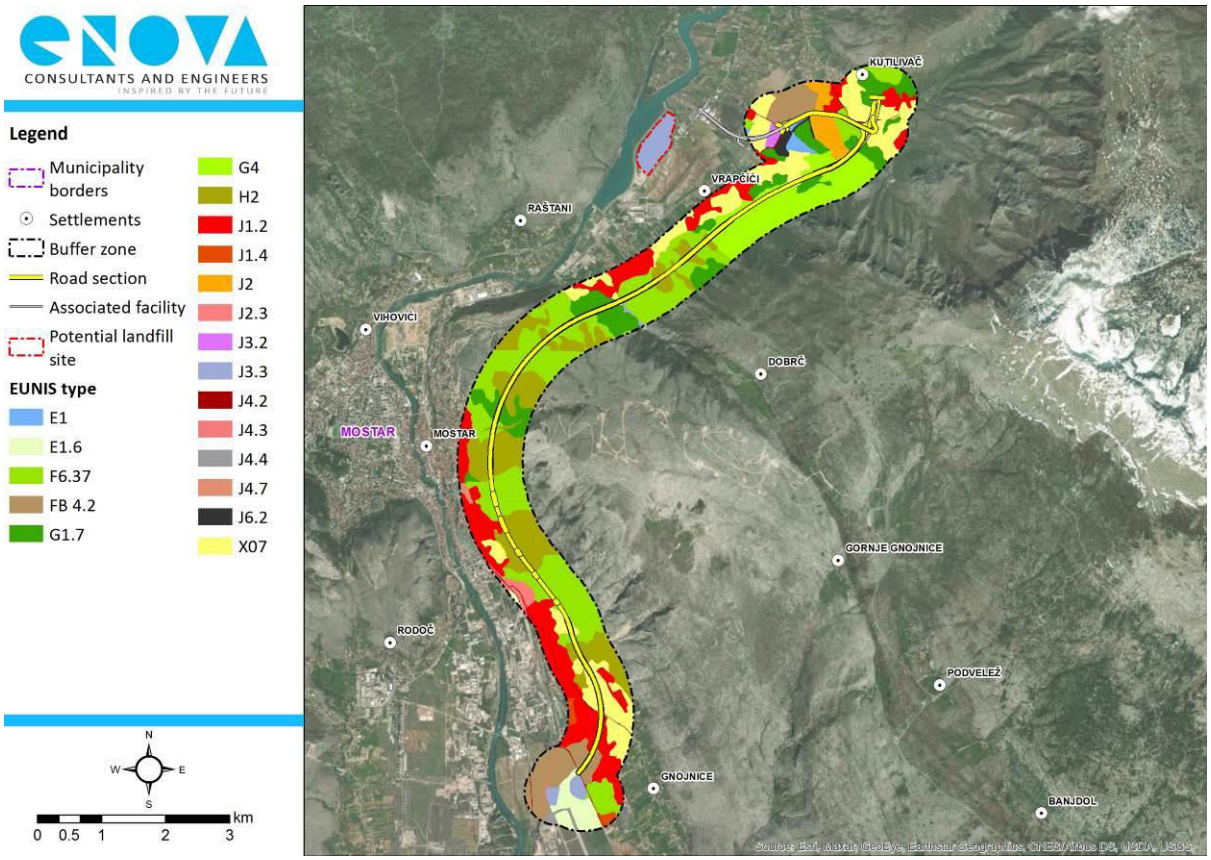

Figure 24: Map of EUNIS habitat types in the surveyed area

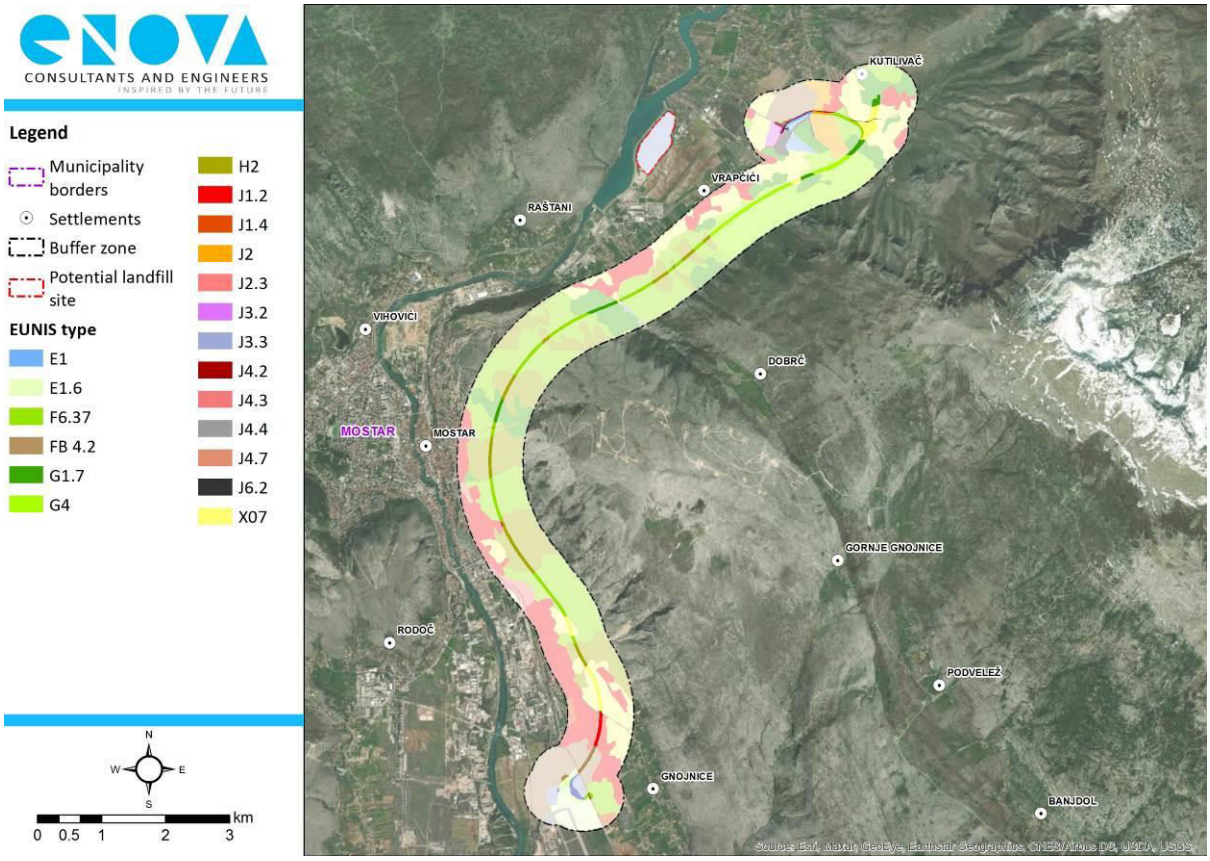

Figure 25: The map of EUNIS habitat types in the project footprint zone

5.2 Field notes

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	1	N 43° 23' 26" E 17° 54' 14"	

Notes: Habitat types include intensively-farmed crops (pomegranates, cherry orchards, vineyards) interspersed with strips of semi-natural vegetation (elements of degraded thermophilous oriental hornbeam woodland and dry grasslands), and ruderal vegetation developed along the roadsides, around houses and in a small cemetery.

Common dogwood	*Cornussanguinea*	Red clover	*Trifolium pratense*
Downy oak	*Quercus pubescens*	Old man's beard	*Clematis vitalba*
Pomegranate (planted)	*Punica granatum*	Yellow bluestem	*Dichanthiumischaemum*
Oriental hornbeam	*Carpinus orientalis*	Manna ash	*Fraxinus ornus*
Cherry (planted)	*Prunus avium*	Grape vine (planted)	*Vitis vinifera*
Jerusalem thorn	*Paliurus spina-christi*	Common ivy	*Hedera helix*
Flattened meadow-grass	*Poa compressa*	Wild carrot	*Daucus carota*
Field rose	*Rosa arvensis*	Hairy melic	*Melicaciliata*
Black bindweed	*Dioscorea communis*	Elmleaf blackberry	*Rubus ulmifolius*
White mulberry	*Morus alba*	Common agrimony	*Agrimonia eupatoria*
Tree of heaven	*Ailanthus altissima*	Prickly juniper	*Juniperus oxycedrus*
Common wild oat	*Avenafatua*	Barren brome	*Bromus sterilis*
Wormwood	*Artemisia absinthium*	Small toadflax	*Chaenorhinum minus*
Canadian horseweed	*Conyza canadensis*	Purple woodruff	*Asperula purpurea*
Orchard grass	*Dactylis glomerata*	Rush skeletonweed	*Chondrillajuncea*
Wild buckwheat	*Fallopia convolvulus*	Greater burdock	*Arctium lappa*
Amethyst eryngo	*Eryngium amethystinum*	Barnyard grass	*Echinochloa crus-galli*
Redroot pigweed	*Amaranthus retroflexus*	Bird's-foot trefoil	*Lotus corniculatus*
Wild asparagus	*Asparagus acutifolius*	Button medick	*Medicago orbicularis*
Dog rose	*Rosa canina*	Proliferous pink	*Petrorhagiaprolifera*
Small burnet	*Sanguisorba minor*	Tasteless stonecrop	*Sedum sexangulare*
Green bristlegrass	*Setariaviridis*	Common vervain	*Verbena officinalis*
Bristly hawkbit	*Leontodon hispidus*	Tunic flower	*Petrorhagiasaxifraga*
Yellow bristle-grass	*Setaria pumila*	Rye brome	*Bromus secalinus*
Persian speedwell	*Veronica persica*	Rat's-tail fescue	*Vulpiaciliata*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	2	N 43° 23' 15" E 17° 54' 03"	

Notes: Habitat types include degraded thermophilous oriental hornbeam woodland and intensively-farmed crops (lavender and pomegranate plantations and vineyards) interspersed with strips of semi-natural vegetation).

Oriental hornbeam	*Carpinus orientalis*	Downy oak	*Quercus pubescens*
Lavender (planted)	*Lavandula angustifolia*	Jerusalem thorn	*Paliurus spina-christi*
Pomegranate (planted)	*Punica granatum*	Grape vine (planted)	*Vitis vinifera*
Common vervain	*Verbena officinalis*	Manna ash	*Fraxinus ornus*
Compact brome	*Bromus madritensis*	Green bristlegrass	*Setariaviridis*
Orchard grass	*Dactylis glomerata*	Old man's beard	*Clematis vitalba*
Common chicory	*Cichorium intybus*	Small burnet	*Sanguisorba minor*
Yarrow	*Achillea millefolium*	Common ivy	*Hedera helix*
Common ragweed	*Ambrosia artemisiifolia*	Blackberry	*Rubus fruticosus*
Persian speedwell	*Veronica persica*	Scarlet firethorn	*Pyracantha coccinea*
Brown knapweed	*Centaurea jacea*	Dwarf morning glory	*Convolvulus cantabrica*
Black bindweed	*Dioscorea communis*	Tunic flower	*Petrorhagiasaxifraga*
Autumn moor grass	*Sesleriaautumnalis*		

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	3	N 43° 23' 23" E 17° 53' 54"	

Notes: Habitat types include degraded thermophilous oriental hornbeam and manna ash woodland and dry grasslands.

Oriental hornbeam	*Carpinus orientalis*	Manna ash	*Fraxinus ornus*
Yellow bluestem	*Dichanthiumischaemum*	Bird's-foot trefoil	*Lotus corniculatus*
European hop-hornbeam	*Ostrya carpinifolia*	Common hedge parsley	*Torilis arvensis*
Downy oak	*Quercus pubescens*	Pomegranate	*Punica granatum*

Jerusalem thorn	*Paliurus spina-christi*	Ribwort plantain	*Plantago lanceolata*
Black medick	*Medicago lupulina*	Common chicory	*Cichorium intybus*
Common dogwood	*Cornussanguinea*	Amethyst eryngo	*Eryngium amethystinum*
Dove's-foot crane's-bill	*Geranium molle*	Mosquito grass	*Dasypyrumvillosum*
Dwarf morning glory	*Convolvulus cantabrica*	Scutch grass	*Cynodondactylon*
Three-awn goat grass	*Aegilops neglecta*	Tree of heaven	*Ailanthus altissima*
Knapweed	*Centaurea deusta*	Field maple	*Acer campestre*
Yarrow	*Achillea millefolium*	Drooping brome	*Bromus tectorum*
Goldbeard grass	*Chrysopogongryllus*	Purple woodruff	*Asperula purpurea*
False-brome	*Brachypodiumsylvaticum*	Hairy rock-cress	*Arabis hirsuta*
Bastard agrimony	*Aremoniaagrimonoides*	Carline thistle	*Carlina vulgaris*
Orchard grass	*Dactylis glomerata*	Smoke tree	*Cotinus coggygria*
Canary clover	*Dorycniumhirsutum*	Common wild oat	*Avenafatua*
Rabbitfoot clover	*Trifolium arvense*	White clover	*Trifolium repens*
Lesser calaminth	*Calaminthaglandulosa*	Purple clematis	*Clematis viticella*
Common mallow	*Malva sylvestris*	Hairy melic	*Melicaciliata*
Yellow bedstraw	*Galium verum*	Love-in-a-mist	*Nigella damascena*
Tunic flower	*Petrorhagiasaxifraga*	Alfalfa	*Medicago sativa*
Field rose	*Rosa arvensis*	Blackberry	*Rubus fruticosus*
Autumn squill	*Scilla autumnalis*	Grey cinquefoil	*Potentilla incana*
Reflexed stonecrop	*Sedum rupestre*	Bladder campion	*Silene vulgaris*
Small burnet	*Sanguisorba minor*		

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	4	N 43° 23' 21" E 17° 53' 44"	

Notes: The habitat type in this location is garrigue mostly composed of *Paliurus spina-christi* and *Punica granatum*, and dry rocky grassland.

Jerusalem thorn	*Paliurus spina-christi*	Yellow bluestem	*Dichanthiumischaemum*
Common wild oat	*Avenafatua*	Amethyst eryngo	*Eryngium amethystinum*
Orchard grass	*Dactylis glomerata*	Manna ash	*Fraxinus ornus*
Field rose	*Rosa arvensis*	Blackberry	*Rubus fruticosus*
Downy oak	*Quercus pubescens*	Barnyard grass	*Echinochloa crus-galli*
Fat hen	*Chenopodium album*	Rough bristle-grass	*Setariaverticillata*
Rush skeletonweed	*Chondrillajuncea*	Common knotgrass	*Polygonum aviculare*
Oregano	*Origanum vulgare*	Dwarf morning glory	*Convolvulus cantabrica*
Needle sunrose	*Fumana vulgaris*	Purple woodruff	*Asperula purpurea*
Spanish stonecrop	*Sedum hispanicum*	Barren brome	*Bromus sterilis*
Prickly juniper	*Juniperus oxycedrus*	Common fig	*Ficus carica*
Felty germander	*Teucrium polium*	Horehound	*Marrubiumperegrinum*
Button medick	*Medicago orbicularis*	Pomegranate	*Punica granatum*
Old man's beard	*Clematis vitalba*	Mosquito grass	*Dasypyrumvillosum*
Spear saltbush	*Atriplex patula*	Dog rose	*Rosa canina*
Yarrow	*Achillea millefolium*	Hairy melic	*Melicaciliata*
Three-awn goat grass	*Aegilops neglecta*	Oriental hornbeam	*Carpinus orientalis*
Micromeria	*Micromeriajuliana*	Tunic flower	*Petrorhagiasaxifraga*
Small burnet	*Sanguisorba minor*	Wall germander	*Teucrium chamaedrys*
Star clover	*Trifolium stellatum*		

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	5	N 43° 23' 30" E 17° 53' 35"	

Notes: The habitat type in this location is garrigue (mostly composed of *Paliurus spina-christi* and *Punica granatum*) dry grassland and a mosaic of domestic gardens, with dry ruderal vegetation developed along the roadsides.

Yellow bluestem	*Dichanthiumischaemum*	Strawberry (planted)	*Fragaria ananassa*
Common fig	*Ficus carica*	Tree of heaven	*Ailanthus altissima*
Amethyst eryngo	*Eryngium amethystinum*	Velvetleaf	*Abutilon theophrasti*
Black locust	*Robiniapseudoacacia*	Black pine	*Pinus nigra*
Felty germander	*Teucrium polium*	Needle sunrose	*Fumana vulgaris*
Three-awn goat grass	*Aegilops neglecta*	Purple clematis	*Clematis viticella*

Oriental hornbeam	*Carpinus orientalis*	Common ragweed	*Ambrosia artemisiifolia*
Wormwood	*Artemisia absinthium*	Rush skeletonweed	*Chondrillajuncea*
Orchard grass	*Dactylis glomerata*	Wild carrot	*Daucus carota*
Compact brome	*Bromus madritensis*	Shepherd's purse	*Capsella bursa-pastoris*
Dwarf morning glory	*Convolvulus cantabrica*	Annual fleabane	*Erigeron annuus*
Canadian horseweed	*Conyza canadensis*	Mediterranean cypress	*Cupressus sempervirens*
Pomegranate	*Punica granatum*	Field rose	*Rosa arvensis*
Manna ash	*Fraxinus ornus*	Common wild oat	*Avenafatua*
Blackberry	*Rubus fruticosus*	Clary sage	*Salvia sclarea*
Common chicory	*Cichorium intybus*	Walnut	*Juglans regia*
Lavender (planted)	*Lavandula angustifolia*	Prickly juniper	*Juniperus oxycedrus*
Barnyard grass	*Echinochloa crus-galli*	Scutch grass	*Cynodondactylon*
Common vervain	*Verbena officinalis*	Love-in-a-mist	*Nigella damascena*
Jerusalem thorn	*Paliurus spina-christi*	Tunic flower	*Petrorhagiasaxifraga*
Cut-leaved Crane's-bill	*Geranium dissectum*	Common bean (planted)	*Phaseolus vulgaris*
Persian speedwell	*Veronica persica*	Hawthorn	*Crataegus monogyna*
Armenian plum (planted)	*Prunus armeniaca*	Spreading pellitory	*Parietariajudaica*
Common knotgrass	*Polygonum aviculare*	Bird's-foot trefoil	*Lotus corniculatus*
Reflexed stonecrop	*Sedum rupestre*	Green bristlegrass	*Setariaviridis*
Tasteless stonecrop	*Sedum sexangulare*	Service tree	*Sorbus domestica*
Rabbitfoot clover	*Trifolium arvense*	Alfalfa	*Medicago sativa*
Spiny cocklebur	*Xanthium spinosum*	Rat's-tail fescue	*Vulpiaciliata*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	6	N 43° 23’ 28” E 17° 53’ 15”	

Notes: Habitat types include intensive vineyards and dry grasslands with ruderal vegetation along the roadsides.

Grape vine (planed)	*Vitis vinifera*	Yellow bluestem	*Dichanthiumischaemum*
Button medick	*Medicago orbicularis*	Blackberry	*Rubus fruticosus*
Wild carrot	*Daucus carota*	Annual fleabane	*Erigeron annuus*
Small scabious	*Scabiosa columbaria*	Amethyst eryngo	*Eryngium amethystinum*
Reflexed stonecrop	*Sedum rupestre*	Common knotgrass	*Polygonum aviculare*
Common rock-rose	*Helianthemum nummularium*	Hair grass	*Koeleria splendens*
Orchard grass	*Dactylis glomerata*	Plantain	*Plantago carinata*
Felty germander	*Teucrium polium*	Tasteless stonecrop	*Sedum sexangulare*
Hairy melic	*Melicaciliata*	Elmleaf blackberry	*Rubus ulmifolius*
Field rose	*Rosa arvensis*	Yellow bristle-grass	*Setaria pumila*
Redroot pigweed	*Amaranthus retroflexus*	Fat hen	*Chenopodium album*
Green bristlegrass	*Setariaviridis*	Canadian horseweed	*Conyza canadensis*
Barnyard grass	*Echinochloa crus-galli*	Old man's beard	*Clematis vitalba*
Jerusalem thorn	*Paliurus spina-christi*	Tunic flower	*Petrorhagiasaxifraga*
Johnson grass	*Sorghum halepense*	Three-awn goat grass	*Aegilops neglecta*
Common vervain	*Verbena officinalis*	Common chicory	*Cichorium intybus*
Rush skeletonweed	*Chondrillajuncea*	Barren brome	*Bromus sterilis*
Spear saltbush	*Atriplex patula*	Drooping brome	*Bromus tectorum*
Brown knapweed	*Centaurea jacea*	Scutch grass	*Cynodondactylon*
Persian speedwell	*Veronica persica*	Autumn squill	*Scilla autumnalis*
Buckler-mustard	*Biscutella laevigata*	Cut-leaved Crane's-bill	*Geranium dissectum*
Common wild oat	*Avenafatua*	Red clover	*Trifolium pratense*
Prickly lettuce	*Lactucaserriola*	Shepherd's purse	*Capsella bursa-pastoris*
Wild basil	*Clinopodium vulgare*	Roadside pepperweed	*Lepidium ruderale*
Love-in-a-mist	*Nigella damascena*	White laceflower	*Orlaya grandiflora*
Creeping cinquefoil	*Potentilla reptans*	Dwarf morning glory	*Convolvulus cantabrica*
Small burnet	*Sanguisorba minor*		

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	7	N 43° 23’ 24” E 17° 52’ 41”	

Notes: Habitat types include intensive vineyards, degraded thermophilous oriental hornbeam and manna ash woodland and dry grasslands, with ruderal vegetation along the roads.

Grape vine (planed)	*Vitis vinifera*	Jerusalem thorn	*Paliurus spina-christi*
Common rock-rose	*Helianthamumnummularium*	Blackberry	*Rubus fruticosus*
Common vervain	*Verbena officinalis*	Johnson grass	*Sorghum halepense*
Annual fleabane	*Erigeron annuus*	Drooping brome	*Bromus tectorum*
Autumn squill	*Scilla autumnalis*	Dwarf morning glory	*Convolvulus cantabrica*
Dog rose	*Rosa canina*	Elmleaf blackberry	*Rubus ulmifolius*
Downy oak	*Quercus pubescens*	Canadian horseweed	*Conyza canadensis*
Fat hen	*Chenopodium album*	Common wild oat	*Avenafatua*
Amethyst eryngo	*Eryngium amethystinum*	Common chicory	*Cichorium intybus*
Field rose	*Rosa arvensis*	Barren brome	*Bromus sterilis*
Button medick	*Medicago orbicularis*	Manna ash	*Fraxinus ornus*
Green bristlegrass	*Setariaviridis*	Mosquito grass	*Dasypyrumvillosum*
Hairy melic	*Melicaciliata*	Needle sunrose	*Fumana vulgaris*
European hop-hornbeam	*Ostrya carpinifolia*	Yellow bristle-grass	*Setaria pumila*
Orchard grass	*Dactylis glomerata*	Old man's beard	*Clematis vitalba*
Hair grass	*Koeleria splendens*	Tunic flower	*Petrorhagiasaxifraga*
Prickly juniper	*Juniperus oxycedrus*	Wall germander	*Teucrium chamaedrys*
Prickly lettuce	*Lactucaserriola*	White laceflower	*Orlaya grandiflora*
Oriental hornbeam	*Carpinus orientalis*	Redroot pigweed	*Amaranthus retroflexus*
Plantain	*Plantago carinata*	Reflexed stonecrop	*Sedum rupestre*
Pomegranate	*Punica granatum*	Rough bristle-grass	*Setariaverticillata*
Spear saltbush	*Atriplex patula*	Common knotgrass	*Polygonum aviculare*
Star clover	*Trifolium stellatum*	Felty germander	*Teucrium polium*
Tasteless stonecrop	*Sedum sexangulare*	Small burnet	*Sanguisorba minor*
Three-awn goat grass	*Aegilops neglecta*	Small scabious	*Scabiosa columbaria*
Scutch grass	*Cynodondactylon*	Spanish stonecrop	*Sedum hispanicum*
Yellow bluestem	*Dichanthiumischaemum*	Rush skeletonweed	*Chondrillajuncea*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	8	N 43° 23’ 16” E 17° 52’ 27”	

Notes: The habitat type in this site is a dry grassland, unmanaged and partially overgrown with woody and ruderal vegetation.

Proliferous pink	*Petrorhagiaprolifera*	Rush skeletonweed	*Chondrillajuncea*
Hairy melic	*Melicaciliata*	St John's wort	*Hypericum perforatum*
Amethyst eryngo	*Eryngium amethystinum*	White laceflower	*Orlaya grandiflora*
Yellow bluestem	*Dichanthiumischaemum*	Common mullein	*Verbascum thapsus*
Canadian horseweed	*Conyza canadensis*	Common mallow	*Malva sylvestris*
Blackberry	*Rubus fruticosus*	Common knotgrass	*Polygonum aviculare*
Common ragweed	*Ambrosia artemisiifolia*	Yellow bristle-grass	*Setaria pumila*
Jerusalem thorn	*Paliurus spina-christi*	Rough cocklebur	*Xanthium strumarium*
Tree of heaven	*Ailanthus altissima*	Common chicory	*Cichorium intybus*
Tunic flower	*Petrorhagiasaxifraga*	Wild carrot	*Daucus carota*
Green bristlegrass	*Setariaviridis*	Oregano	*Origanum vulgare*
Pyrethrum	*Tanacetum cinerariifolium*	Pomegranate	*Punica granatum*
Nodding thistle	*Carduus nutans*	Common golden thistle	*Scolymus hispanicus*
Prostrate spurge	*Euphorbia prostrata*	Purple clematis	*Clematis viticella*
Three-awn goat grass	*Aegilops neglecta*	Redroot pigweed	*Amaranthus retroflexus*
Scutch grass	*Cynodondactylon*	Common wild oat	*Avenafatua*
Hoary cress	*Cardariadraba*	Barren brome	*Bromus sterilis*
Small toadflax	*Chaenorhinum minus*	Wormwood	*Artemisia absinthium*
Needle sunrose	*Fumana vulgaris*	Bristly hawkbit	*Leontodon hispidus*
Hair grass	*Koeleria splendens*	Roadside pepperweed	*Lepidium ruderale*
Star clover	*Trifolium stellatum*	Jacquin's speedwell	*Veronica jacquinii*
Button medick	*Medicago orbicularis*	Orchard grass	*Dactylis glomerata*
Flattened meadow-grass	*Poa compressa*	Slender-leaved elecampane	*Inulaensifolia*
Compact brome	*Bromus madritensis*	Dwarf morning glory	*Convolvulus cantabrica*
Hardgrass	*Sclerochloa dura*	Dog figwort	*Scrophularia canina*
Black nightshade	*Solanum nigrum*	Johnson grass	*Sorghum halepense*
Spanish stonecrop	*Sedum hispanicum*	Wall germander	*Teucrium chamaedrys*
Felty germander	*Teucrium polium*	Red clover	*Trifolium pratense*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	9	N 43° 22' 54" E 17° 53' 07"	

Notes: The habitat type in this site is thermophilous oriental hornbeam and manna ash woodland.

Oriental hornbeam	*Carpinus orientalis*	Manna ash	*Fraxinus ornus*
Butcher's-broom	*Ruscus aculeatus*	Old man's beard	*Clematis vitalba*
Common ivy	*Hedera helix*	Jerusalem thorn	*Paliurus spina-christi*
Common privet	*Ligustrum vulgare*	Pomegranate	*Punica granatum*
Black bindweed	*Dioscorea communis*	Wild asparagus	*Asparagus acutifolius*
Common dogwood	*Cornussanguinea*	Cherry	*Prunus avium*
Elderberry	*Sambucus nigra*	Tree of heaven	*Ailanthus altissima*
European hop-hornbeam	*Ostrya carpinifolia*	Swallow-wort	*Vincetoxicumhirundinaria*
European nettle tree	*Celtis australis*	Bastard agrimony	*Aremoniaagrimonoides*
Montpellier maple	*Acer monspessulanum*	Wild service tree	*Sorbus torminalis*
Mahaleb cherry	*Prunus mahaleb*	False-brome	*Brachypodiumsylvaticum*
Maidenhair spleenwort	*Asplenium trichomanes*	Smoke tree	*Cotinus coggygria*
Hawthorn	*Crataegus monogyna*	Turkey oak	*Quercus cerris*
Waited spindle-tree	*Euonymus verrucosus*	Hedge bindweed	*Calystegiasepium*
Downy oak	*Quercus pubescens*	Wood spurge	*Euphorbia amygdaloides*
European cornel	*Cornus mas*	Dog rose	*Rosa canina*
Blackberry	*Rubus fruticosus*	Wood sanicle	*Sanicula europaea*
Bloody dock	*Rumex sanguineus*	Autumn moor grass	*Sesleriaautumnalis*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	10	N 43° 22' 54" E 17° 53' 14"	

Notes: Habitat types include mixed deciduous and coniferous woodland which is partly degraded and strips of dry rocky grasslands.

Oriental hornbeam	*Carpinus orientalis*	Prickly juniper	*Juniperus oxycedrus*
Turkey oak	*Quercus cerris*	Downy oak	*Quercus pubescens*
European hop-hornbeam	*Ostrya carpinifolia*	Star clover	*Trifolium stellatum*
Autumn moor grass	*Sesleriaautumnalis*	Dog rose	*Rosa canina*
Montpellier maple	*Acer monspessulanum*	Red bryony	*Bryonia dioica*
Rock thyme	*Acinosorontius*	False-brome	*Brachypodiumsylvaticum*
Jerusalem thorn	*Paliurus spina-christi*	Common ivy	*Hedera helix*
Old man's beard	*Clematis vitalba*	Tower cress	*Arabis turrita*
Rustyback	*Asplenium ceterach*	European cornel	*Cornus mas*
Common hornbeam	*Carpinus betulus*	Hairy melic	*Melicaciliata*
Mountain cornflower	*Centaurea montana*	Stemless carline thistle	*Carlina acaulis*
Manna ash	*Fraxinus ornus*	Black bindweed	*Dioscorea communis*
Erect brome	*Bromus erectus*	Black pine	*Pinus nigra*
Wood spurge	*Euphorbia amygdaloides*	Smoke tree	*Cotinus coggygria*
Wild asparagus	*Asparagus acutifolius*	Waited spindle-tree	*Euonymus verrucosus*
Herb-Robert	*Geranium robertianum*	Hairy broom	*Chamaecytisushirsutus*
Wall germander	*Teucrium chamaedrys*	Jacquin's speedwell	*Veronica jacquinii*
Common dogwood	*Cornussanguinea*	Buckthorn	*Frangula rupestris*
Orchard grass	*Dactylis glomerata*	St John's wort	*Hypericum perforatum*
Amethyst eryngo	*Eryngium amethystinum*	Tunic flower	*Petrorhagiasaxifraga*
Canary clover	*Dorycniumhirsutum*	Stickyweed	*Galium aparine*
Hoary plantain	*Plantago media*	Hawthorn	*Crataegus monogyna*
Blackberry	*Rubus fruticosus*	Cherry	*Prunus avium*
Micromeria	*Micromeriajuliana*	Bloody dock	*Rumex sanguineus*
Mountain savory	*Saturejasubspicata*	Butcher's-broom	*Ruscus aculeatus*
Wild service tree	*Sorbus torminalis*	Smyrnium	*Smyrnium perfoliatum*
Danewort	*Sambucus ebulus*	Asarabacca	*Asarum europaeum*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	11	N 43° 22' 54" E 17° 52' 60"	

Notes: Habitat types include dry grassland, degraded mixed forest and ruderal vegetation.			
Micromeria	*Micromeriajuliana*	Tree of heaven	*Ailanthus altissima*
Jerusalem thorn	*Paliurus spina-christi*	Oriental hornbeam	*Carpinus orientalis*
European hop-hornbeam	*Ostrya carpinifolia*	Rough bristle-grass	*Setariaverticillata*
Prickly juniper	*Juniperus oxycedrus*	Old man's beard	*Clematis vitalba*
Prostrate spurge	*Euphorbia prostrata*	Purple clematis	*Clematis viticella*
Turkey oak	*Quercus cerris*	Common dandelion	*Taraxacum officinale*
Green bristlegrass	*Setariaviridis*	Yellow bluestem	*Dichanthiumischaemum*
White laceflower	*Orlaya grandiflora*	Fat hen	*Chenopodium album*
Common knotgrass	*Polygonum aviculare*	Common chicory	*Cichorium intybus*
Blackberry	*Rubus fruticosus*	Tunic flower	*Petrorhagiasaxifraga*
Pomegranate	*Punica granatum*	Dog rose	*Rosa canina*
Orchard grass	*Dactylis glomerata*	Mahaleb cherry	*Prunus mahaleb*
Barren brome	*Bromus sterilis*	Common oat	*Avena sativa*
Shepherd's purse	*Capsella bursa-pastoris*	Scutch grass	*Cynodondactylon*
Wild strawberry	*Fragaria vesca*	Ribwort plantain	*Plantago lanceolata*
Perennial ryegrass	*Lolium perenne*	Jimsonweed	*Datura stramonium*
Manna ash	*Fraxinus ornus*	Common fig	*Ficus carica*
Greater plantain	*Plantago major*	Three-awn goat grass	*Aegilops neglecta*
Hoary plantain	*Plantago media*	Canadian horseweed	*Conyza canadensis*
Spiny cocklebur	*Xanthium spinosum*	Field thistle	*Cirsium arvense*
Wild carrot	*Daucus carota*	Common mugwort	*Artemisia vulgaris*
Creeping woodsorrel,	*Oxalis corniculata*	Redroot pigweed	*Amaranthus retroflexus*
Rock thyme	*Acinosorontius*	Common ragweed	*Ambrosia artemisiifolia*
Hawthorn	*Crataegus monogyna*	Spreading pellitory	*Parietariajudaica*
Alfalfa	*Medicago sativa*	Crab apple	*Malus sylvestris*
Mouse-ear hawkweed	*Hieraciumpilosella*	Barnyard grass	*Echinochloa crus-galli*
Purple woodruff	*Asperula purpurea*	Black horehound	*Ballota nigra*
Common meadow-grass	*Poa pratensis*	Tasteless stonecrop	*Sedum sexangulare*
Johnson grass	*Sorghum halepense*	Rough-fruited cinquefoil	*Potentilla recta*
Stinging nettle	*Urtica dioica*	Yellow bristle-grass	*Setaria pumila*
Common hedge parsley	*Torilis arvensis*	Red clover	*Trifolium pratense*
Common mallow	*Malva sylvestris*	Persian speedwell	*Veronica persica*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	12	N 43° 22’ 45” E 17° 52’ 25”	

Notes: Habitat types include intensively-farmed crops (cherry and peach orchards and vineyards) interspersed with strips of semi-natural vegetation (elements of mixed woodland and dry grasslands), with dry ruderal vegetation developed along the roadsides and domestic gardens.			
Grape vine (planted)	*Vitis vinifera*	Blackberry	*Rubus fruticosus*
Common ivy	*Hedera helix*	Jerusalem thorn	*Paliurus spina-christi*
Montpellier maple	*Acer monspessulanum*	European dewberry	*Rubus caesius*
Oriental hornbeam	*Carpinus orientalis*	Common dogwood	*Cornussanguinea*
Turkey oak	*Quercus cerris*	Cherry (planted)	*Prunus avium*
Scutch grass	*Cynodondactylon*	Common knotgrass	*Polygonum aviculare*
Old man's beard	*Clematis vitalba*	Common mugwort	*Artemisia vulgaris*
Black bindweed	*Dioscorea communis*	Wild asparagus	*Asparagus acutifolius*
Peach (planted)	*Prunus persica*	European cornel	*Cornus mas*
Field rose	*Rosa arvensis*	Red bryony	*Bryonia dioica*
Black locust	*Robiniapseudoacacia*	Butcher's-broom	*Ruscus aculeatus*
Common ragweed	*Ambrosia artemisiifolia*	Johnson grass	*Sorghum halepense*
Wild carrot	*Daucus carota*	Hollyhock	*Alcea rosea*
Manna ash	*Fraxinus ornus*	Green bristlegrass	*Setariaviridis*
Rush skeletonweed	*Chondrillajuncea*	Spear saltbush	*Atriplex patula*
False-brome	*Brachypodiumsylvaticum*	Barren brome	*Bromus sterilis*
Smooth bedstraw	*Cruciatalaevipes*	Common oat	*Avena sativa*
Hoary cress	*Cardariadraba*	Orchard grass	*Dactylis glomerata*
St John's wort	*Hypericum perforatum*	Mosquito grass	*Dasypyrumvillosum*
Yarrow	*Achillea millefolium*	Burnt candytuft	*Aethionema saxatile*

Redroot pigweed	*Amaranthus retroflexus*	Wormwood	*Artemisia absinthium*
Bird's-foot trefoil	*Lotus corniculatus*	Hairy melic	*Melicaciliata*
White mulberry	*Morus alba*	Three-awn goat grass	*Aegilops neglecta*
Common agrimony	*Agrimonia eupatoria*	White laceflower	*Orlaya grandiflora*
Squarrose knapweed	*Centaurea triumfetti*	Amethyst eryngo	*Eryngium amethystinum*
Compact brome	*Bromus madritensis*	Canadian horseweed	*Conyza canadensis*
Common dandelion	*Taraxacum officinale*	Persian speedwell	*Veronica persica*
Yellow bluestem	*Dichanthiumischaemum*	Smoke tree	*Cotinus coggygria*
Various-leaved fescue	*Festuca heterophylla*	Alfalfa	*Medicago sativa*
Common vervain	*Verbena officinalis*	Rye brome	*Bromus secalinus*
Common fig	*Ficus carica*	Perennial ryegrass	*Lolium perenne*
Dove's-foot crane's-bill	*Geranium molle*	Prickly lettuce	*Lactucaserriola*
Common chicory	*Cichorium intybus*	Walnut	*Juglans regia*
Tree of heaven	*Ailanthus altissima*	Fat hen	*Chenopodium album*
Spanish stonecrop	*Sedum hispanicum*	Reflexed stonecrop	*Sedum rupestre*
Spreading pellitory	*Parietariajudaica*	Tunic flower	*Petrorhagiasaxifraga*
Small burnet	*Sanguisorba minor*	Dog figwort	*Scrophularia canina*
Plantain	*Plantago carinata*	Pomegranate	*Punica granatum*
Rough bristle-grass	*Setariaverticillata*	White clover	*Trifolium repens*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	13	N 43° 23' 13" E 17° 51' 39"	

Notes: Habitat type in this site is recently abandoned extractive industrial site in which ruderal vegetation has developed.

Wormwood	*Artemisia absinthium*	Johnson grass	*Sorghum halepense*
Common ragweed	*Ambrosia artemisiifolia*	Cocklebur	*Xanthium strumarium*
Fat hen	*Chenopodium album*	Common fig	*Ficus carica*
St John's wort	*Hypericum perforatum*	Prickly lettuce	*Lactucaserriola*
White willow	*Salix alba*	Green bristlegrass	*Setariaviridis*
Orchard grass	*Dactylis glomerata*	Canadian horseweed	*Conyza canadensis*
Mediterranean cypress	*Cupressus sempervirens*	Black poplar	*Populus nigra*
Barren brome	*Bromus sterilis*	Common chicory	*Cichorium intybus*
Old man's beard	*Clematis vitalba*	Rush skeletonweed	*Chondrillajuncea*
Tree of heaven	*Ailanthus altissima*	Little lovegrass	*Eragrostis minor*
Blackberry	*Rubus fruticosus*	Creeping cinquefoil	*Potentilla reptans*
Rough bristle-grass	*Setariaverticillata*	Common vervain	*Verbena officinalis*
Scutch grass	*Cynodondactylon*	Common wild oat	*Avenafatua*
Roadside pepperweed	*Lepidium ruderale*	Hawkweed oxtongue	*Picris hieracioides*
Common knotgrass	*Polygonum aviculare*	Common mallow	*Malva sylvestris*
Greater plantain	*Plantago major*	Bird's-foot trefoil	*Lotus corniculatus*
Black nightshade	*Solanum nigrum*	Common dandelion	*Taraxacum officinale*
White clover	*Trifolium repens*	Rat's-tail fescue	*Vulpiaciliata*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	14	N 43° 23' 44" E 17° 51' 53"	

Notes: Habitat types include degraded thermophilous woodland and dry grasslands, partially dominated with ruderal vegetation.

Pomegranate	*Punica granatum*	Autumn squill	*Scilla autumnalis*
Jerusalem thorn	*Paliurus spina-christi*	Manna ash	*Fraxinus ornus*
Yellow bluestem	*Dichanthiumischaemum*	Green bristlegrass	*Setariaviridis*
Felty germander	*Teucrium polium*	Johnson grass	*Sorghum halepense*
Wormwood	*Artemisia absinthium*	Canadian horseweed	*Conyza canadensis*
Mountain savory	*Saturejasubspicata*	Prickly juniper	*Juniperus oxycedrus*
Scutch grass	*Cynodondactylon*	Three-awn goat grass	*Aegilops neglecta*
Common wild oat	*Avenafatua*	White clover	*Trifolium repens*
Rock thyme	*Acinosorontius*	Star clover	*Trifolium stellatum*
Knapweed	*Centaurea deusta*	Dwarf morning glory	*Convolvulus cantabrica*
Tunic flower	*Petrorhagiasaxifraga*	Old man's beard	*Clematis vitalba*
Roadside pepperweed	*Lepidium ruderale*	Ribwort plantain	*Plantago lanceolata*
Orchard grass	*Dactylis glomerata*	Hairy melic	*Melicaciliata*

Horehound	*Marrubiumperegrinum*	Mosquito grass	*Dasypyrumvillosum*
Blackberry	*Rubus fruticosus*	Tasteless stonecrop	*Sedum sexangulare*
Wall germander	*Teucrium chamaedrys*	Common dandelion	*Taraxacum officinale*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	15	N 43° 22' 17" E 17° 51' 34"	

Notes: Habitat types include garrigue (with *Juniperus oxycedrus* and *Paliurus spina-christi*), screes with sparse vegetation, and small domestic gardens.

Jerusalem thorn	*Paliurus spina-christi*	Prickly juniper	*Juniperus oxycedrus*
Grape vine	*Vitis vinifera*	Rustyback	*Asplenium ceterach*
Yellow bluestem	*Dichanthiumischaemum*	Drooping brome	*Bromus tectorum*
Hairy melic	*Melicaciliata*	Micromeria	*Micromeriajuliana*
Rock thyme	*Acinosorontius*	Velvetleaf	*Abutilon theophrasti*
Montpellier maple	*Acer monspessulanum*	Carrot bur parsley	*Caucalisplatycarpos*
Compact brome	*Bromus madritensis*	Spear grass	*Achnatherumcalamagrostis*
Mediterranean spurge	*Euphorbia wulfenii*	Spreading pellitory	*Parietariajudaica*
Common rock-rose	*Helianthamumnummularium*	Tunic flower	*Petrorhagiasaxifraga*
European stonecrop	*Sedum ochroleucum*	Spanish stonecrop	*Sedum hispanicum*
Common knotgrass	*Polygonum aviculare*	Amethyst eryngo	*Eryngium amethystinum*
White laceflower	*Orlaya grandiflora*	Tree of heaven	*Ailanthus altissima*
Common sage	*Salvia officinalis*	Mountain savory	*Saturejasubspicata*
Paper mulberry	*Broussonetiapapyrifera*	Smoke tree	*Cotinus coggygria*
Hairy sedge	*Carexhirta*	Mosquito grass	*Dasypyrumvillosum*
Wild asparagus	*Asparagus acutifolius*	Old man's beard	*Clematis vitalba*
Goldbeard grass	*Chrysopogongryllus*	Oriental hornbeam	*Carpinus orientalis*
Yellow bristle-grass	*Setaria pumila*	Field eryngo	*Eryngium campestre*
Common wild oat	*Avenafatua*	Common fig	*Ficus carica*
Black pine	*Pinus nigra*	Pomegranate	*Punica granatum*
Tasteless stonecrop	*Sedum sexangulare*	Felty germander	*Teucrium polium*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	16	N 43° 22' 11" E 17° 51' 22"	

Notes: Habitat types include screes and garrigue (mostly composed of *Juniperus oxycedrus*, *Paliurus spina-christi* and *Pinus nigra*).

Prickly juniper	*Juniperus oxycedrus*	Hairy melic	*Melicaciliata*
Purple woodruff	*Asperula purpurea*	Great quaking grass	*Briza maxima*
Mediterranean cypress	*Cupressus sempervirens*	Rock thyme	*Acinosorontius*
European nettle tree	*Celtis australis*	Purple clematis	*Clematis viticella*
Black pine	*Pinus nigra*	Downy oak	*Quercus pubescens*
Hairy rock-cress	*Arabis hirsuta*	Jerusalem thorn	*Paliurus spina-christi*
Manna ash	*Fraxinus ornus*	Drooping brome	*Bromus tectorum*
Montpellier maple	*Acer monspessulanum*	Maidenhair spleenwort	*Asplenium trichomanes*
Compact brome	*Bromus madritensis*	Herb-Robert	*Geranium robertianum*
Tunic flower	*Petrorhagiasaxifraga*	Yellow bluestem	*Dichanthiumischaemum*
Pomegranate	*Punica granatum*	Mountain savory	*Saturejasubspicata*
European stonecrop	*Sedum ochroleucum*	Field eryngo	*Eryngium campestre*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	17	N 43° 21' 43" E 17° 51' 12"	

Notes: Habitat types include garrigue, termophilous woodland, dry rocky grasslandsand recently abandoned quarry.

Oriental hornbeam	*Carpinus orientalis*	Manna ash	*Fraxinus ornus*
Black broom	*Lembotropis nigricans*	Betony	*Stachys officinalis*
Glossy buckthorn	*Frangula alnus*	Blackberry	*Rubus fruticosus*
Common chicory	*Cichorium intybus*	Redroot pigweed	*Amaranthus retroflexus*
Wild carrot	*Daucus carota*	Hairy melic	*Melicaciliata*
Autumn moor grass	*Sesleriaautumnalis*	Mouse-ear hawkweed	*Hieraciumpilosella*
Downy oak	*Quercus pubescens*	False-brome	*Brachypodiumsylvaticum*
Black pine	*Pinus nigra*	Barren strawberry	*Potentilla micrantha*

Dog figwort	*Scrophularia canina*	Prickly lettuce	*Lactucaserriola*
Mediterranean spurge	*Euphorbia wulfenii*	Jerusalem thorn	*Paliurus spina-christi*
Common privet	*Ligustrum vulgare*	Common whitebeam	*Sorbus aria*
Goat willow	*Salix caprea*	Grey cinquefoil	*Potentilla incana*
Hairy rock-cress	*Arabis hirsuta*	Hair grass	*Koeleria splendens*
Mountain savory	*Saturejasubspicata*	Horseshoe vetch	*Hippocrepiscomosa*
Common ivy	*Hedera helix*	Coltsfoot	*Tussilago farfara*
Prickly juniper	*Juniperus oxycedrus*	Reflexed stonecrop	*Sedum rupestre*
Wild thyme	*Thymus serpyllum*	Purple woodruff	*Asperula purpurea*
Burnt candytuft	*Aethionema saxatile*	Common mugwort	*Artemisia vulgaris*
Diffuse knapweed	*Centaurea diffusa*	European hop-hornbeam	*Ostrya carpinifolia*
Alpine willowherb	*Epilobium dodonaei*	Rock thyme	*Acinosorontius*
Old man's beard	*Clematis vitalba*	Prostrate canary clover	*Dorycniumherbaceum*
Micromeria	*Micromeriajuliana*	Erect brome	*Bromus erectus*
European cornel	*Cornus mas*	Hedge bedstraw	*Galiummollugo*
Tree of heaven	*Ailanthus altissima*	Spear grass	*Achnatherumcalamagrostis*
Bastard agrimony	*Aremoniaagrimonoides*	Buckler-mustard	*Biscutella laevigata*
Yellow bluestem	*Dichanthiumischaemum*	Wayfaring tree	*Viburnum lantana*
Grass-leaved scabious	*Scabiosa graminifolia*	Mountain germander	*Teucrium montanum*
Field rose	*Rosa arvensis*	Green bristlegrass	*Setariaviridis*
Cocklebur	*Xanthium strumarium*	Broad-leaved spindle	*Euonymus latifolius*
Hawthorn	*Crataegus monogyna*		

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	18	N 43° 21’ 50” E 17° 51’ 02”	

Notes: Habitat types in this site include garrigue, dry grasslands and screes.

Oriental hornbeam	*Carpinus orientalis*	Black broom	*Lembotropis nigricans*
Bird's-foot trefoil	*Lotus corniculatus*	Elderberry	*Sambucus nigra*
Downy oak	*Quercus pubescens*	Autumn moor grass	*Sesleriaautumnalis*
Barren strawberry	*Potentilla micrantha*	Curly hawkbit	*Leontodon crispus*
Amethyst eryngo	*Eryngium amethystinum*	Manna ash	*Fraxinus ornus*
Common agrimony	*Agrimonia eupatoria*	Buckthorn	*Frangula rupestris*
Hair grass	*Koeleria splendens*	Hoary plantain	*Plantago media*
Erect brome	*Bromus erectus*	Dog rose	*Rosa canina*
Buckler-mustard	*Biscutella laevigata*	Bristly hawkbit	*Leontodon hispidus*
Field rose	*Rosa arvensis*	Common sage	*Salvia officinalis*
Mountain savory	*Saturejasubspicata*	Grass-leaved scabious	*Scabiosa graminifolia*
Elmleaf blackberry	*Rubus ulmifolius*	Prickly juniper	*Juniperus oxycedrus*
Mouse-ear hawkweed	*Hieraciumpilosella*	Mahaleb cherry	*Prunus mahaleb*
Prostrate canary clover	*Dorycniumherbaceum*	Old man's beard	*Clematis vitalba*
Black pine	*Pinus nigra*	Blackberry	*Rubus fruticosus*
Jacquin's speedwell	*Veronica jacquinii*	Broad-leaved spindle	*Euonymus latifolius*
Betony	*Stachys officinalis*	Rock thyme	*Acinosorontius*
Grey cinquefoil	*Potentilla incana*	Bastard agrimony	*Aremoniaagrimonoides*
Wild carrot	*Daucus carota*	Common ivy	*Hedera helix*
Green bristlegrass	*Setariaviridis*	Cocklebur	*Xanthium strumarium*
Common rock-rose	*Helianthamumnummularium*	Ground virginsbower	*Clematis recta*
Bloody cranesbill	*Geranium sanguineum*	Smoke tree	*Cotinus coggygria*
Stemless carline thistle	*Carlina acaulis*	Small burnet	*Sanguisorba minor*
Tansy daisy	*Tanacetum macrophyllum*	Tunic flower	*Petrorhagiasaxifraga*
Wild thyme	*Thymus serpyllum*	Common dandelion	*Taraxacum officinale*
Yarrow	*Achillea millefolium*	Wall germander	*Teucrium chamaedrys*
Canadian horseweed	*Conyza canadensis*	Mediterranean spurge	*Euphorbia wulfenii*
Pomegranate	*Punica granatum*	Black locust	*Robiniapseudoacacia*
Yellow bluestem	*Dichanthiumischaemum*	Rye brome	*Bromus secalinus*

Date	*Sample number*	*Location Grid ref*	Surveyed by NS
16/09/2020	19	N 43° 20’ 16” E 17° 49’ 20”	

Notes: Habitat types include constructed parts of cemeteries, residential buildings of urban periphery, very degraded garrigue and screes.			
Oriental hornbeam	*Carpinus orientalis*	Prickly juniper	*Juniperus oxycedrus*
Jerusalem thorn	*Paliurus spina-christi*	Pomegranate	*Punica granatum*
Burnt candytuft	*Aethionema saxatile*	Mediterranean cypress	*Cupressus sempervirens*
Hollyhock	*Alcea rosea*	Small toadflax	*Chaenorhinum minus*
Maidenhair spleenwort	*Asplenium trichomanes*	Scutch grass	*Cynodondactylon*
Rock thyme	*Acinosorontius*	Orchard grass	*Dactylis glomerata*
Yellow bluestem	*Dichanthiumischaemum*	Prostrate spurge	*Euphorbia prostrata*
Wormwood	*Artemisia absinthium*	Purple clematis	*Clematis viticella*
Hairy sedge	*Carexhirta*	Common fig	*Ficus carica*
Hairy rock-cress	*Arabis hirsuta*	Common wild oat	*Avenafatua*
Perennial ryegrass	*Lolium perenne*	Creeping woodsorrel	*Oxalis corniculata*
Barren brome	*Bromus sterilis*	Button medick	*Medicago orbicularis*
Hairy melic	*Melicaciliata*	Roadside pepperweed	*Lepidium ruderale*
Rush skeletonweed	*Chondrillajuncea*	Reflexed stonecrop	*Sedum rupestre*
Common rock-rose	*Helianthamumnummularium*	Bird's-foot trefoil	*Lotus corniculatus*
Green bristlegrass	*Setariaviridis*	Common dandelion	*Taraxacum officinale*
Tree of heaven	*Ailanthus altissima*	Redroot pigweed	*Amaranthus retroflexus*
Spreading pellitory	*Parietariajudaica*	Tunic flower	*Petrorhagiasaxifraga*
Hoary plantain	*Plantago media*	Flattened meadow-grass	*Poa compressa*
Spanish stonecrop	*Sedum hispanicum*	Three-awn goat grass	*Aegilops neglecta*
White clover	*Trifolium repens*	Common vervain	*Verbena officinalis*
Common mallow	*Malva sylvestris*		

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	20	N 43° 20' 04" E 17° 49' 27"	
Notes: Habitat types include garrigue and screes.			
Tunic flower	*Petrorhagiasaxifraga*	Yellow bluestem	*Dichanthiumischaemum*
Pomegranate	*Punica granatum*	Jerusalem thorn	*Paliurus spina-christi*
Felty germander	*Teucrium polium*	Hairy melic	*Melicaciliata*
Amethyst eryngo	*Eryngium amethystinum*	Tasteless stonecrop	*Sedum sexangulare*
Common sage	*Salvia officinalis*	Prickly juniper	*Juniperus oxycedrus*
European stonecrop	*Sedum ochroleucum*		

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	21	N 43° 19' 52" E 17° 49' 32"	
Notes: Habitat types include residential buildings of villages and urban peripheries, garrigue and screes.			
Jerusalem thorn	*Paliurus spina-christi*	Prickly juniper	*Juniperus oxycedrus*
Orchard grass	*Dactylis glomerata*	Common fig	*Ficus carica*
Pomegranate	*Punica granatum*	Black pine	*Pinus nigra*
Oriental hornbeam	*Carpinus orientalis*	Johnson grass	*Sorghum halepense*
Montpellier maple	*Acer monspessulanum*	Drooping brome	*Bromus tectorum*
Field rose	*Rosa arvensis*	Mahaleb cherry	*Prunus mahaleb*
Purple clematis	*Clematis viticella*	Tree of heaven	*Ailanthus altissima*
Spanish stonecrop	*Sedum hispanicum*	Green bristlegrass	*Setariaviridis*
European stonecrop	*sedum ochroleucum*	Felty germander	*Teucrium polium*
Common wild oat	*Avenafatua*	Dwarf morning glory	*Convolvulus cantabrica*
Mediterranean cypress	*Cupressus sempervirens*	Canadian horseweed	*Conyza canadensis*
Grape vine	*Vitis vinifera*	Manna ash	*Fraxinus ornus*
Scutch grass	*Cynodondactylon*	Peach (planted)	*Prunus persica*
Needle sunrose	*Fumana vulgaris*	Tunic flower	*Petrorhagiasaxifraga*
Wood sanicle	*Sanicula europaea*	Hardgrass	*Sclerochloa dura*
Yellow toadflax	*Linaria vulgaris*	Yellow toadflax	*Linaria vulgaris*
Hairy melic	*Melicaciliata*	Yellow bluestem	*Dichanthiumischaemum*
Three-awn goat grass	*Aegilops neglecta*	Common ragweed	*Ambrosia artemisiifolia*
Common knotgrass	*Polygonum aviculare*	Downy oak	*Quercus pubescens*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	22	N 43° 19' 45" E 17° 49' 29"	

Notes: Habitat types include residential buildings of villages and urban peripheries, garrigue and dry grasslands.

Scutch grass	*Cynodondactylon*	Yellow bluestem	*Dichanthiumischaemum*
Hedge bedstraw	*Galiummollugo*	Common fig	*Ficus carica*
Jerusalem thorn	*Paliurus spina-christi*	Old man's beard	*Clematis vitalba*
Carrot bur parsley	*Caucalisplatycarpos*	Love-in-a-mist	*Nigella damascena*
Hawkweed oxtongue	*Picris hieracioides*	Wild carrot	*Daucus carota*
Hairy melic	*Melicaciliata*	Montpellier maple	*Acer monspessulanum*
Redroot pigweed	*Amaranthus retroflexus*	Hoary cress	*Cardariadraba*
Velvetleaf	*Abutilon theophrasti*	Smooth bedstraw	*Cruciatalaevipes*
Bird's-foot trefoil	*Lotus corniculatus*	Mediterranean cypress	*Cupressus sempervirens*
Barren brome	*Bromus sterilis*	Bastard agrimony	*Aremoniaagrimonoides*
Common wild oat	*Avenafatua*	Roadside pepperweed	*Lepidium ruderale*
Orchard grass	*Dactylis glomerata*	European nettle tree	*Celtis australis*
Wormwood	*Artemisia absinthium*	Amethyst eryngo	*Eryngium amethystinum*
Fat hen	*Chenopodium album*	Spear saltbush	*Atriplex patula*
Rush skeletonweed	*Chondrillajuncea*	Indian goosegrass	*Eleusine indica*
Green bristlegrass	*Setariaviridis*	Black nightshade	*Solanum nigrum*
Common dogwood	*Cornussanguinea*	Hollyhock	*Alcea rosea*
Grey cinquefoil	*Potentilla incana*	Pomegranate	*Punica granatum*
Tree of heaven	*Ailanthus altissima*	Canadian horseweed	*Conyza canadensis*
Prickly juniper	*Juniperus oxycedrus*	Three-awn goat grass	*Aegilops neglecta*
Rabbitfoot clover	*Trifolium arvense*	Felty germander	*Teucrium polium*
Ribwort plantain	*Plantago lanceolata*	Blackberry	*Rubus fruticosus*
Field rose	*Rosa arvensis*	Reflexed stonecrop	*Sedum rupestre*
Common dandelion	*Taraxacum officinale*	Common vervain	*Verbena officinalis*
Small burnet	*Sanguisorba minor*	Common knotgrass	*Polygonum aviculare*
Grape vine	*Vitis vinifera*	Rough bristle-grass	*Setariaverticillata*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	23	N 43° 19' 28" E 17° 49' 53"	

Notes: Habitat types include garrigue and rural industrial and commercial sites still in active use, with ruderal vegetation.

Hollyhock	*Alcea rosea*	Manna ash	*Fraxinus ornus*
Rush skeletonweed	*Chondrillajuncea*	Oriental hornbeam	*Carpinus orientalis*
Mediterranean cypress	*Cupressus sempervirens*	Three-awn goat grass	*Aegilops neglecta*
Wormwood	*Artemisia absinthium*	Yellow bluestem	*Dichanthiumischaemum*
Wild carrot	*Daucus carota*	Common wild oat	*Avenafatua*
Tree of heaven	*Ailanthus altissima*	Canadian horseweed	*Conyza canadensis*
Carrot bur parsley	*Caucalisplatycarpos*	Redroot pigweed	*Amaranthus retroflexus*
Herb-Robert	*Geranium robertianum*	Common rock-rose	*Helianthamumnummularium*
Scutch grass	*Cynodondactylon*	Orchard grass	*Dactylis glomerata*
Creeping cinquefoil	*Potentilla reptans*	Pomegranate	*Punica granatum*
Common dandelion	*Taraxacum officinale*	Johnson grass	*Sorghum halepense*
Prostrate spurge	*Euphorbia prostrata*	Mosquito grass	*Dasypyrumvillosum*
Barren brome	*Bromus sterilis*	Fat hen	*Chenopodium album*
Roadside pepperweed	*Lepidium ruderale*	Prickly lettuce	*Lactucaserriola*
Hairy melic	*Melicaciliata*	Jerusalem thorn	*Paliurus spina-christi*
Reflexed stonecrop	*Sedum rupestre*	Green bristlegrass	*Setariaviridis*
Prickly juniper	*Juniperus oxycedrus*	Ribwort plantain	*Plantago lanceolata*
Flattened meadow-grass	*Poa compressa*	Perennial ryegrass	*Lolium perenne*
Tunic flower	*Petrorhagiasaxifraga*	Hawkweed oxtongue	*Picris hieracioides*
Sessile oak	*Quercus petraea*	Blackberry	*Rubus fruticosus*
Field rose	*Rosa arvensis*	Common knotgrass	*Polygonum aviculare*
Common vervain	*Verbena officinalis*	Rabbitfoot clover	*Trifolium arvense*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	24	N 43° 19' 13" E 17° 50' 09"	

Notes: Habitat types include residential buildings of urban peripheries, with ruderal and dry grassland vegetation developed along the roadsides.			
Canadian horseweed	*Conyza canadensis*	Barren brome	*Bromus sterilis*
Bird's-foot trefoil	*Lotus corniculatus*	Common fig	*Ficus carica*
Armenian plum (planted)	*Prunus armeniaca*	Carrot bur parsley	*Caucalisplatycarpos*
Dog rose	*Rosa canina*	Alfalfa	*Medicago sativa*
Common knotgrass	*Polygonum aviculare*	Creeping cinquefoil	*Potentilla reptans*
Grape vine	*Vitis vinifera*	Common mullein	*Verbascum thapsus*
Common vervain	*Verbena officinalis*	Green bristlegrass	*Setariaviridis*
Fat hen	*Chenopodium album*	Hardgrass	*Sclerochloa dura*
Felty germander	*Teucrium polium*	Hollyhock	*Alcea rosea*
Annual fleabane	*Erigeron annuus*	Buckler-mustard	*Biscutella laevigata*
Common bean (planted)	*Phaseolus vulgaris*	Jerusalem thorn	*Paliurus spina-christi*
Pomegranate	*Punica granatum*	Walnut	*Juglans regia*
Blackberry	*Rubus fruticosus*	Black poplar	*Populus nigra*
Hairy melic	*Melicaciliata*	Downy oak	*Quercus pubescens*
Compact brome	*Bromus madritensis*	Drooping brome	*Bromus tectorum*
European nettle tree	*Celtis australis*	Common purslane	*Portulaca oleracea*
Johnson grass	*Sorghum halepense*	Field needleleaf	*Polycnemumarvense*
Black locust	*Robiniapseudoacacia*	Mediterranean cypress	*Cupressus sempervirens*
Manna ash	*Fraxinus ornus*	Love-in-a-mist	*Nigella damascena*
Mountain savory	*Saturejasubspicata*	Prickly juniper	*Juniperus oxycedrus*
Tree of heaven	*Ailanthus altissima*	Spreading pellitory	*Parietariajudaica*
Common chicory	*Cichorium intybus*	Barnyard grass	*Echinochloa crus-galli*
Old man's beard	*Clematis vitalba*	Orchard grass	*Dactylis glomerata*
Peach (planted)	*Prunus persica*	Oriental hornbeam	*Carpinus orientalis*
Reflexed stonecrop	*Sedum rupestre*	Rat's-tail fescue	*Vulpiaciliata*
Paper mulberry	*Broussonetiapapyrifera*	Rush skeletonweed	*Chondrillajuncea*
Scutch grass	*Cynodondactylon*	Tomato (planted)	*Solanum lycopersicum*
Three-awn goat grass	*Aegilops neglecta*	Small burnet	*Sanguisorba minor*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	25	N 43° 17' 55" E 17° 50' 31"	

Notes: Habitat types include intensive vineyards and elements of dry grasslands with ruderal vegetation developed along the roadsides.			
Grape vine (planted)	*Vitis vinifera*	Orchard grass	*Dactylis glomerata*
Wild carrot	*Daucus carota*	Common knotgrass	*Polygonum aviculare*
Common dandelion	*Taraxacum officinale*	Scutch grass	*Cynodondactylon*
Tree of heaven	*Ailanthus altissima*	Johnson grass	*Sorghum halepense*
Amethyst eryngo	*Eryngium amethystinum*	Common wild oat	*Avenafatua*
Carrot bur parsley	*Caucalisplatycarpos*	Rush skeletonweed	*Chondrillajuncea*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	26	N 43° 17' 41" E 17° 50' 41"	

Notes: Habitat types include subnitrophilous annual grassland, garrigue and dry ruderal vegetation along the roadsides.			
Canary clover	*Dorycniumhirsutum*	Common mallow	*Malva sylvestris*
Creeping cinquefoil	*Potentilla reptans*	Jerusalem thorn	*Paliurus spina-christi*
Aleppo pine	*Pinus halepensis*	Pomegranate	*Punica granatum*
White laceflower	*Orlaya grandiflora*	Field eryngo	*Eryngium campestre*
Mediterranean cypress	*Cupressus sempervirens*	Tree of heaven	*Ailanthus altissima*
Yellow bristle-grass	*Setaria pumila*	Yarrow	*Achillea millefolium*
Common oat	*Avena sativa*	Wormwood	*Artemisia absinthium*
Orchard grass	*Dactylis glomerata*	Wild carrot	*Daucus carota*
Common chicory	*Cichorium intybus*	Compact brome	*Bromus madritensis*
Mosquito grass	*Dasypyrumvillosum*	Proliferous pink	*Petrorhagiaprolifera*
Love-in-a-mist	*Nigella damascena*	Prickly lettuce	*Lactucaserriola*
Dwarf morning glory	*Convolvulus cantabrica*	Three-awn goat grass	*Aegilops neglecta*
Roadside pepperweed	*Lepidium ruderale*	Felty germander	*Teucrium polium*

Tunic flower	*Petrorhagiasaxifraga*	Hardgrass	*Sclerochloa dura*
Oriental hornbeam	*Carpinus orientalis*	Barren brome	*Bromus sterilis*

Date	*Sample number*	*Location Grid ref*	*Surveyed by NS*
16/09/2020	27	N 43° 17' 46" E 17° 50' 19"	

Notes: Habitat types include extractive industrial sites (partially overgrown with ruderal vegetation), intensive vineyards and subnitrophilous annual grassland.

Grape vine (planted)	*Vitis vinifera*	Moth mullein	*Verbascum blattaria*
Wild carrot	*Daucus carota*	Jerusalem thorn	*Paliurus spina-christi*
Tree of heaven	*Ailanthus altissima*	Hollyhock	*Alcea rosea*
Compact brome	*Bromus madritensis*	Orchard grass	*Dactylis glomerata*
Rabbitfoot clover	*Trifolium arvense*	Johnson grass	*Sorghum halepense*
Scutch grass	*Cynodondactylon*	Ribwort plantain	*Plantago lanceolata*
Prickly lettuce	*Lactucaserriola*	Yellow bluestem	*Dichanthiumischaemum*
Dwarf morning glory	*Convolvulus cantabrica*	White laceflower	*Orlaya grandiflora*
Barren brome	*Bromus sterilis*	Common wild oat	*Avenafatua*
Rush skeletonweed	*Chondrillajuncea*	Musk thistle	*Carduus nutans*
Wormwood	*Artemisia absinthium*	Field eryngo	*Eryngium campestre*
Roadside pepperweed	*Lepidium ruderale*	Yellow bristle-grass	*Setaria pumila*
Common chicory	*Cichorium intybus*	Creeping cinquefoil	*Potentilla reptans*
Mosquito grass	*Dasypyrumvillosum*	Three-awn goat grass	*Aegilops neglecta*
Small burnet	*Sanguisorba minor*	Green bristlegrass	*Setariaviridis*
Purple clematis	*Clematis viticella*	White clover	*Trifolium repens*
Hairy melic	*Melicaciliata*	Star clover	*Trifolium stellatum*

CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

Environmental and Social Impact Assessment
Mostar North-Mostar South

ANNEX B: INVERTEBRATES

May 2021

Table of Contents

1 INTRODUCTION

1.1 Project background

During 2020 ENOVA was commissioned to undertake Environmental and Social Assessment relating to the Corridor Vc section Mostar North-Mostar South. The results of the previous gap analysis for biodiversity found that supplementary biodiversity information would be required, so that an informed assessment of sensitive habitats and biodiversity features could be undertaken. The supplementary information has been gathered through both field surveys and an up to date desk study. The following field surveys have been undertaken and will form an Annex to the final Environmental and Social Assessment study:

- Annex A: Habitats, vegetation and invasive species
- **Annex B: Invertebrates**[1]
- Annex C: Vertebrates
    - Annex C-1: Herpetofauna (amphibians and reptiles)
    - Annex C-2: Ornithofauna
    - Annex C-3: Mammals - bats
    - Annex C-4: Large mammals.

This report provides the results of the invertebrates field survey.

1.2 Site locations

The 14.2 km long section Mostar North-Mostar South begins 500 m before the Mostar North Interchange in the Kutilivac settlement, east of Vrapcici, and ends just before the Mostar South Interchange near the Mostar Airport. After the interchange, the alignment extends towards the settlement of Suhi Do, where the route is moved to the east ("up the hill"), in order to avoid houses.

After Suhi Do, the section enters the Tunnel Ostri Rat (L=3,380 m), turning towards the south and bypassing the City of Mostar. In the area east of Luke settlement, the alignment exits the tunnel and passes the slopes above the settlements and extends south towards the Buna valley. The section crosses the relatively uneven terrain between Ostri Rat and Gnojnice viaducts and tunnels. In Kocine settlement the alignment passes through a tunnel (L=2,600 m). After exiting this tunnel, the alignment descends towards the Mostar South Interchange.

The section ends at the Mostar South Interchange, which enables the connection between the motorway and main road M6.1 and it is located east of Mostar Airport. This location provides direct connection between the City of Mostar, the Airport and western Herzegovina via the planned southern bypass of the City to the motorway on Corridor Vc.

On this section the total length of the tunnels is 8,110 m, and the total length of the bridges is 940 m. The alignment passes mainly through hilly and mountainous terrain with significant spatial limitations, so along the section, cuts and embankments with a larger number of buildings alternate.

1.3 Report aim and objectives

The main aim of this assignment is to provide a written report to inform the ESIA Disclosure Package and Biodiversity Management Plan. In order to achieve this aim, this report has been written to satisfy the following objectives:

- Provide the methodology and results of the field survey
- Evaluate project area and project area of influence for the likely presence of sensitive species/species of conservation concern

[1] Only of conservation concern

- Recommend preconstruction surveys, additional mitigation and/or monitoring only if required.

2 METHODOLOGY

2.1 Survey background

The purpose of this survey was to determine the presence and the distribution of invertebrate species of conservation concern which are recorded in the project area or have the potential to occur within the project impact area due to the habitat type, in order to determine the potential effects of the project activities on key habitats and species.

The field survey for invertebrates (Invertebrata) was conducted by Dejan Kulijer, graduated biologist, Curator of Entomology, Head of the Natural History Department of National Museum of Bosnia and Herzegovina.

This survey included several groups of invertebrates, mainly insects, focusing on species of national (Federation BiH), or international conservation concern (Habitats Directive, IUCN Red lists). The field study of the project footprint area from the Mostar North interchange to Mostar South interchange, as well as project area of influence was carried out during four field visits: 1) 1-2 September 2020, 2) 13-14 September 2020, 3) 21-22 September 2020, 4) 5-6 October 2020, covering morning, mid-day and evening hours. The weather was mostly sunny and favourable for field research with temperatures between 16 ^{o} and 32^{o}C.

2.2 Methodology

Prior to undertaking the field surveys, relevant literature (e.g. previous and ongoing assessments, papers and reports) has been reviewed with regard to the presence of Invertebrate species of conservation concern in the project area, as well as the ecological conditions of the project area and area of influence in order to determine the most appropriate survey locations.

The survey was conducted at eight survey locations along the motorway section (Table 1 and Figure 1). At each location a 500-1.500 m long transect was undertaken. For some species, the material was sampled for identification in the laboratory. Due the fact some parts of the terrain were inaccessible, thorough research of the whole area could not be undertaken. Desk research was undertaken to fill the information gaps and supplement and/or verify the data collected through the field surveys. Consultations with local experts and expert organizations have also been undertaken where appropriate.

With regard to field research, standard techniques were used, specific for different invertebrate groups and at the possible level, considering the period of the year. Field work methodology included:

- observations and active searching at selected points or along transects in selected habitats as well as
- active searching and observations in microhabitats of specific species at selected survey locations.

Table 1: List of survey locations with coordinates and habitat information

No.	*Coordinates*		*Location name*	*Habitat type*
1.	43.39199	17.90376	L1_Interchange_north	Residential buildings of villages and urban peripheries with hedgerow, maquis shrubland
2.	43.38049	17.90183	L1_scree	Oak forests with macchia, scree, maquis shrubland
3.	43.38068	17.88747	L2_tunnel_T1	Oak stump forests
4.	43.37437	17.86261	L3_viaducts	rocky meadows and screes
5.	43.36307	17.85117	L4_viaduct _M2	Cliffs and forests of pine and oak
6.	43.35193	17.82615	L5_tunnel_T4	Thermophilic meadows and garrigue
7.	43.32564	17.82996	L6_viaduct _M6	Maquis shrubland
8.	43.31651	17.84213	L7_tunnel _T6	Maquis shrubland

For the identification of nationally protected/threatened species in the study area, the Red List of Protected Wild Species and Subspecies of Plants, Fungi, and Animals in the Federation of BiH (O.G. of FBiH, No. 7/14) was used (Crvena lista divljih vrsta i podvrsta biljaka, zivotinja i gljiva – Sluzbene novine FBiH, br. 7/14).

The list of the species of international conservation concern given within this report is based on the following documents:

- Annexes II and IV of the Habitats Directive – Council of the European Union. (2013). Council Directive 2013/17/EU of 13 May 2013 adapting certain directives in the field of environment, by reason of the accession of the Republic of Croatia. Official Journal of the European Union L158: 193–229.
- The IUCN Red List of Threatened Species http://www.iucnredlist.org/
- European Red List of Saproxylic Beetles – Nieto, A. and Alexander, K.N.A. 2010. European Red List of Saproxylic Beetles. Luxembourg: Publications Office of the European Union.
- European Red List of Butterfies – Van Swaay, C., Cuttelod, A., Collins, S., Maes, D., López Munguira, M., Sasic, M., Settele, J., Verovnik, R., Verstrael, T., Warren, M., Wiemers, M. and Wynhof, I. 2010. European Red List of Butterflies Luxembourg: Publications Office of the European Union.
- European Red List of Dragonflies – V.J. Kalkman, J.-P. Boudot, R. Bernard, K.-J. Conze, G. De Knijf, E. Dyatlova, S. Ferreira, M. Jovic, J. Ott, E. Riservato and G. Sahlén. 2010. European Red List of Dragonflies. Luxembourg: Publications Office of the European Union.
- The Status and Distribution of Dragonflies of the Mediterranean Basin – Riservato, E. et al. (2009). The Status and Distribution of Dragonflies of the Mediterranean Basin. Gland, Switzerland and Malaga, Spain: IUCN. vii + 33 pp.

2.3 Assumptions and limitations

The field survey assumptions and limitations were the following:

- Although the field survey results provided a good representation of the habitat richness of the area, these surveys may be considered as preliminary findings that will serve as the baseline data for further studies of the area. All groups need different methodologies for field research, as well as designated survey time throughout the year during all seasons. Many threatened species are seasonal and can be found during specific periods of the year. Therefore, additional surveys have been suggested for Invertebrates during preconstruction phase. The conducted survey enabled data collecting mainly for the species that are active during late summer/early autumn.
- Desktop survey was used to provide basic information on the biodiversity and presence/abundance of the species of conservation concern in the assessment area. The area is largely un-investigated in terms of invertebrate distribution and available data are scarce or missing for some groups. Consultations with other experts confirmed that the existing data on the invertebrate biodiversity of the area is insufficient.

2.4 Project area of influence

The project area of influence corresponds to a preliminary determined buffer of 500 m on each side of the motorway and is considered as sufficient for invertebrate fauna.

3 RESULTS

This section summarizes the results of desk and field survey for invertebrate species of conservation concern and identifies the key potential sensitive species and their habitats. The evaluation is based on the field survey of threatened species/habitats of the species of invertebrates at the selected localities.

A summary of the survey results is shown in Table 2 below, whereas data on species of conservation concern from previous studies are critically assessed as well.

The following abbreviations have been used:

IUCN – International Union for Conservation of Nature

FBiH RL –Federation of Bosnia and Herzegovina Red List

- CR – Critically Endangered
- EN – Endangered
- VU – Vulnerable
- NT – Near Threatened
- LC – Least Concern
- DD – Data Deficient

HD – European Habitats Directive

- II – Annex II
- IV – Annex IV.

Table 2: Field survey results

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Survey Area?*	*Survey Finding – was species Found?*	*Location (where?)*	*Map reference*
Southern festoon	*Zerynthia polyxena*	FBiH NT, HD IV	Yes	Not found during the survey, found earlier by the author in the wider area. Host plants found at L1 and L4		Annexes, Figure 1., L 1 and L 4
Jersey tiger	*Euplagia quadripunctaria*	HD II (*)	Yes	Yes, found at one location, likely to be present along the whole route. Common and abundant species in the country.	Shrubland at L4	Annexes, Figure 1., L 4
European stag beetle	*Lucanus cervus*	IUCN NT, FBiH VU, HD II	Yes	Yes, at one location (further research needed during spring and early summer particularly at L1 locations)	Degraded oak woodland at L1_tocilo (scree)	Annexes, Figure 1., L. 1_tocilo
Cerambyx Longicorn	*Cerambyx cerdo*	IUCN VU, HD II, IV	Yes	Not found during the survey (further research needed during spring and early summer, particularly at L1 locations)		
Tree grayling	*Hipparchia statilinus*	FBiH VU	Yes	Yes, found at L1, L2 and L8.	Maquis, garrigue and rocky grasslands at L 1, L 2 and L 8.	Annexes, Figure 1.

4 DISCUSSION AND RECOMMENDATIONS

4.1 Summary of main findings

In total, the data on the presence of five species of national and/or international conservation concern in the project area were gathered during desk survey, three of which was found during the field survey (*Lucanus cervus, Euplagia quadripunctaria* and *Hipparchia statilinus*). In addition, suitable habitats for 2 other species (*Cerambyx cerdo* and *Zerynthia polyxena*) that have some level of national and/or international protection were also found. This number is probably higher, but the survey needs to include additional seasons, spring and early summer, to confirm this.

Among the species found, *Lucanus cervus* and *Euplagia quadripunctaria* are the species of the Annex II of the Habitats Directive. The loss, devastation and reduction of habitat caused by the removal of natural vegetation and the excavation of alignment, cuts and tunnels, and the disposal of excess excavated material in the area of the planned motorway route is considered to be as potential impact on the invertebrate fauna of the area.

4.1.1 Sensitive species

Valuable habitats with regard to invertebrates include woodlands and single veteran trees, the habitat mainly present at L1 and its vicinity. These habitats are particularly important for saproxylic species, e.g. saproxylic beetles *Lucanus cervus* or *Cerambyx cerdo* that inhabit the wider area. The presence of *L. cervus* was also confirmed during this survey at L1.

4.2 Mitigation measures

4.2.1 Preconstruction phase

Before the commencement of construction activities, parking lots and manoeuvring of machinery and fuel depots should be selected in a way to avoid destruction of most valuable habitats in terms of (areas with well-developed tree vegetation).

Additional field research should be undertaken during spring and early summer in order to investigate presence of other species of conservation concern, particularly in the northern part of project area (L1 to L4).

4.2.2 Construction phase

Restrict the movement of construction machinery, mechanization and means of transport exclusively in the construction area for the purpose of maximal habitat protection without any additional disturbance of habitats. Avoid unnecessary cutting of older trees and removal of dead wood, particularly oak, from habitats as they are important for saproxylics species, including saproxylic Natura 2000 beetles: *Lucanus cervus* or *Cerambyx cerdo* that occur in the area.

Provide bio-speleological monitoring during the excavations. In case of encountering underground structures, it is obligatory to suspend the works until the bio-speleologist determines the present state of the site and defines the value, and the necessary measures for the protection of underground fauna.

4.2.3 Operation phase

Avoid the use of dissolving salts and other chemicals as much as possible and their discharge into the natural habitats.

Revitalization of habitats after the construction with planting of autochthonous plant species characteristic for the area (e.g. oak trees on slopes) and prevents growing and spread of invasive species.

4.3 Monitoring measures

4.3.1 Preconstruction phase

Additional studies are needed to be undertaken at least once prior to work commencement (preferably in period May to end of June) in order to determine populations of identified species of conservation concern or their habitats. The work should be focused particularly to the northern part of project area (L1 to L4).

4.3.2 Construction phase

Conduct continuous bio-speleological supervision during excavations along the route.

Conduct seasonal (i.e. spring, early summer) monitoring of threatened species habitats (particularly Natura 2000 species) in order to determine possible negative effect to their populations.

4.3.3 Operation phase

Twice a year for the first three years, undertake survey of threatened species (particularly Natura 2000 species) with regard to the area of influence of the motorway.

4.3.4 Conclusions

The following general conclusions are:

- The motorway is not located within formally protected area and does not affect any protected area.
- The data on the biodiversity of the area, particularly invertebrate biodiversity, are scarce and for most groups/area nonexistent. Five species of conservation concern are found to inhabit the project impact area, out of which three are Natura 2000 species: *Lucanus cervus, Euplagia quadripunctaria* and *Cerambyx cerdo*. This number would probably be higher if the survey included all seasons of the year.
- The habitats in the project area are mainly represented by secondary ad tertiary habitats that are degraded and under strong anthropogenic influence. The recorded species of conservation concern are common and widespread in the country and none of them has important populations in the area that will be significantly affected with the project, but further research in other seasons is recommended in order to investigate potential presence of other species of conservation concern and propose additional mitigation if found in revised Biodiversity Management Plan.
- Underground habitats are not known in the area therefore bio-speleological monitoring during the excavations is needed.
- Mitigation measures for recorded species include avoiding of unnecessary cutting of older trees and removal of dead wood, particularly oak, from habitats as they are important for saproxylics species, and to avoid any additional destruction of woodlands and other well-developed tree vegetation (e.g. to only use the area of the project footprint without additional disturbance of other areas and to avoid access roads in such areas).
- After the construction it is important that in the revitalisation of habitats autochthonous species of trees are used, particularly oak.
- Monitoring measures are recommended during different seasons (spring, early summer) in the construction phase and first three years of the operational phase in order to investigate the impact on populations of threatened species, particularly Natura 2000 species and to determine if other species of conservation concern are present in the area.

5 ANNEXES

5.1 Maps

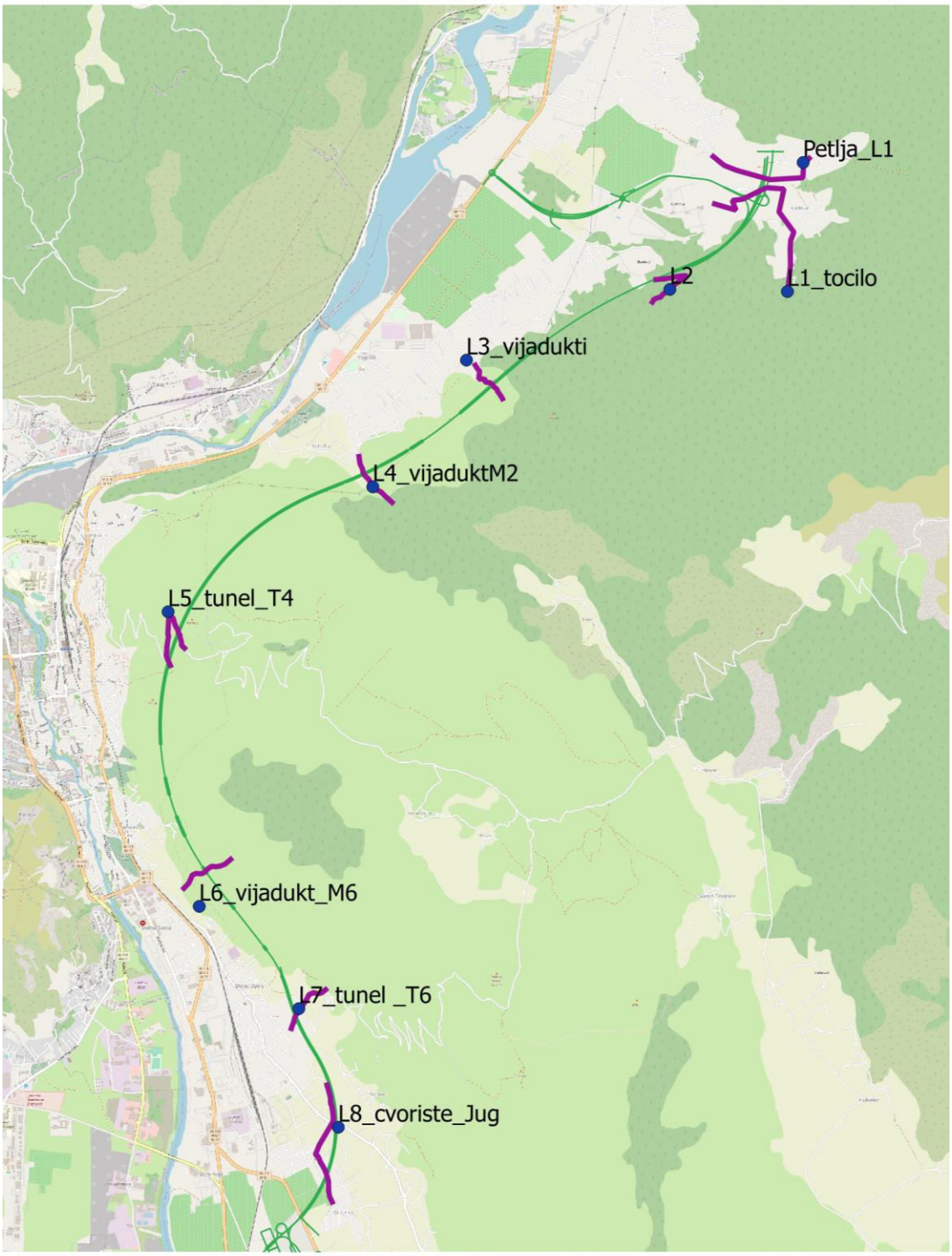

Figure 1: Distribution of survey locations along the motorway route

5.2 Photographs

Figure 2: Hipparchia statilinus, found at L 1 transect

Figure 3: Euplagia quadripunctaria, found at L 4 transect

Figure 4: L 4 location, Suhi Do

Figure 5: Degraded oak forest and shrubland at L 2

CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

Environmental and Social Impact Assessment
Mostar North-Mostar South

ANNEX C-2: HERPETOFAUNA (AMPHIBIANS AND REPTILES)

May 2021

Table of Contents

1 INTRODUCTION

1.1 Project background

During 2020 ENOVA was commissioned to undertake Environmental and Social Assessment relating to the Corridor Vc section Mostar North-Mostar South. The results of the previous gap analysis for biodiversity found that supplementary biodiversity information would be required, so that an informed assessment of sensitive habitats and biodiversity features could be undertaken. The supplementary information has been gathered through both field surveys and an up to date desk study. The following field surveys have been undertaken and will form an Annex to the final Environmental and Social Assessment study:

- Annex A: Habitats, vegetation and invasive species
- Annex B: Invertebrates[1]
- Annex C: Vertebrates
    - **Annex C-1: Herpetofauna (amphibians and reptiles)**
    - Annex C-2: Ornithofauna
    - Annex C-3: Mammals - bats
    - Annex C-4: Large mammals.

This report provides the results of the herpetofauna (amphibians and reptiles) field survey.

1.2 Site locations

The 14.2 km long section Mostar North-Mostar South begins 500 m before the Mostar North Interchange in the Kutilivac settlement, east of Vrapcici, and ends just before the Mostar South Interchange near the Mostar Airport. After the interchange, the alignment extends towards the settlement of Suhi Do, where the route is moved to the east ("up the hill"), in order to avoid houses.

After Suhi Do, the section enters the Tunnel Ostri Rat (L=3,380 m), turning towards the south and bypassing the City of Mostar. In the area east of Luke settlement, the alignment exits the tunnel and passes the slopes above the settlements and extends south towards the Buna valley. The section crosses the relatively uneven terrain between Ostri Rat and Gnojnice viaducts and tunnels. In Kocine settlement the alignment passes through a tunnel (L=2,600 m). After exiting this tunnel, the alignment descends towards the Mostar South Interchange.

The section ends at the Mostar South Interchange, which enables the connection between the motorway and main road M6.1 and it is located east of Mostar Airport. This location provides direct connection between the City of Mostar, the Airport and western Herzegovina via the planned southern bypass of the City to the motorway on Corridor Vc.

On this section the total length of the tunnels is 8,110 m, and the total length of the bridges is 940 m. The alignment passes mainly through hilly and mountainous terrain with significant spatial limitations, so along the section, cuts and embankments with a larger number of buildings alternate.

1.3 Report aim and objectives

The main aim of this assignment is to provide a written report to inform the ESIA Disclosure Package and Biodiversity Management Plan. In order to achieve this aim, this report has been written to satisfy the following objectives:

- Provide the methodology and results of the field survey
- Evaluate project area and project area of influence for the likely presence of sensitive species/species of conservation concern

1 Only of conservation concern

- Recommend preconstruction surveys, additional mitigation and/or monitoring only if required.

2 METHODOLOGY

2.1 Survey background

The survey of amphibians and reptiles was undertaken by Doc. dr. Adi Vesnic, who has more than 10 years of experience as an ecologist, environmental biologist and independent expert for biodiversity surveys for designation of new protected areas as well as for environmental impact assessments. He is an experienced researcher in the field of zoology, systematic (taxonomy) and ecology.

A field survey of the area from the Mostar North interchange to Mostar South interchange has been undertaken during four field visits: 1) 1-2 September 2020, 2) 13-14 September 2020, 3) 21-22 September 2020, 4) 5-6 October 2020. The survey has been carried out in optimal weather (daily temperatures 16-32^{o}C).

2.2 Methodology

Field work was based on the methodology of active data collecting, presence of species and the frequency of amphibians and reptiles was recorded within EAAA and AOI. The survey was conducted at eight points along the section of the corridor route Vc (Figure 1). At each sampling point, a 500-1.500 meter transect perpendicular to the corridor line was made and representatives of amphibian and reptile fauna were actively searched in transect 2.5 meters wide on each side. The coordinates, location name, general observations (e.g. habitat type or state) are in Table 1.

Table 1: The coordinates, location name, general observations regarding sampling points along the Vc corridor

Coordinates		*Sampling point name*	*General observations regarding sampling points*
Lon.	Lat.		
17.90376	43.39199	L1_petlja (interchange)	Residential buildings of villages and urban peripheries with hedgerow
17.90183	43.38049	L1_tocilo (scree)	Oak forests with macchia
17.88747	43.38068	L2_tunel_T1 (tunnel t1)	Oak stump forests
17.86261	43.37437	L3_vijadukti (viaducts)	Sipar
17.85117	43.36307	L4_vijaduktM2 (viaduct M2)	Cliffs and forests of pine and oak
17.82615	43.35193	L5_tunel_T4 (tunnel T4)	Thermophilic meadows and garrigue
17.82996	43.32564	L6_vijadukt_M6 (viaduct M6)	Macchia
17.84213	43.31651	L7_tunel _T6 (tunnel M6)	Macchia
17.84695	43.30592	L8_cvoriste_Jug (interchange south)	Residential buildings of villages and urban peripheries

For identification of species, the following publication was used:

- Field Guide to the Amphibians, Reptiles of Britain and Europe was used for sample ID and general biological data and idioecology of species (*Speybroeck, J., Beukema, W., Bok, B., & Van Der Voort, J. (2016). Field guide to the amphibians and reptiles of Britain and Europe. Bloomsbury publishing*).

2.3 Assumptions and limitations

Field research was optimal for the analysis of the amphibians and reptile species richness. The survey was carried out under covering the amplitude of temperature and humidity variations in summer months and beginning of autumn, which enabled the larger number of individuals and species to be found on site since amphibians and reptiles are *poikilothermic* species. In order to increase the probability of finding amphibians and reptiles, the period of maximum daily insolation and temperature was avoided. Field research was conducted during the morning hours and at night. During the research period, the starting points of transects were adjusted to the conditions in the field due to fenced private properties along the route.

2.4 Project area of influence

With regard to the project area of influence on amphibians and reptiles, a buffer of 500 meters measured on each side of the road route is considered appropriate. In areas where rocky garrigue and agricultural areas are found, the project area of influence is considered to be 100 meters.

3 RESULTS

A summary of the survey results and results from the previous studies are shown below in Table 2 and Table 3 in tabular format. The locations of species sightings are shown in Chapter Maps, Annex A. The following abbreviations have been used in Table 2 and Table 3:

IUCN – International Union for Conservation of Nature

FBiH RL – Federation of Bosnia and Herzegovina Red List

- CR – Critically Endangered
- VU – Vulnerable
- NT – Near Threatened
- LC – Least Concern

HD – European Habitats Directive

- II – Annex II
- IV – Annex IV.

BC – Bern Convention

- II – Annex II
- III – Annex III.

Table 2: Field survey results for amphibians

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Survey Area?*	*Survey Finding – was species found?*	*Location (where?)*	*Map reference*
Marsh Frog	*Pelophylax ridibundus*	IUCN LC, FBiH LC, HD-V	No	No	-	Environmental Impact Study for Corridor Vc Motorway Mostar North-South Border LOT 4 (IGH Jsc., 2007)
Common Toad	*Bufo bufo*	IUCN LC, FBiH LC	No	No	-	Same as above
Yellow-bellied Toad	*Bombina variegata*	IUCN LC, FBiH NT, HD-II, IV	Yes	No	-	Same as above
Green Toad	*Bufo viridis*	IUCN LC, FBiH LC, HD-IV	Yes	No	-	Same as above
Common Tree Frog	*Hyla arborea*	HD-IV	Yes	No	-	Same as above
Agile Frog	*Rana dalmatina*	IUCN LC, FBiH LC, HD IV	Yes	No	-	Same as above
Greek Stream Frog	*Rana graeca*	IUCN LC, FBiH NT, HD-IV	No	No	-	Same as above
Fire Salamander	*Salamandra salamandra*	FBiH LC	No	No	-	Same as above

Table 3: Field survey results for reptiles

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Survey Area?*	*Survey Finding – was species found?*	*Location (where?)*	*Map reference*
The Hermann's Tortoise	*Testudo hermanni*	IUCN NT, FBiH VU HD-II, IV	Yes	Found on seven transects during the survey.	Kutilivac, Gnojnice	Map 1, transects: L1, L2 and L8
Glass Lizard	*Pseudopus apodus*	IUCN LC, FBiH LC HD-IV	Yes	Found on four transects during the survey.	Kutilivac, Gnojnice	Map 1, transects: L1 and L8
Balkan Green Lizard	*Lacerta trilineata*	IUCN LC, FBiH LC, HD-IV	Yes	Found on three transects during the survey.	Dronjevac, Grablja-Hadzica do	Map 1, transects: L5 and L7
Dalmatian Wall Lizard	*Podarcis melisellensis*	IUCN LC, FBiH-LC, HD-IV	Yes	Found on three transects during the survey.	Kutilivac, Dronjevac, Grablja-Hadzica do	Map 1, transects: L1, L5 and L7
Balkan Whip Snake	*Hierophis gemonensis*	IUCN LC, FBiH LC	Yes	Found on one transect during the survey.	Suhi do	Map 1, transect: L4
Sharp-snouted Rock Lizard	*Dalmatolacerta oxycephala*	IUCN LC, FBiH NT, HD-IV	Yes	Found on one transect during the survey.	Suhi do	Map 1, transect: L4
Nose-horned Whiper	*Vipera ammodytes*	IUCN LC, FBiH LC, HD-II, IV	Yes	Found on one transect during the survey.	Suhi do	Map 1, transect: L4
Eastern Montpellier Snake	*Malpolon insignitus*	IUCN LC, FBiH LC	Yes	No	-	Environmental Impact Study for Corridor Vc Motorway Mostar North-South Border LOT 4 (IGH Jsc., 2007)
Dalmatian Algyroides	*Algyroides nigropunctatus*	IUCN LC, FBiH NT, HD-IV	Yes	No	-	Same as above
Eastern Green Lizard	*Lacerta viridis*	IUCN LC, FBiH LC, HD-IV	Yes	No	-	Same as above
Common Wall Lizard	*Podarcis muralis*	IUCN LC, FBiH LC, BC II, HD IV	Yes	No	-	Same as above
Dahls Whip Snake	*Platyceps najadum*	FBiH-LC, HD-IV	Yes	No	-	Same as above
Dice Snake	*Natrix tessellata*	IUCN LC, FBiH LC, HD-IV	No, mainly near rivers and lakes	No	-	Same as above

4 DISCUSSION AND RECOMMENDATIONS

4.1 Summary of main findings

During the field research, and according to the literature data, **no critically endangered or endangered species** of amphibians and reptiles were recorded. The mitigation measures have been proposed for species listed in the Annexes of the Habitats Directive, which are previously mentioned in Table 2 and Table 3.

The habitats within the project are ecotone between rural areas and wild habitats represented by machia and thermophile rocky meadows. The habitats important for reptiles and amphibians within the project cannot be considered as IUCN Red List EN or CR habitats nor is EAAA listed in the Annex 1 of EU marked as "priority habitat type" due to high level of degradation and high anthropogenic pressure. The species present in the area of the motorway are listed in EU Habitats Directive. Species such as The Hermann's Tortoise, Sharp-snouted Rock Lizard, Balkan Whip Snake are range restricted to Balkan Peninsula or Dinaric Alps. EAAA for all present species within the Project supports less than 0.5% of global population, however for many species the population size for total distribution is not estimated. Based on the presence of strictly protected species listed on Annexes II and IV of Habitat Directive we can conclude that these represent the Priority Biodiversity Features. Also it must be stated that local populations of reptiles in the project area and EAAA for the species should not be considered as habitats of significant importance for the persistence of listed species in Table 2 and Table 3 at the national level.

4.1.1 Sensitive species

The species of amphibians and reptiles identified in the field and mentioned in literature for the territory of Bosnia and Herzegovina are not on the European IUCN red list of critically endangered, endangered and vulnerable species for the EU.

During the field survey conducted as part of this assignment, six strictly protected species of reptiles from the Habitat Directive listed in Annex IV were recorded on the Project site. In addition to these findings, sixteen species of amphibians and reptiles that are listed in Annexes II-IV of the Habitat Directive have been recorded in previous studies, as given in Table 2 and Table 3.

4.2 Mitigation measures

During the field survey, the presence of amphibians could not be confirmed at the project site, nor permanent aquatic habitats within the area of influence.

Regarding the reptiles, the field observation confirmed that the area of the planned motorway includes rocky habitats with vegetation of garrigue that are suitable for the following reptiles: viper (*Vipera amodytes*), Balkan Whip Snake (*Hierophis gemonensis*) and lizards, of which the sharp-headed lizard (*Dalmatolacerta oxycephala*), the Dalmatian wall lizard (*Podarcis melisellensis*) are endemic to the Western Balkans, as well as the Hermanns Tortoise (*Testudo hermanii*).

The presence of *Platyceps najadum, Algyroides nigropunctatu*s and other reptile species, species listed in Table 3, along the motorway route is expected, but so far these species have not been found through field survey conducted as part of this Project. The habitats of the aforementioned reptile species are widely represented along the investigated route. The mentioned species are not steno-endemic, so that the eventual loss of individuals is compensable by the subsequent colonization.

All species of reptiles found in the field survey or identified in previous studies are fast moving organisms (able to run away from danger), except The Hermann's Tortoise which is the common species in the wider area of the planned project.

4.2.1 Preconstruction phase

During the field surveys undertaken as part of this project, occasional watercourses were completely dry therefore the presence of amphibians could not be determined on site. Additional field research shall be undertaken in the area of Kutilivac, Kuti and Brasinski potok during early spring season in order to confirm the presence of amphibians.

4.2.2 Construction phase

During the construction phase, reptile species could be at risk of fatalities and injuries. Since a high frequency of individuals of the Hermann's Tortoise (*Testudo hermanni)* species has been determined in the area of the motorway route, it is necessary to implement several mitigation measures in order to reduce the possibility of tortoises being run over during construction phase.

The species occupies a wide variety of typical Mediterranean biotopes up to an altitude of 1.800 meters on dry and semi-humid habitats. The Hermann's Tortoise was detected on three points, where one to three individuals were found per location.

Daily inspection of the Hermann's Tortoise - *Testudo hermanni* individuals needs to be undertaken by a suitable biologist employed by the contractor, and if species found, safely removed away from site into the nearby habitat of same type. During the construction period, the construction site will be managed so that they do not provide suitable habitat for reptiles (e.g. shelter and hibernation). Measures refer to avoiding the stockpiling of waste when reptile presence is expected (temperatures are above 7^{o}C and when reptiles are not in hibernation/aestivation) and adequate waste management as suggested in WMP and CWMP.

4.2.3 Operation phase

The fence along the motorway should be constructed properly during construction phase (1 m-high wire fence which in the lower parts (at least 50 cm from the ground) has a diameter of 2cm or less), to ensure there would be no injuries of trespassing of these species during construction phase. The use of a dense net in the lower part of the fence will prevent the passage of reptiles to the motorway route. The fence should be connected to the ground, thus preventing crawling of individuals under the fence.

The fence of the motorway should be maintained and regularly repaired.

4.3 Monitoring measures

4.3.1 Preconstruction phase

Due to the presence of species listed in Annex II and IV of Habitat Directive (Table *2*) that have been found at the area of Kutijevo, Suhi do and Gnojnice, it is important to avoid additional habitat destruction except the area designated for construction of the motorway e. g. to avoid construction of auxiliary or access roads or formation of disposal sites. It is especially important to preserve the grinders along the route and to prevent them being buried by filling with material.

4.3.2 Construction phase

The most significant negative impact of construction on reptiles is habitat fragmentation, deaths caused by cars and movement of machines during the construction phase. Therefore, the installation of a fence with a narrow diameter of the eyelets and the installation of passages for small animals during both construction and operation phase is needed, as said above in Chapter 4.2.

The presence of the Hermann's Tortoise (*Testudo hermanni*) indicates the need for mitigation measures to be implemented during the construction of the motorway section as aforementioned.

Every morning, workers engaged on the site must do route monitoring and eventually remove individuals of Hermann's Tortoise (*Testudo hermanni*) from the route under construction. The period of vegetation clearance and excavation and earth works must be undertaken after daily supervision and removal of individuals outside from the route. Monitoring

should be undertaken by the biologists employed in the Contractor's team. The data on species should be analysed on a monthly basis and mitigation measures applied accordingly.

Compared to Hermann's Tortoise, other species of reptiles are fast moving and move away from construction sites upon the vibrations of heavy machinery.

4.3.3 Operation phase

It is necessary to inspect the route and remove any individuals of the Hermann's Tortoise (*Testudo hermanni*) out of the motorway area after the fencing of the motorway is completed and prior to commencement of operation phase.

Monitoring of access roads and the motorway must be conducted six months after construction, to determine any amphibian and reptile deaths by run over. These activities shall be conducted by the skilled biologist/herpetologist. In case the number of run over individuals is high and frequent, it is necessary to remove the individuals and set the live traps in order to move the individuals out of the project area of influence to another suitable habitat in a safe and acceptable manner.

5 ANNEXES

5.1 Maps

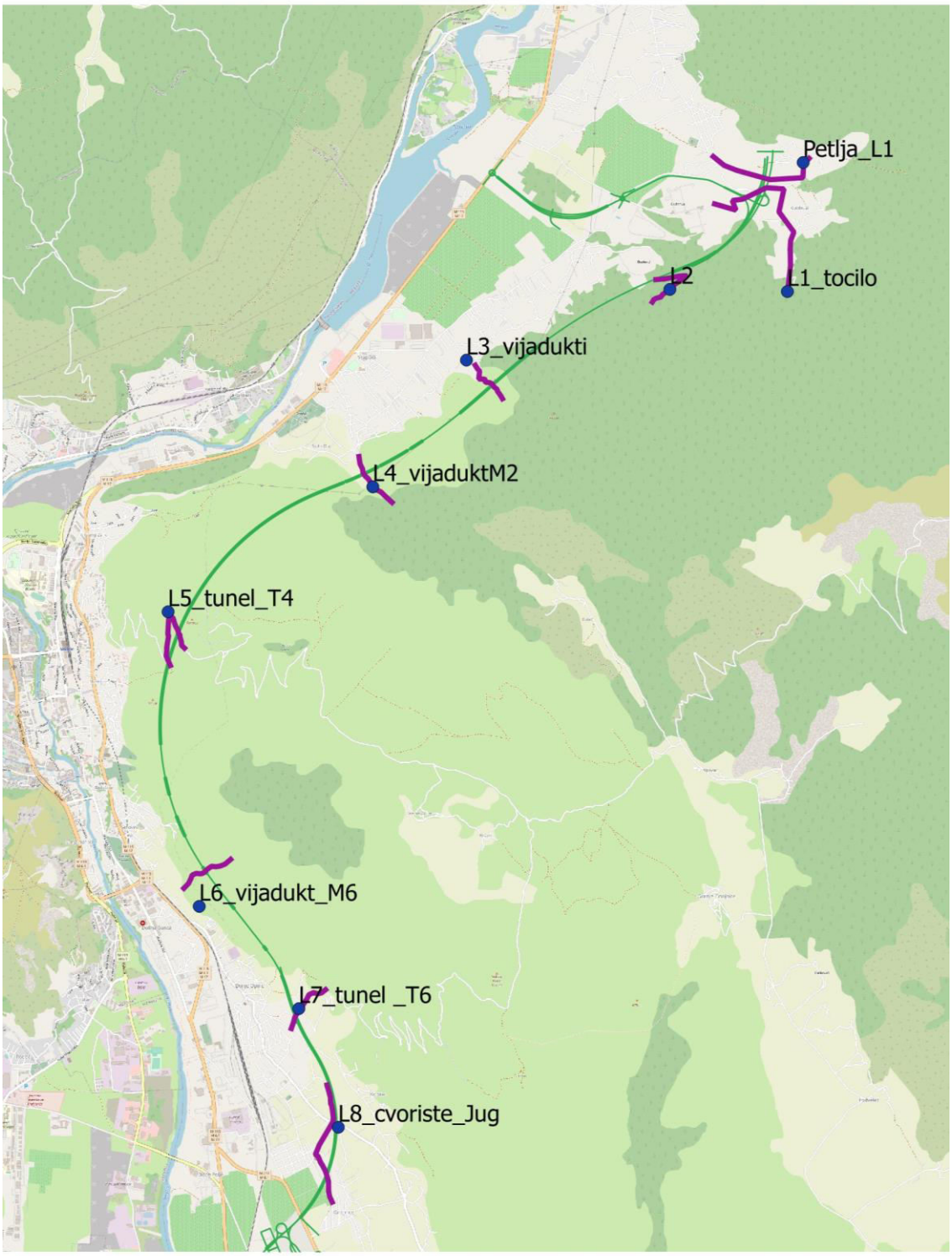

Figure 1: Distribution of the transect points along the motorway route

5.2 Photographs of habitats

Figure 2: L1_petlja Residential buildings of villages and urban peripheries with hedgerow

Figure 3: L1_petlja Residential buildings of villages and urban peripheries with hedgerow

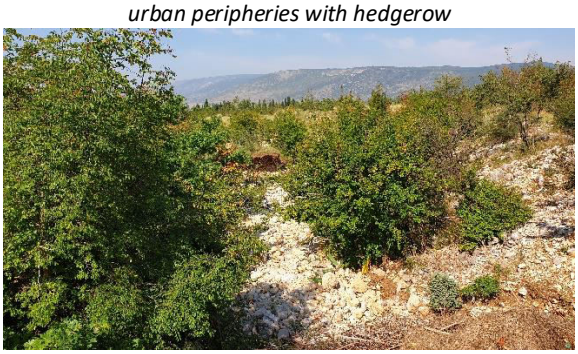

Figure 4: L1_tocilo Oak forests and macchia

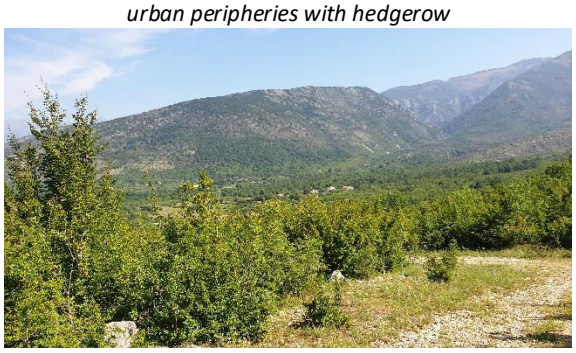

Figure 5: L1_tocilo Oak forests and macchia

Figure 6: L2_tunel_T1 Oak stump forests

Figure 7: L2_tunel_T1 Oak stump forests

Figure 8: L3_vijadukti Sipar

Figure 9: L3_vijadukti Sipar

Figure 10: L4_vijaduktM2 Cliffs and forests of pine and oak

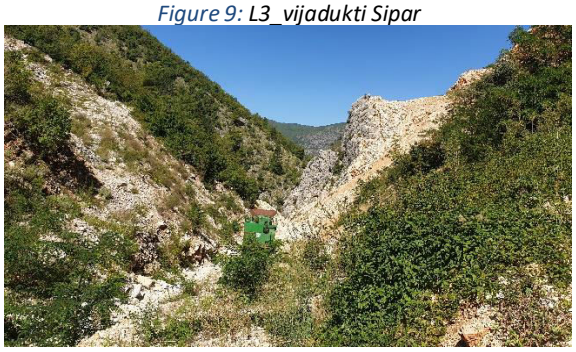

Figure 11: L4_vijaduktM2 Cliffs and forests of pine and oak

Figure 12: L5_tunel_T4 Thermophilic meadows

Figure 13: L5_tunel_T4 Thermophilic meadows

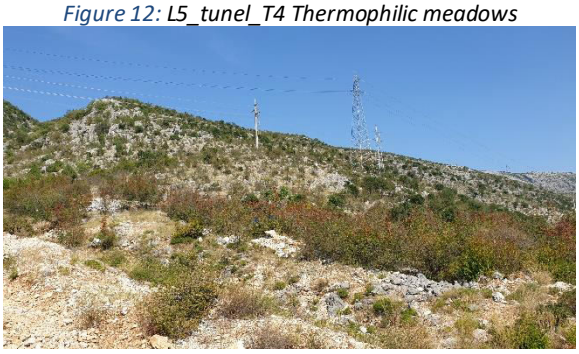

Figure 14: L6_vijadukt_M6 Macchia

Figure 15: L6_vijadukt_M6 Macchia

Figure 16: L7_tunel_T6 Macchia

Figure 17: L7_tunel_T6 Macchia

Figure 18: L8_cvoriste_Jug Residential buildings of villages and urban peripheries

Figure 19: L8_cvoriste_Jug Residential buildings of villages and urban peripheries

5.3 Photographs of species

Figure 20: Dalmatolacerta oxycephala

Figure 21: Lacerta trilineata

Figure 22: Podarcis melliselensis

Figure 23: Testudo hermanni

CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

Environmental and Social Impact Assessment

Mostar North-Mostar South

ANNEX C-2: ORNITHOFAUNA

May 2021

Table of Contents

1 INTRODUCTION

1.1 Project background

During 2020 ENOVA was commissioned to undertake Environmental and Social Assessment relating to the Corridor Vc section Mostar North-Mostar South. The results of the previous gap analysis for biodiversity found that supplementary biodiversity information would be required, so that an informed assessment of sensitive habitats and biodiversity features could be undertaken. The supplementary information has been gathered through both field surveys and an up to date desk study. The following field surveys have been undertaken and will form an Annex to the final Environmental and Social Assessment study:

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    - **Annex C-2: Ornithofauna**
    - Annex C-3: Mammals - bats
    - Annex C-4: Large mammals.

This report provides the results of the ornithofauna field survey.

1.2 Site locations

The 14.2 km long section Mostar North-Mostar South begins 500 m before the Mostar North Interchange in the Kutilivac settlement, east of Vrapcici, and ends just before the Mostar South Interchange near the Mostar Airport. After the interchange, the alignment extends towards the settlement of Suhi Do, where the route is moved to the east (“up the hill”), in order to avoid houses.

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The section ends at the Mostar South Interchange, which enables the connection between the motorway and main road M6.1 and it is located east of Mostar Airport. This location provides direct connection between the City of Mostar, the Airport and western Herzegovina via the planned southern bypass of the City to the motorway on Corridor Vc.

On this section the total length of the tunnels is 8,110 m, and the total length of the bridges is 940 m. The alignment passes mainly through hilly and mountainous terrain with significant spatial limitations, so along the section, cuts and embankments with a larger number of buildings alternate.

[1] Only of conservation concern

1.3 Report aim and objectives

The main aim of this assignment is to provide a written report to inform the ESIA Disclosure Package and Biodiversity Management Plan. In order to achieve this aim, this report has been written to satisfy the following objectives:

- Provide the methodology and results of the field survey
- Evaluate project area and project area of influence for the likely presence of sensitive species/species of conservation concern
- Recommend preconstruction surveys, additional mitigation and/or monitoring only if required.

2 METHODOLOGY

2.1 Survey background

The ornithofauna field surveys for the project area were conducted by the local ornithologist Goran Topic. Based on his 15-year-long experience in studying and protection of birds, he has participated in numerous population researches on single bird species, faunistic researches of a significant number of localities in BiH, data collecting for the European Nesting Birds Atlas 2 in Bosnia and Herzegovina, as well as in various studies for designation of new protected areas. He is the author of a dozen of scientific ornithological papers, expert in assessment of bird habitat conditions, as well as he participated in projects regarding implementation of mitigation measures for specific endangered bird species.

Field research was carried out along the route of the future motorway as well as in the surrounding area considered as preliminary buffer zone, in the area between the tunels, covering partially late summer/early autumn aspect of the ornithofauna research which includes vagrant and migrating species, while only a small number of recorded species are physically related to nesting territories in the given period.

The buffer zone for the future motorway is defined by the engaged ornithologist and varies from 200-500 m, depending on the habitat conditions. The research was conducted from 5:00 - 10:30 a.m., as well as in the evening from 17:00- 19:30 and coincides with the period of maximum activity of birds.

2.2 Methodology

The ornithofauna field survey has been undertaken by the transect method over the project footprint area and surrounding area considered as preliminary buffer, as well as counting birds on the surface from the census point (Gregory et al., 2004). The counting has been undertaken by a Minox spyglass, magnification 20x45, and Vortex Crossfire 10x50 binoculars. Photographs were taken with Nikon p900 camera and optical zoom 83x was used. Data recording was done with the NaturaList application which enables precise georeferencing of field survey findings. For the assessment of the size of the nesting population of single species in Bosnia and Herzegovina, and for the valorisation of the given area, the internal data base of the Ornithological Society Nase ptice was used, previously conducted for the European Breeding Birds Atlas 2 in the period from 2013-2017. For identification of species, Collins Bird Guide, 2nd edition has been used, while for bird songs the online data base www.xseno-canto.org has been used.

The following publication was used for reference: Bem, D., 1990: Ornitofauna Blagaja i njegove okoline. Godisnjak bioloskog instituta, 43: 83-100. (Bem, D., 1990: Ornithofauna of Blagaj and surrounding areas. Annual Bulletin of Biological Institute, 43: 83-100. and Kotrosan, D., 2016: Ornithological resources of Mostarsko blato. 5th Ornithological festival, Capljina: 53-70.

The field survey area has been divided into 14 segments as showed on the map in Chapter 5.1 of Annexes (Figure 3). There are four (4) predominant habitat types in the given area:

1. Anthropogenic type secondary habitats created by successive overgrowing of open terrains by trees and shrubs,
2. Bare rock habitats,
3. The rocks overgrown with low xerophilic shrubs,
4. Dry meadows and pastures.

Table 1: Observed locations with coordinates

No.	*Location*	*Motorway section (m)*	*Latitude*	*Longitude*
1	Access road to M17	0	43°23'12.72"N	17°52'42.25"E
2	Interchange "Mostar North"	500	43°23'12.51"N	17°53'39.99"E
3	Budevci	1900	43°23'4.70"N	17°52'44.78"E
4	Vrapcici 1	2500	43°22'46.11"N	17°52'33.84"E
5	Vrapcici 2	3100	43°22'38.32"N	17°52'16.98"E
6	Jamni Do 1	4400	43°22'5.35"N	17°51'39.84"E
7	Jamni Do 2	4800	43°21'59.88"N	17°51'23.48"E
8	Suhi Do	5300	43°21'47.87"N	17°51'4.11"E
9	Tunel T4-Tunel T5	9100	43°20'21.58"N	17°49'32.51"E
10	Bridge M3	9800	43°19'58.70"N	17°49'41.19"E
11	Bridge M4	10300	43°19'42.14"N	17°49'52.30"E
12	Bridge M5	10800	43°19'32.01"N	17°49'59.51"E
13	Bridge M6	11300	43°19'17.87"N	17°50'16.60"E
14	Donje Opine	11500	43°19'11.83"N	17°50'20.27"E

2.3 Assumptions and limitations

According to the bibliographic database of ornithological data (http://www.wild-herzegovina.com/bibliography.html), no bird research has been carried out on this section of the motorway so far. Regarding ornithofauna of the surrounding area, bird research was performed in the area of Mostarsko Blato (6.5 km away) and in the area of Blagaj (5.8 km away). However, based on the habitat conditions of mentioned areas, these diverse drastically in relation to the habitats found in the project area, which is why the literature data can not be applied to this section.

The timeframe of the research, i.e. late summer/early autumn period on the territory of Herzegovina is not optimum for ornithological research. Long summers with high daily temperatures, correlated with periods of drought are an extremely unfavorable period for birds, which after nesting usually move to more optimal habitats with abundance of food, while more environmentally tolerant or highly specialized species remain in the area.

In addition to the data on birds collected during the mentioned research, comparison of habitat types of the project area with well-researched sites from the Mediterranean part of Herzegovina are the only reference data for ornithofauna of the project area and planning of mitigation measures.

2.4 Project area of influence

In addition to unfavourable meteorological conditions and research periods, the obtained results are mostly conditioned by habitat conditions. Only 38 bird species have been registered in the project area, two of which are listed in Annex I of the European Birds Directive, while according to the Red List of Fauna of FBiH only two species, Eurasian Eagle-Owl and Red-rumped Swallow, have the status of vulnerable species (VU). Two Eurasian Eagle-Owl territories have been registered in the buffer zone, at 20 and 500 m from the route, respectively. One breeding territory was registered at Suhi Do near chainage 5+300+000, 500m southeast of

the motorway route, while another territory was discovered at the chainage 9+000+000, 20 m west from the planned route (Figure 1).

Therefore, it is necessary to apply specific mitigation measures, e.g. protective bird panels, in order to preserve the given species as given below in this report.

Due to the increased concentration of birds at the city landfill Uborak in Vrapcici, there is a danger of bird collision with cars at high speed, therefore it is necessary to install protective panels at this location as well.

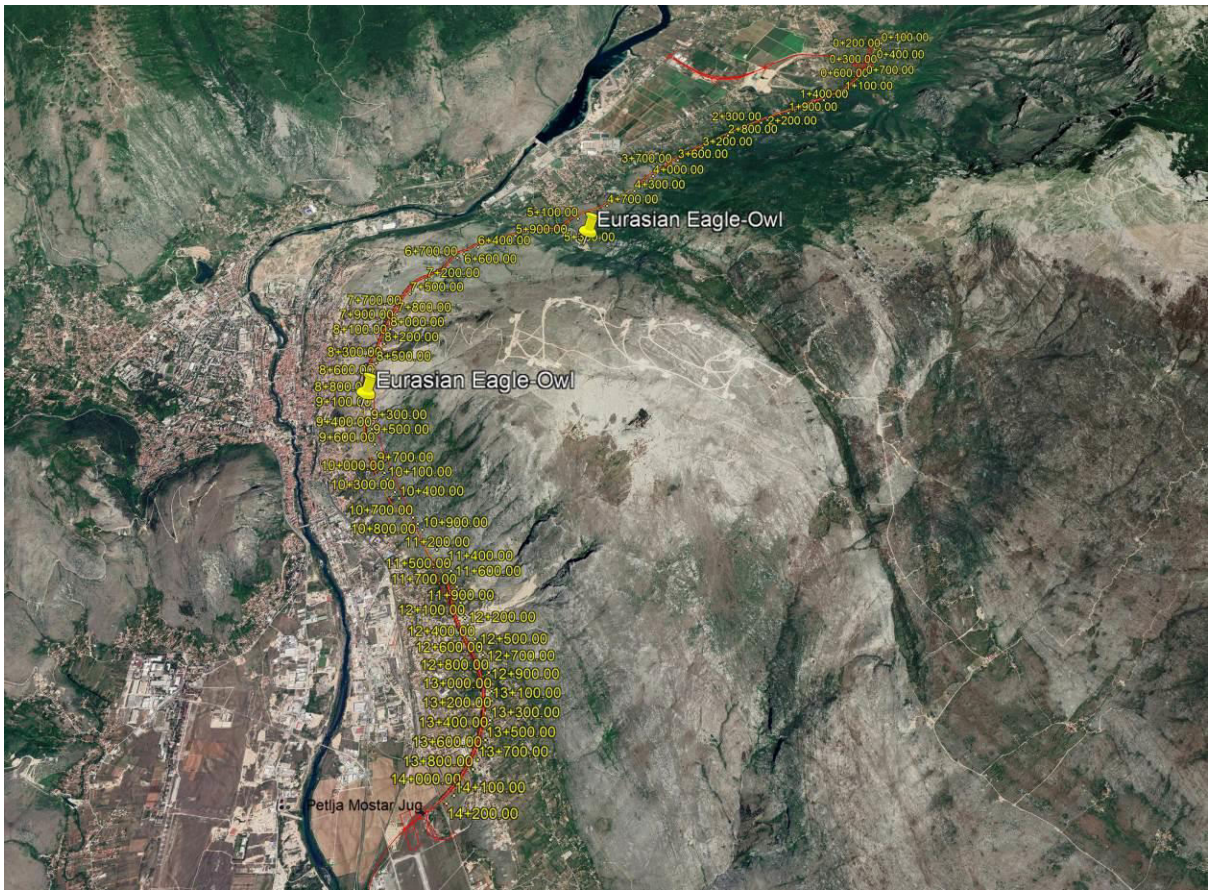

Figure 1: Territory of Eurasian Eagle-Owl (Bubo bubo)

3 RESULTS

Bird research was carried out on 14 segments along the future motorway route, as well as in the narrower zone of impact on birds, which, depending on habitat conditions, ranges from 20-600 m from the route. A total of 140 data on the ornithofauna of the given area were collected, with 2269 recorded individuals within 38 bird species. The data on the impact on birds from the previously conducted study were not defined on the basis of real habitat conditions and as such can be considered as irrelevant, and will not be the subject of this analysis.

There are no published data on birds of the project area, while on the other hand other publicized data for the surrounding areas may be scoped out since the habitats from the previous researches do not match the project area. Therefore, the data on birds collected as part of this assignment represent the only data on the project area.

Table 2 below provides the overview of ornithofauna in tabular format. The locations of observed sample points and assessed habitats are shown on maps in Chapter 5.1 Maps. The following abbreviations have been used in Table 2:

IUCN – International Union for Conservation of Nature

FBiH RL – Federation of Bosnia and Herzegovina Red List

- CR – Critically Endangered
- VU – Vulnerable
- NT – Near Threatened
- LC – Least Concern
- DD - Data Deficient

BD – European Birds Directive

- I – Annex I
- II – Annex II
- III – Annex III.

Table 2: Overview of ornithofauna

English Name	Latin name	Motorway (m)										
		0	500	1900	2500	3100	4400	4800	5300	9100	9800	10300
Tree Pipit	*Anthus trivialis*		4		1	3	1	2				
Alpine Swift	*Apus melba*						6					
Little Owl	*Athene noctua*									1		
Eurasian Eagle-Owl	*Bubo bubo*								1	1		
Common Buzzard	*Buteo buteo*		1									
European Goldfinch	*Carduelis carduelis*		3									
European Greenfinch	*Carduelis chloris*	12			3							
Red-rumped Swallow	*Cecropis daurica*		3									
Feral Pigeon	*Columba livia f. domestica*	200									5	6
Hooded Crow	*Corvus cornix*	28	5		2	2						
Western Jackdaw	*Corvus monedula*	15	58									
Eurasian Blue Tit	*Cyanistes caeruleus*		2						2			
Common House Martin	*Delichon urbicum*	170			37		87	38				
Cirl Bunting	*Emberiza cirlus*		4	18	2	5	6	3	1	5	2	4
Common Chaffinch	*Fringilla coelebs*						1					
Eurasian Jay	*Garrulus glandarius*		5	2	1	3		1	4		1	
Barn Swallow	*Hirundo rustica*		11	4	14		5					
Red-backed Shrike	*Lanius collurio*		1	1		1	2					
Yellow-legged Gull	*Larus michahellis*	96	700			2						
European Bee-eater	*Merops apiaster*	52					7					
White Wagtail	*Motacilla alba*	8	6									
Spotted Flycatcher	*Muscicapa striata*									2		
Western / Eastern Black-eared Wheatear	*Oenanthe hispanica*									1		
Northern Wheatear	*Oenanthe oenanthe*	1										
Eurasian Golden Oriole	*Oriolus oriolus*			1								
Great Tit	*Parus major*		14	3	5	4	4	5		4	2	2
House Sparrow	*Passer domesticus*		15	8		7					8	
Common Chiffchaff	*Phylloscopus collybita*		1									
Wood Warbler	*Phylloscopus sibilatrix*				2							
Eurasian Magpie	*Pica pica*	2					2	2			2	
European Green Woodpecker	*Picus viridis*		1		1							
Sombre Tit	*Poecile lugubris*											2
Eurasian Nuthatch	*Sitta europaea*										1	
Western Rock Nuthatch	*Sitta neumayer*									6		4
Common Starling	*Sturnus vulgaris*	8	7									
Eurasian Blackcap	*Sylvia atricapilla*				5							
Subalpine Warbler	*Sylvia cantillans*		3				2					
Common Blackbird	*Turdus merula*	3	2		5				1			

Table 3: Survey results

No	Latin name	English name	IUCN	RL FBiH nesting	BD	Suitable Habitat in Survey Area?	Location (where?)
1	*Anthus trivialis*	Tree Pipit	LC	LC		yes	Present at migration
2	*Apus melba*	Alpine Swift	LC	NT		yes	Nests in the wider zone of the project area and feeds high in the sky.
3	*Athene noctua*	Little Owl	LC	NT		yes	Common species in settlements in the buffer zone.
4	*Bubo bubo*	Eurasian Eagle-Owl	LC	VU	I	yes	Present on rocky habitats.
5	*Buteo buteo*	Common Buzzard	LC	LC		yes	Does not breed in the project area but it feeds in the open fields within the project area of influence.
6	*Carduelis carduelis*	European Goldfinch	LC	LC		yes	Common species of the project area.
7	*Chloris chloris*	Greenfinch	LC	LC		yes	Common species in settlements in the buffer zone.
8	*Cecropis daurica*	Red-rumped Swallow	LC	VU		yes	Common species in settlements in the buffer zone.
9	*Columba livia f. domestica*	Feral Pigeon	LC	LC	IIA	yes	Common species in settlements in the buffer zone.
10	*Corvus cornix*	Hooded Crow	LC	LC	IIB	yes	Common species in settlements in the buffer zone.
11	*Corvus monedula*	Western Jackdaw	LC	LC	IIB	yes	Rare breeder in the settlements in the buffer zone.
12	*Cyanistes caeruleus*	Blue Tit	LC	LC		yes	Rare breeder of the project area. Common in the heartland of the BiH.
13	*Delichon urbicum*	House Martin	LC	LC		yes	Common species in settlements in the buffer zone.
14	*Emberiza cirlus*	Cirl Bunting	LC	LC		yes	Nests in small numbers in the project area
15	*Fringilla coelebs*	Chaffinch	LC	LC		yes	Rare breeder in forest habitats. Common in the heartland of the BiH.
16	*Garrulus glandarius*	Jay	LC	LC	IIB	yes	Rare breeder in forest habitats. Common in the heartland of the BiH.
17	*Hirundo rustica*	Barn Swallow	LC	LC		yes	Common species in settlements in the buffer zone.
18	*Lanius collurio*	Red-backed Shrike	LC	LC	I	yes	Common species of the project area.
19	*Larus michahellis*	Yellow-legged Gull	LC			yes	Vagrant.
20	*Merops apiaster*	Bee-eater	LC	NT		yes	The small colony registered near the access road to M17.
21	*Motacilla alba*	White / Pied Wagtail	LC	LC		yes	Common species in settlements in the buffer zone.
22	*Muscicapa striata*	Spotted Flycatcher	LC	LC		yes	Present at migration.
23	*Oenanthe hispanica*	Black-eared Wheatear	LC	NT		yes	Present on rocky habitats with trees and shrubs.
24	*Oenanthe oenanthe*	Wheatear	LC	LC		yes	Present on rocky habitats.
25	*Oriolus oriolus*	Golden Oriole	LC	LC		yes	Common species of the project area.
26	*Parus major*	Great Tit	LC	LC		yes	Common species in all habitats that have at least some trees
27	*Passer domesticus*	House Sparrow	LC	LC		yes	Common species in settlements in the buffer zone.
28	*Phylloscopus collybita*	Chiffchaff	LC	LC		yes	Common species of the project area.

No	*Latin name*	*English name*	*IUCN*	*RL FBiH nesting*	*BD*	*Suitable Habitat in Survey Area?*	*Location (where?)*
29	*Phylloscopus sibilatrix*	Wood Warbler	LC	NT		yes	Present at migration.
30	*Pica pica*	Magpie	LC	LC	IIB	yes	Common species in settlements in the buffer zone.
31	*Picus viridis*	Green Woodpecker	LC	LC		yes	Rare breeder of the project area. Common in the heartland of the BiH.
32	*Poecile lugubris*		LC	LC		yes	Probable nesting of the project area.
33	*Sitta europaea*	Nuthatch	LC	LC		yes	Rare breeder of the project area. Common in the heartland of the BiH.
34	*Sitta neumayer*	Western Rock Nuthatch	LC	DD		yes	Present on rocky habitats.
35	*Sturnus vulgaris*	Starling	LC	LC	IIB	yes	Common species of the project area.
36	*Sylvia atricapilla*	Blackcap	LC	LC		yes	Common species in all shrubby and forest habitats.
37	*Sylvia cantillans*	Subalpine Warbler	LC			yes	Common species in the taller shrubs
38	*Turdus merula*	Blackbird	LC	LC	IIB	yes	Common species in all habitats with trees and shrubs.

4 DISCUSSION AND RECOMMENDATIONS

4.1 Summary of main findings

A total of 38 bird species were registered during the research undertaken as part of this assignment. Although the research covers late summer/early autumn aspect, based on the insight into the habitat conditions, it can be concluded that the given area is characterized by a relatively small diversity of bird species. Species that are highly specialized for dry, rocky habitats or for xerophilous woody and shrubby vegetation nest in the given area.

According to the IUCN Red List, all registred species have LC status. According to the Red List of Fauna of FBiH, two species have the status of vulnerable species (VU), meaning the construction of the motorway will not have a negative impact on the state of species populations at the national level.

Two species of conservation interest are listed in Annex I of the Birds Directive. As aforementioned, two territories of the Eurasian Eagle-Owl (*Bubo bubo*) have been registered during research. At the site Suhi Do (5+300+000 m), one individual of the Eurasian Eagle-Owl was heard during the night surveys for several times before going for night hunting. During the period of the research, the nest of this species has not been found. However, the habitat conditions for nesting of the Eurasian Eagle-Owl are optimal at the locality Suhi Do. In addition, it is known that this species protects the territory throughout the year, so it can be assumed that the species will nest at this site in the future period as well. The species has a teritory of 2km^2. The potential location of nesting is 500 m away from the motorway route in the project zone of influence, therefore will require specific protective measures. The second specimen was found 20 m away northwest from the motorway route near chainage 9+000+000, based on the traces of faeces. This nesting pair will need to be protected during construction works.

Of the species from Annex I of the European Birds Directive, 6 units of Red-backed Shrike (*Lanius collurio*) were found in 5 segments, however, this species is common in the inland of the country, which is why the construction of the motorway will not have negative impact on its nesting population. In addition to the listed species, Western Rock Nuthatch (*Sitta neumayer*) also stands out for its protection. According to the Red List of FBiH, this species has the status of Data Deficient (DD). Recent ornithological researches shows that this species has a narrow distribution in Bosnia and Herzegovina, limited to the Mediterranean part of Herzegovina. It is closely related to rocky areas with scattered trees and shrubs and its population is stable.

The other typical species of the rocky habitats with scattered trees and shrubs is the Black-eared Wheatear (*Oenanthe hispanica*). This species is also limited exclusively to the Mediterranean part of Herzegovina with a nesting area up to 600 m above sea level. The population of BiH is stable and consists of 2000-3000 pairs (European Red List of Birds (ERLoB) Data Input Spreadsheet. *Art. 12 Report format for the period 2013-2018).* Despite of the suitable habitat conditions only a small number of individuals of the Black-eared Wheatear was registered during the research within this project, which is due to unfavorable meteorological conditions, as well as the unfavorable period of the year, when the breedinig season is finished and individuals of this species are already in dispersion or migration.

Cirl Bunting (*Emberiza cirlus*) and Subalpine Warbler (*Sylvia cantillans*) also nest on the highway route, however, these species are common in the whole region of Herzegovina. Other registered species are closely related to settlements located in the impact zone of the highway. These other species are common throughout the country or in a given region, so the highway will not have a major negative impact on their populations.

4.2 Sensitive species

Habitats along the future motorway on the route from Kutilivac to Vrapcici were formed under the significant influence of anthropogenic factors. The rest of the section up to Gnojnice consists of steep, rocky habitats with scattered trees and bushes. Xerophilous, scarce habitats significantly reduce species diversity, so common species with wide ecological tolerance are found in a given area, as well as highly specialized species that prefer dry, rocky habitats, such as Eurasian Eagle-Owl (*Bubo bubo*), Black-eared Wheatear (*Oenanthe hispanica*) and Western Rock Nuthatch (*Sitta neumayer*). Other recorded species are numerous in the territory of Bosnia and Herzegovina.

It is estimated that 200-400 Eurasian Eagle-Owl pairs nest in Bosnia and Herzegovina, two thirds (66%) of which are located in the rocky parts of Herzegovina. Two individuals of the Eurasian Eagle-Owl (*Bubo bubo*) have been registered in the project zone of influence, one near the site Suhi Do (chainage 5+300+000 m) and the other individual was recorded near 9+000+000 m.

In addition to the listed species, Western Rock Nuthatch (*Sitta neumayer*) also stands out for its protection. According to the Red List of FBiH, this species has the status of Data Deficient (DD). Recent ornithological researches shows that this species has a narrow distribution in Bosnia and Herzegovina, limited to the Mediterranean part of Herzegovina. It is closely related to rocky areas with scattered trees and shrubs and its population is stable.

4.3 Mitigation measures

4.3.1 Preconstruction phase

In order to reduce the negative impact on the population of native bird species, construction activities should be planned during the non-breeding period of birds i.e. from beginning of June to the end of March of the next year. The commencement of works such as vegetation clearance or preparation of the construction site should not take place during the period from March to end of May.

4.3.2 Construction phase

The applicable mitigation measures that shall be applied during construction phase refer to the installation of protective bird panels, which need to be placed on the most frequent zones of bird flyover:

- It is estimated that 5000-10000 crows, seagulls and other birds feed daily at the city landfill Uborak in Vrapcici, which reresents a safety issue for vehicles in motion. Hence, it is recommended to install protective panels from the both sides of the road in the length of 500 m just after leaving the T1 tunnel, i.e. from chainage 1+700+000 to 2+200+000 m. That way the likelihood of a potential collision of vechicles with the flying birds that are coming to feed on the city landfill will be avoided.
- Protective panels in the total length of 500 m should be placed alongside the M2 viaduct with the aim to prevent potential collision of Eurasian Eagle-Owl (*Bubo bubo*) with cars.
- Protective panels in the total lenght of 300 m should be placed between the T4 tunnel and T5 tunnel with the purpose to protect sensitive species that are nesting in the given area, including Eurasian Eagle-Owl (*Bubo bubo*).
- Construction must be planned in a way that will not affect the young Eurasian Eagle-Owls leaving the nest at both nesting localities; therefore, works must not be done in the period from February to the end of May.
- No access roads or construction waste disposal is allowed between the T4 tunnel and T5 tunnel and also 100 m in direction northeast in order protect the second breeding pair of Eurasian Eagle-Owl

(*Bubo Bubo*, as well as to protect the features of high geological value –vertical sandstone pillars, found near the chainage 9+000+000, as shown on Figure 2.

Figure 2: Spatial distribution of suitable nesting area of Eurasian Eagle-Owl (Bubo bubo) to be avoided during construction activities

4.3.3 Operation phase

Should any fatalities of birds be observed during regular maintenance of the road in operation phase, protective barriers should be placed at such locations in consultation with the local ornithological society.

4.4 Monitoring measures

4.4.1 Preconstruction phase

- The Neretva River and its tributaries in the Mediterranean- sub-Mediterranean climate zone are one of the most important parts of the entire Adriatic Migratory Corridor i.e. Adriatic Flyway and a large number of species use these aquatic and coastal habitats for feeding and resting during the migration. The Neretva River flows 1-2 km away from the route of the future motorway. Width of the migration front is not known yet since no ornithological research has been conducted in this area so far and aadditional ornithology surveys will need to take place from March to April to cover early spring migrations with regard to Charadriiformes and Anseriformes species.

- The project area may be a potentially significant feeding or nesting site for some species of Passeriformes, Accipitriformes and Falconiformes, which is why it is necessary to conduct additional research in the period from March to the end of May.

4.4.2 Construction phase

As stipulated by this report, specific mitigation measures will need to be applied for Eurasian Eagle-Owl during construction phase. Applicable monitoring measure is to supervise over adherence to the suggested measures by the Supervisory Authority on-site.

4.4.3 Operation phase

During the first three years, undertake monitoring of eventual fatalities of birds. Should any fatalities of birds be observed, protective barriers should be placed.

5 ANNEXES

5.1 Maps

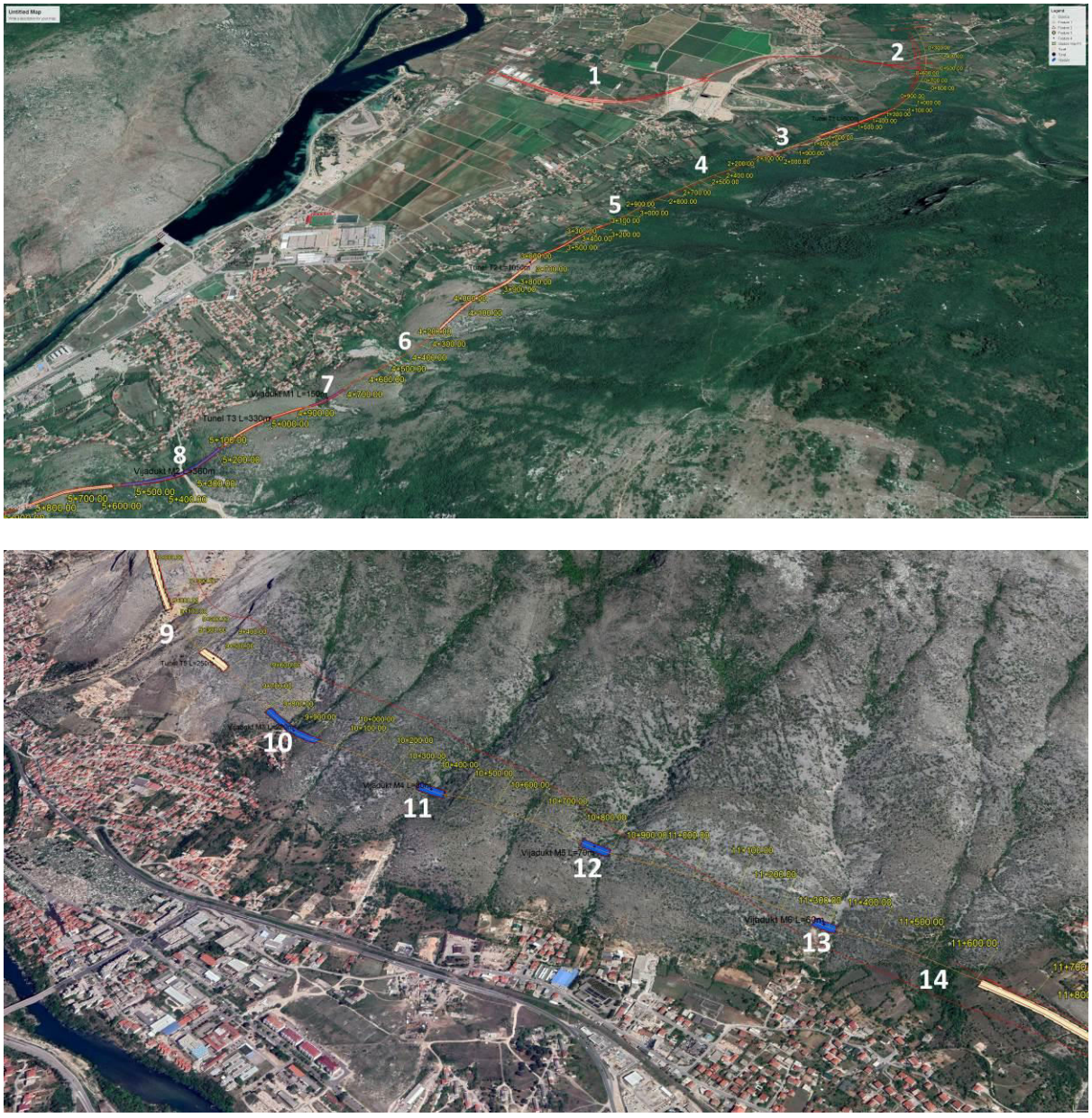

Figure 3: Spatial distribution of surveyed locations along the motorway route and project area of influence (buffer zone)

CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

Environmental and Social Impact Assessment
Mostar North-Mostar South

ANNEX C-3: MAMMALS - BATS

May 2021

Table of Contents

1 INTRODUCTION

1.1 Project background

During 2020 ENOVA was commissioned to undertake Environmental and Social Assessment relating to the Corridor Vc section Mostar North-Mostar South. The results of the previous gap analysis for biodiversity found that supplementary biodiversity information would be required, so that an informed assessment of sensitive habitats and biodiversity features could be undertaken. The supplementary information has been gathered through both field surveys and an up to date desk study. The following field surveys have been undertaken and will form an Annex to the final Environmental and Social Assessment study:

- Annex A: Habitats, vegetation and invasive species
- Annex B: Invertebrates[1]
- Annex C: Vertebrates
    - Annex C-1: Herpetofauna (amphibians and reptiles)
    - Annex C-2: Ornithofauna
    - **Annex C-3: Mammals - bats**
    - Annex C-4: Large mammals.

This report provides the results of the Mammals - bats field survey.

1.2 Site locations

The 14.2 km long section Mostar North-Mostar South begins 500 m before the Mostar North Interchange in the Kutilivac settlement, east of Vrapcici, and ends just before the Mostar South Interchange near the Mostar Airport. After the interchange, the alignment extends towards the settlement of Suhi Do, where the route is moved to the east ("up the hill"), in order to avoid houses.

After Suhi Do, the section enters the Tunnel Ostri Rat (L=3,380 m), turning towards the south and bypassing the City of Mostar. In the area east of Luke settlement, the alignment exits the tunnel and passes the slopes above the settlements and extends south towards the Buna valley. The section crosses the relatively uneven terrain between Ostri Rat and Gnojnice viaducts and tunnels. In Kocine settlement the alignment passes through a tunnel (L=2,600 m). After exiting this tunnel, the alignment descends towards the Mostar South Interchange.

The section ends at the Mostar South Interchange, which enables the connection between the motorway and main road M6.1 and it is located east of Mostar Airport. This location provides direct connection between the City of Mostar, the Airport and western Herzegovina via the planned southern bypass of the City to the motorway on Corridor Vc.

On this section the total length of the tunnels is 8,110 m, and the total length of the bridges is 940 m. The alignment passes mainly through hilly and mountainous terrain with significant spatial limitations, so along the section, cuts and embankments with a larger number of buildings alternate.

1.3 Report aim and objectives

The main aim of this assignment is to provide a written report to inform the ESIA Disclosure Package and Biodiversity Management Plan. In order to achieve this aim, this report has been written to satisfy the following objectives:

- Provide the methodology and results of the field survey
- Evaluate project area and project area of influence for the likely presence of sensitive species/species of conservation concern
- Recommend preconstruction surveys, additional mitigation and/or monitoring only if required.

[1] Only of conservation concern

2 METHODOLOGY

2.1 Survey background

The bat survey was undertaken by Admir Aladzuz, MA in ecology who has more than 10 years of experience with working as an environmental consultant for environmental impact assessment. He is an experienced researcher in the field of zoology, mammalogy, systematic (taxonomy) and ecology. Site investigations have been carried out during September 2020). The weather during the night was partly cloudy with approximate temperature of 11-18 °C and slow wind.

2.2 Methodology

Records of bats echolocation signals have been collected using a DODOTRONIC ULTRAMIC 250K connected to a TOSHIBA SATELLITE l750-1XV laptop. For recording and real-time analyses, the software: Sea Wave - Sound Emission Analyser Wave edition developed by CIBRA and AEST has been used. Identification was based on Walters et al 2012, and additional literature specific for social calls. Because of site morphology, instead of a classical linear transect approach the survey opted for a finite number of observation areas ("Point counts" method based on Barataud 2015) covering different habitat conditions across the project area and buffer zone up to 1 km buffer determined on site (Rodrigues et al., 2014). The complete list of references is available in Chapter 5.3. Spatial distribution of recording points is provided in Figure 3, while for coordinates are given in Table 1.

Table 2 provides an overview of the exact time after sunset for each recording and the average time for each location. Total recording time per point was approximately 20 minutes. In total, 2h 30min of material was recorded per day. Sites were selected based on the following criteria:

- at least 1 site in area of settlement;
- at least 1 natural area on hilly landscape;
- at least 1 sites on the occasional creek;
- at least 2 sites near artificial structures (buildings and industrial zones);
- at least 2 site at mixed mid-sized tree and agricultural habitats.

In total 7 sites were chosen (Figure 3) encompassing the motorway route and buffer zone (1.000 meters) from the motorway on both sides).

Table 1: Coordinates and short description of bat-detector monitoring point

Location	*N*	*E*	*Description*
T1	43°18'21.87"	17°50'48.66"	This point was situated in Opine settlement, on local road, near the planned motorway section. The point is relevant since it is close to the settlement, orchards and frequent local road.
T2	43°20'48.86"	17°49'35.27"	This point was situated on the hill of Podvelezje plateau near the local road. The point is relevant since if covers natural mixed bushy and rudimental vegetation of Podvelezje area.
T3	43°21'59.28"	17°50'56.65"	Outskirts of the Vrapcici settlement near the occasional creek Suhi Do (dry during the survey). Primary vegetation in the area is represented with the mid-sized trees.
T4	43°22'28.84"	17°51'43.15"	Outskirt of the Vrapcici industrial zone in the mixed agricultural areas and mid-sized tree vegetation.

Location	*N*	*E*	*Description*
T5	43°23'3.64"	17°52'48.28"	Agricultural - tree mixed habitats in Kutilivac area.
T6	43°23'19.37"	17°52'55.04"	Frequent local road, near municipal landfill site "Uborak".
T7	43°23'22.46"	17°53'53.38"	Agricultural area in Kutilivac area (orchards).

Table 2: Recording time delay from sunset (h:mm format)

Point	*Day*	
	1	**2**
T1	0:30	2:30
T2	0:50	2:10
T3	1:10	1:50
T4	1:30	1:30
T5	1:50	1:10
T6	2:10	0:50
T7	2:30	0:30

Roost sites inspection: Based on the surveyor's previous experience, already known roost site have been shown as part of the report and potential roost sites have been investigated during field work in order to assess their importance. Field inspection was aimed to record the presence of bats or other traces such as bat's guano or bones, to estimate the presence of species and the type of the use of the site (e.g. hibernation, maternity etc.). These activities have been performed by visual identification supported by photographic documentation.

According to field investigation, **there are no speleological objects in the range of 1 km from both sides of the planned motorway**[2]. Abandoned houses are rare in the area and can provide a shelter for the bats, but inspection of few abandon houses showed **no active resting or roosting places of bat species.** The only known potential roost sites are situated **at Podvelezje.** This area of Podvelezje has not been inspected for roosts considering the distance from the planned motorway as well as higher altitudes (e.g. 700 m.a.s.l and approx. 400 m higher in elevation compared to the project area). Based on the literature, the closest known speleological objects with regard to the project area (Mulaomerovic et al. 2006) are (Figure 1):

- Svabinja cave – app. 1.3 km east of the planned motorway
- Krasnica cave – app. 2.9 km east-southeast of the planned motorway
- Krmljesina cave – app. 3.5 km east-southeast of the planned motorway
- Jama na Vlakama – approx. 6 km east of the planned motorway.[3]

So far **two maternity colonies** were discovered on Podvelezje plateau (Mulaomerovic et al. 2006), both being outside ofthe project area of influence:

- Jama na Vlakama – maternity colony of *Myotis blythii* Tomes, 1.857 species*;*
- Prosjecenica cave - maternity colony of *Rhinolophus blasii* Peters, 1.866 species.

[2] Based on the coordinates of the speleological objects in Mulaomerovic et al. 2006 and distances taken from the Google Earth computer programme
[3] Based on the coordinates of the speleological objects in Mulaomerovic et al. 2006 and distances taken from the Google Earth computer programme

Prosjecenica cave is relatively away from the planned motorway route (approx. 9 km south – east from the T1 point). Jama na Vlakama sinkhole is located at approx. 6 km south east) and around 650 individuals of *Myotis blythii oxygnathus* (Rnjak et al. 2017) species were registered inside the sinkhole. However, during this recording species *Myotis blythii oxygnathus* was not recorded at any of the seven points while species *Rhinolophus blasii* was recorded at several points along the planned motorway (Table 4).

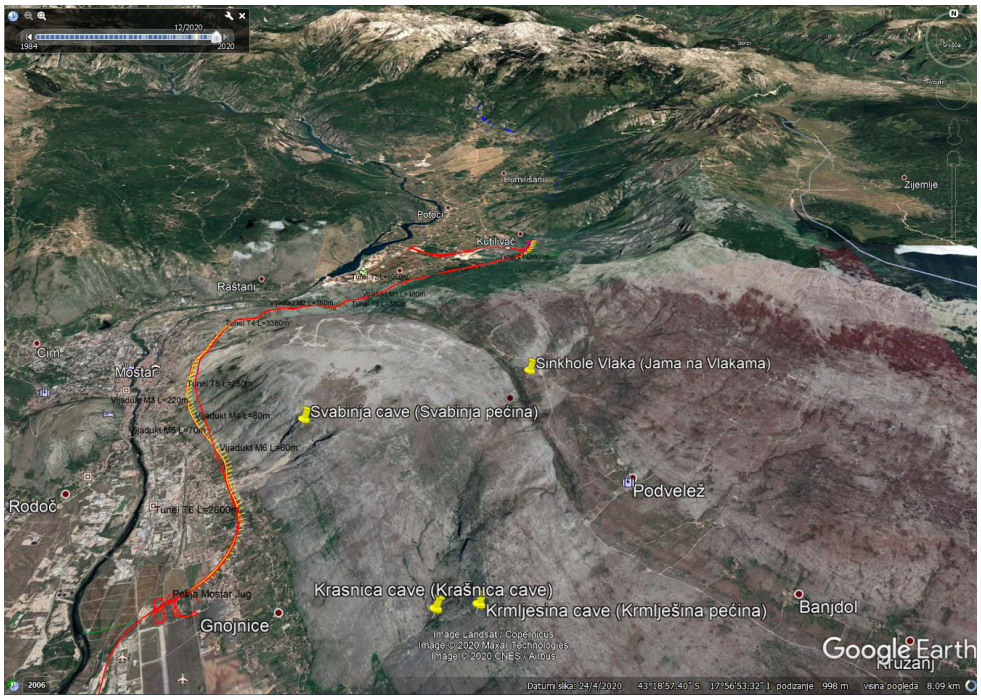

Figure 1: Spatial distribution of nearest speleological objects with regard to the motorway[4]

Figure 2: One of speleological objects on Podvelezje plateau (Photo: Admir Aladzuz)

Monitoring of bats by ultrasound detectors have been performed from 21.06.2020 until 22.06.2020. Seven recording points (Figure 3) were investigated all in different habitat conditions.

[4] Based on the coordinates of the speleological objects in Mulaomerovic et al. 2006 and Google Earth computer programme

2.3 Assumptions and limitations

Based on the EUROBATS's recommendations, monitoring of bats should be undertaken during the whole year. The used recording time is also not approved by EUROBATS or other scientific criteria. Therefore, these data may be used as a reference to avoid / minimize the future damage to bat at the early stage of project planning, and also as inputs for much needed further bat species monitoring.

Capture by mist-nets: no capturing of bats by using mist nets has been undertaken. Survey time did not allow any mist net positioning because special research permission from the Federal Ministry of environment and tourism is needed for these activities.

The whole observation area is mine – cleaned. The areas at risk from mines and UXOs, are located east of the project area at Podvelezje plateau, and far from the planned motorway section.

2.4 Project area of influence

With regards to habitats relevant for bats, the dominant habitats are mixed agricultural fields and orchards with suburban mid-sized tree vegetation which is dominant on the northern part of the motorway (T1 and T3-T7) and scrubland vegetation on T location. The motorway does not cross any rivers or creeks, which is important due to a fact that rivers and other water bodies represent good hunting ground for most of bat species. A significance of habitats for bats species in relation with their ecological role is given in Table 3. During the field recording it was observed that on T2 point during the dusk, bat species migrate from lower to higher altitudes. This point could be the daily migration path for these species, however this cannot be confirmed without the longer research period.

Bats use different types of roosts, often moving and changing roost depending on the period of the year (summer or winter roosts) and availability of roosts. Typical roosts include underground sites (caves or artificial objects), hollow trees and buildings (especially old).

The motorway is planned over local settlements and villages which can provide potential roost sites. Woodland is mainly present by scrubland, but the region near T3 (Vrapcici) and near T5-T7 (Kutilivac) could represent the potentially active hunting grounds for several registered species. During the field recordings it was observed that on T2 point during the dusk, bat species migrate from lower to higher altitudes. This point could be on daily migration pathway of species recorded there. These daily migration pathways are important since species use them to migrate from resting areas to hunting grounds. This pathway cannot be confirmed without longer research period.

Table 3: Habitat significance for bats in relations with different ecological use

	Forest	*Shrubland*	*Grassland*	*Wetlands (inland)*	*Rocky Areas*	*Caves and Subterranean*	*Artificial*
Roosts	High	No	No	High	Moderate	High	High
Hunting areas	High	High	Moderate	High	Moderate	No	High
Flight paths	High	High	Moderate	High	No	No	High
Migration routes	High	Small	?	High	?	No	Small

?) potentially significant but not enough data for assessment (Paunovic et al. 2011)

3 RESULTS

Based on the recent data, 31 species of bats are recorded in BiH (Karapandza et al 2014; Pasic and Mulaomerovic 2016, Babic et al 2018) belonging to 11 genera: *Rhinolophus hipposideros* (Bechstein, 1800), *Rhinolophus ferrumequinum* (Schreber, 1774), *Rhinolophus Euryale* Blasius, 1853, *Rhinolophus blasii* Peters, 1866, *Myotis myotis* (Borkhausen, 1797), *Myotis blythii* Tomes, 1857, *Myotis bechsteinii* (Kuhl, 1817), *Myotis nattereri* (Kuhl, 1817), *Myotis emarginatus* (E. Geoffroy Saint-Hilaire, 1806), *Myotis mystacinus* (Kuhl, 1817), *Myotis brandtii* (Eversmann, 1845), *Myotis capaccinii* Bonaparte, 1837, *Myotis dasycneme* (Boie, 1825), *Myotis daubentonii* (Kuhl, 1817), *Myotis alcathoe* O. von Helversen and K.-G. Heller, 2001, *Pipistrellus pipistrellus* (Schreber, 1774), *Pipistrellus pygmaeus* (Leach, 1825), *Pipistrellus kuhlii*

Kuhl, 1817*, Pipistrellus nathusii* (Keyserling & Blasius, 1839)*, Hypsugo savii* Bonaparte, 1837*, Eptesicus serotinus* (Schreber, 1774)*, Nyctalus noctula* (Schreber, 1774)*, Nyctalus leisleri* (Kuhl, 1817)*, Vespertilio murinus* Linnaeus, 1758*, Plecotus auritus* (Linnaeus, 1758)*, Plecotus macrobullaris* Kuzjakin, 1965*, Plecotus austriacus* (J.B. Fischer, 1829)*, Plecotus kolombatovici* Dulic, 1980*, Barbastella barbastellus* (Schreber, 1774)*, Miniopterus schreibersii* (Kuhl, 1817)*, Tadarida teniotis* (Rafinesque, 1814).

None of these 31 species can be fully excluded due of the site morphology and habitat distribution. Even the species that are usually strongly associated with watercourses, which are found to be only occasional in the project area, are included in this report due to its international conservation status:

- *Miniopterus schreibersii* (Kuhl, 1817)
- *Myotis blythii* Tomes, 1857
- *Myotis capaccinii* Bonaparte, 1837,
- *Myotis dasycneme* (Boie, 1825) and
- *Myotis daubentonii* (Kuhl, 1817).

Based on the scarce literature data (Presetnik et al. 2014a, Presetnik et al. 2014b, Mulaomerovic et al. 2015, Hodzic et al. 2017 and Rnjak et al. 2017), in the wider area of including Velez Mountain, so far 19 species were recorded which belong to the 11 genera known in BiH. Other species may be also present in the region.

During the survey with ultrasound detector, at least 8 genera have been detected (Figure 4): *Rhinolophus* Lacépède, 1799*, Myotis* Kaup, 1829*, Pipistrellus* Kaup, 1829*, Hypsugo* Kolenati, 1856*, Eptesicus* Rafinesque, 1820*, Nyctalus* Bowdich, 1825*, Miniopterus* Bonaparte, 1837 and *Tadarida* Rafinesque, 1814. **In total, 12 taxons have been confirmed at all 7 locations:** *Rhinolophus hipposideros* (Bechstein, 1800), *Rhinolophus ferrumequinum* (Schreber, 1774), *Rhinolophus blasii* Peters, 1866, *Pipistrellus pipistrellus* (Schreber, 1774)*, Pipistrellus pygmaeus* (Leach, 1825), *Pipistrellus kuhlii* Kuhl, 1817 */nathusii* (Keyserling & Blasius, 1839), *Hypsugo savii* Bonaparte, 1837, *Eptesicus serotinus* (Schreber, 1774), *Nyctalus noctula* (Schreber, 1774), *Nyctalus leisleri* (Kuhl, 1817), *Miniopterus schreibersii* (Kuhl, 1817), *Tadarida teniotis* (Rafinesque, 1814).

Table 4: Overall relative abundance of genera and species (Corrected values with detect-ability coefficients)

Genus	*Bat species (taxons)*	*Observation points*
Rhinolophus	*R. hipposideros*	T2, T3
	R. ferrumequinum	T2, T3, T5, T7
	R. blassi	T1, T2, T3, T5
Pipistrellus	*P. pipistrellus*	T1, T3, T6
	P. pygmaeus	T1, T6, T7
	P. kuhli/nathusii	T2
Hypsugo	*H. savii*	T3, T6
Tadarida	*T. teniotis*	T1, T2, T3, T5, T6
Eptesicus	*E. serotinus*	T3, T5, T6, T7
Nyctalus	*N. noctula*	T3
	N. leisleri	T3, T5, T6
Miniopterus	*M. schreibersii*	T3, T6

As given in Table 5 it can be seen that the most active observation points with regard to the presence of bats were points T3 (near occasional creek Suhi Do), T6 (near municipal landfill site "Uborak") and T2 (slopes of Podvelezje hill)/T5 (Kutilivac). Moderate active points were point T1 (local road in Opine settlement) and T7 (orchards in Kutilivac) while the point with no activity was point T4 (Vrapcici industrial zone). This was expected and confirmed by the surveys. Bat species activity was highest on point T3 possibly due to a several reasons:

- Vicinity of artificial objects (houses etc.) and street lights which are potentially good hunting site;
- Vicinity of Podvelezje area (rich in underground habitats);
- Vicinity of trees and scrubland vegetation which are hunting ground for some bat species.

The points T3 (near occasional creek Suhi Do), and T6 (near municipal landfill site "Uborak") have the highest bat diversity and flying activity during record time. As hunting grounds are one of sensitive areas for bats, it is evident that the planned motorway that passes through the area T2 and T3 as well as between T5 and T7 will have potential impacts on bat ecology and feeding habits.

Table 5: Bat passing frequency per observation point

Point	*Detected sounds (per 10 sec) – average value for 2-night recording*	*%*
T1	4	8,70
T2	5	10,87
T3	15	32,61
T4	0	0,00
T5	6	13,04
T6	9	19,57
T7	7	15,22
Total	46	100

Table 6 in the next section provides the full results of the surveys in tabular format and assesses the available literature data as well. The locations of species findings and notable habitats are shown on Maps in Annex A. The following abbreviations have been used in Table 6:

IUCN – International Union for Conservation of Nature

FBiH RL – Federation of Bosnia and Herzegovina Red List

- CR – Critically Endangered
- EN – Endangered
- VU – Vulnerable
- NT – Near Threatened
- LC – Least Concern

HD – European Habitats Directive

- II – Annex II
- IV – Annex IV

Table 6: Field survey results

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Survey Are?*	*Survey Finding – was species found?*	*Location (where?)*	*Map reference*
Lesser horseshoe bat	*Rhinolophus hipposideros*	IUCN LC, FBiH EN, HD II, IV	Yes	Found during survey, habitats present	Figure 3	Table 4 - T2, T3
Greater horseshoe bat	*Rhinolophus ferrumequinum*	IUCN LC, FBiH VU, HD II, IV	Yes	Found during survey, habitats present	Figure 3	Table 4 - T2, T3, T5, T7
Mediterranean horseshoe bat	*Rhinolophus euryale*	IUCN NT, FBiH EN, HD II, IV	Possible	Not found, habitats present		
Blasius's horseshoe bat	*Rhinolophus blasii*	IUCN LC, FBiH VU, HD II, IV	Yes	Not found, habitats present	Figure 3	Table 4 - T1, T2, T3, T5
Greater mouse-eared bat	*Myotis myotis*	IUCN LC, FBiH EN, HD II, IV	Possible	Not found, habitats present		
Lesser mouse-eared bat	*Myotis blythii/oxygnathus*	IUCN LC, FBiH EN, HD II, IV	Very possible	Not found but may to be present occasionally due to vicinity of 6 km of confirmed maternity colony in Jama na Vlakama.		
Bechstein's bat	*Myotis bechsteinii*	IUCN NT, HD II, IV	No	No, habitats near water bodies		
Natterer's bat	*Myotis nattereri*	IUCN LC, HD IV	No	No, habitats near water bodies		
Geoffroy's bat	*Myotis emarginatus*	IUCN LC, FBiH VU, HD II, IV	No	No, karst hilly habitat outside buffer zone		
Whiskered bat	*Myotis mystacinus*	IUCN LC, FBiH VU, HD IV	Possible	No, habitats present south of the motorway route		
Brandt's bat	*Myotis brandtii*	IUCN LC, HD IV	Possible	No, habitats present southern of the motorway route		
Long-fingered bat	*Myotis capaccinii*	IUCN VU, FBiH VU, HD II, IV	Near water bodies	Not found, may to be present occasionally since permanent water bodies are not present.		
Pond bat	*Myotis dasycneme*	IUCN NT, HD II, IV	Near water bodies	Not found, may to be present occasionally since permanent water bodies are not present.		
Daubenton's bat	*Myotis daubentonii*	IUCN LC, HD IV	Near water bodies	Not found, may to be present occasionally since permanent water		

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Survey Are?*	*Survey Finding – was species found?*	*Location (where?)*	*Map reference*
				bodies are not present.		
Alcathoe bat	*Myotis alcathoe*	IUCN DD	Possible	No, woodland habitats in the south		
Common pipistrelle	*Pipistrellus pipistrellus*	IUCN LC, FBiH VU, HD IV	Yes	Found during survey, habitats present	Figure 3	Table 4 - T1, T3, T6
Soprano pipistrelle	*Pipistrellus pygmaeus*	IUCN LC, HD IV	Yes	Found during survey, habitats present	Figure 3	Table 4 - T1, T6, T7
Kuhl's pipistrelle	*Pipistrellus kuhlii*	IUCN LC, FBiH VU, HD IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T2
Nathusius's pipistrelle	*Pipistrellus nathusii*	IUCN LC, HD IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T2
Savi's pipistrelle	*Hypsugo savii*	IUCN LC, FBiH VU, HD IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T3, T6
Serotine bat	*Eptesicus serotinus*	IUCN LC, HD IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T3, T5, T6, T7
Common noctule	*Nyctalus noctula*	IUCN LC, FBiH EN, HD IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T3
Lesser noctule	*Nyctalus leisleri*	IUCN LC, HD IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T3, T5, T6
Parti-coloured bat	*Vespertilio murinus*	IUCN LC, FBiH VU, HD IV	Least possible	No, habitats present		
Brown long-eared bat	*Plecotus auritus*	IUCN LC, FBiH VU, HD IV	Possible	No, habitats present		
Alpine long-eared bat	*Plecotus macrobullaris*	IUCN LC, HD IV	Least possible	No, habitats present		
Grey long-eared bat	*Plecotus austriacus*	IUCN LC, FBiH VU, HD IV	Possible	No, habitats present		
Kolombatovic's long-eared bat	*Plecotus kolombatovici*	IUCN LC, HD IV	Possible	No, habitats present		
Western barbastelle	*Barbastella barbastellus*	IUCN NT, HD II, IV	Possible	No, habitats present		
Common bent-wing bat	*Miniopterus schreibersii*	IUCN NT, FBiH EN, HD II, IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T3, T6
European free-tailed bat	*Tadarida teniotis*	IUCN LC, HD IV	Yes	Found during survey in the Project area	Figure 3	Table 4 - T1, T2, T3, T5, T6

**possible species have not been confirmed within the project area, however may be present due to the habitat type. Further monitoring of this area will determine the presence or absence of these species.*

4 DISCUSSION AND RECOMMENDATIONS

4.1 Summary of main findings

4.1.1 Sensitive species

Law on Nature Protection (Official Gazette of FBiH, No. 66/13) in FBiH was adopted in 2013. This law set the fundamental principles for the protection of biodiversity, species and habitat. Although more than 6 years have passed from promulgation, few sections considering biodiversity inventory and official inventory of speleological objects (including biodiversity inventory and therefore the presence of bats and roost sites) are not yet operative or populated with data.

In 2011, the *Decree on the Natura 2000 Program – Protected Areas in Europe* (O.G. of FBiH, No. 41/11), was promulgated including criteria for establishment of Natura 2000 sites in FBiH and establishment of their database. During the period 2012-2015 (as part of the project: *Assistance in the implementation of the Wild birds and Habitat directive*) an international team of experts created among other deliverables, a list of potential candidate sites for the whole territory of BiH. Although none of these potential sites have been yet officially declared, the closest designated NATURA 2000 area to the planned motorway route is Velez in FBiH (Code: BA8200088) which is approx. 1-4 km east.

In 2013 a draft version of "Red List" of species for the Federation of Bosnia and Herzegovina was released (Greenway, 2013). This list was passed in 2014 (Official Gazette of FBiH, No. 7/14). This list, in regards to chiropters, has been proven to be based on outdated references and incomplete analyses of available literature. The list evaluates only 17 out of the 31-known species of bats. All these 17 species are classified as vulnerable or endangered. The threat status is provided for all species in Table 7. Estimated threat status for BiH bat population is questionable due to very low local knowledge of bat population, distribution and trends. The number of known important roost sites in the territory is still low due to lack of field studies. Data on local migration routes are almost completely absent.

Threat status discussed in this report is mainly based on the information retrieved from IUCN Red list (IUCN, 2017). The threat status provided by this list reflects global criteria and trends and therefore may not be fully illustrative of local endangerment status. IUCN provided a regional assessment for the Mediterranean region in 2009 (Temple and Cuttelod, 2009). Of the thirty-one species of bats known in BiH, 28 species were included in this Red list. *Eptesicus serotinus* (Schreber, 1774) and *Myotis dasycneme* (Boie, 1825) have been excluded since considered marginal for the Mediterranean territory.

Table 7: Bat species in BiH and species detected (bold) in the project area with conservation status

Species	*Detected*	*EU Habitat Directive Annex*	*IUCN Red List (Global)*	*IUCN Red List (Mediterranean)*	*FBiH Red List*
Rhinolophus hipposideros	**YES**	**II, IV**	**LC**	**NT**	**EN**
Rhinolophus ferrumequinum	**YES**	**II, IV**	**LC**	**NT**	**VU**
Rhinolophus euryale		II, IV	NT	VU	EN
Rhinolophus blasii	**YES**	**II, IV**	**LC**	**NT**	**VU**
Myotis myotis		II, IV	LC	LC	EN
Myotis oxygnathus		II, IV	LC	NT	EN
Myotis bechsteinii		II, IV	NT	NT	/
Myotis nattereri		IV	LC	LC	/
Myotis emarginatus		II, IV	LC	LC	VU
Myotis mystacinus		IV	LC	LC	VU
Myotis brandtii		IV	LC	LC	/

Species	*Detected*	*EU Habitat Directive Annex*	*IUCN Red List (Global)*	*IUCN Red List (Mediterranean)*	*FBiH Red List*
Myotis capaccinii		II, IV	VU	VU	VU
Myotis dasycneme		II, IV	NT	/	/
Myotis daubentonii		IV	LC	LC	/
Myotis alcathoe					
Pipistrellus pipistrellus	**YES**	**IV**	**LC**	**LC**	**VU**
Pipistrellus pygmaeus	**YES**	**IV**	**LC**	**LC**	**/**
Pipistrellus kuhlii	**YES**	**IV**	**LC**	**LC**	**VU**
Pipistrellus nathusii	**YES**	**IV**	**LC**	**LC**	**/**
Hypsugo savii	**YES**	**IV**	**LC**	**LC**	**VU**
Eptesicus serotinus	**YES**	**IV**	**LC**	**LC**	**/**
Nyctalus noctula	**YES**	**IV**	**LC**	**LC**	**EN**
Nyctalus leisleri	**YES**	**IV**	**LC**	**LC**	**/**
Vespertilio murinus		IV	LC	/	VU
Plecotus auritus		IV	LC	LC	VU
Plecotus macrobullaris		IV	LC	NT	/
Plecotus austriacus		IV	LC	LC	VU
Plecotus kolombatovici		IV	LC	LC	/
Barbastella barbastellus		II, IV	NT	NT	/
Miniopterus schreibersii	**YES**	**II, IV**	**NT**	**NT**	**EN**
Tadarida teniotis	**YES**	**IV**	**LC**	**LC**	**/**

Based on the data presented in Table 7, **at least one NT species from the global IUCN Red List** have been confirmed in the project area of influence, as well as 5 VU and 3 EN species from the Red List of FBiH inhabit this area so adequate mitigation measures are needed to avoid any potential long-term negative impacts. The bat species found in the project are also listed on Annex II and/or IV of the Habitat Directive.

The effects of roads on bats have been largely neglected until recently, despite growing evidence for profound effects on other wildlife. Still, research of impacts of roads on bats is relatively scarce. Lately there is some growing evidence that fragmentation caused by all types of roads (including motorways) reduces access to important habitats, leading to lower reproductive output in bats. The barrier effect is associated with reduced foraging activity and species diversity in proximity to motorways and other main roads. The effects of light and noise pollution may add to this effect in the immediate vicinity of roads and also make bats even more reluctant to approach and cross roads (Altringham, J. 2015).

Bats can be highly sensitive on light pollution and noise pollution. They are mainly gregarious so the expected impacts influence large number of species and individuals causing possible high mortality with very slow recovery.

The most common threats to bat species that are reported are the loss of natural and semi-natural foraging habitats, poor land management practices and the decline in prey species (for example due to the increased use of insecticides). The disturbance and destruction of roosting and breeding sites, (e.g. disturbance of cave and removal of old trees in forests) and feeding sites significantly impact on bat population.

Before commencement of any construction activities, more data and research with regard to bats are needed so adequate steps for further planning of the motorway design may be implemented. The first step in minimizing impacts on bat species is to select the motorway route that avoids important bat habitats. Therefore, **an adequate 1-year monitoring on key different habitats** should be undertaken and bat corridors, other potential roosting sites and

foraging areas should be referenced on maps using GIS software and afterwards, the definitive route changes shall be proposed if found to be required.

Some level of adverse impact of motorway on the bat populations is expected in whole project area, but the highest is expected on the motorway route and 500 m buffer zone from both sides of the road. The northern and middle part of the project area, due to their habitat composition and possible foraging sites are the areas with potential high risk for bat species, while for other areas this risk can be assessed as potentially moderate.

It is unlikely that bat species will be disturbed during the construction phase if it will be conducted during daylight, unless unknown roosts sites are discovered and disturbed. If conducted during the night, construction activities may lead to some species of bats to avoid the area around construction sites due to noise. Presence of light sources may attract some species (increasing collision risk) while repelling others. This impact can be considered an extension of the impact due to loss of habitat. This survey showed that disturbance can extend 100-500 m around the planned motorway route and its auxiliary facilities. Disturbance is considered to have a moderate to potentially high impact to bats population in the area.

Loss of habitat

The two-lane (both directions) motorway in 14.2 km section will destroy approx. 9.5 ha of habitats which bats may use for foraging. Removal of trees, grassland, scrubs can significantly reduce the bats species habitat. As a result, road construction leads to the permanent loss of habitats for bats and thus it is likely to reduce population sizes (Altringham, J. 2015).

Barrier effect

As a typical long-line facility, the motorway can be a potential barrier for almost all bat species, since the motorway can separate foraging site from the nests (shelter), or between summer hunting grounds and winter roosts. Such barriers can reduce or restrict daily and seasonal migration, which directly impacts the bat population in terms of reproducing and linear line flight. Motorway is a barrier influence to bats in terms of sudden habitat change and changing habitat size. Since habitat size can be directly connected with population size, this type of impact can have negative influence on bat population size in area.

Motorway may also have negative impacts in term of communication between two groups of the same species, which leads to a possible genetic isolation and reducing population fitness (inbreeding). There is considerable evidence to suggest that motorway acts as a barrier to bats during foraging and movements between different day roosts (roost switching) in the summer habitat. Bats have been shown to make major detours to avoid motorway or to find appropriate crossing points (Altringham, J. 2015). In overall, bats can see the motorway as a barrier for several reasons: open spaces and artificial light expose them to predation, and moving traffic and noise may be seen as threats.

Roadkill

A significant proportion of European bat species, occupying a range of ecological niches, have been documented as roadkill (Altringham, J. 2015). Woodland-adapted species should be most affected due to their characteristics, low and slow flight (Altringham, J. 2015). All bat species (or individuals) who attempt to cross the motorway line are at collision risk. Additional danger is represented by motorway lights which attract insects and motorway structures which can serve as shelter from predators. Bat roadkills are not researched enough to have adequate conclusions but they certainly exist. Some researches show that bat deaths caused by roadkills vary between 0.3 bats per km to 6.8 bats per km (Altringham, J. 2015), but this depends up to the surrounding habitat. Death ratio, caused by roadkills, is much higher in tree ecosystems, near rivers (foraging sites) or near roost sites, than in the open grounds (fields).

In case of the proposed 14.2 km motorway line, the risks zones include crossing the Podvelezje plateau (T2-T3) and the whole most northern area of the project (Kutilivac).

Habitat Degradation—Light, Noise and Chemical Pollution

Other type of disturbance on bat populations is light pollution. Some bat species (genus *Nyctalus* Bowdich, 1825 and *Pipistrellus* Kaup, 1829) are attracted by lights because light attracts insects which are prey to bats. Other bat species (species living in or near the forest and water) are much more sensitive to light and avoid all types of light pollution. Since nightlight attracts many insect species, bat species that avoid lights may have difficulty in hunting, and this may result in a decrease in their population size over time.

Noise is the second important possible "polluter" which may negatively influence on bat species. All bat species in BiH use echolocation to navigate in area, to hunt and find partner for mating. The noise pollution impact on bats is not yet researched properly, however some experiments show that simulated traffic noise reduced the feeding efficiency of the greater mouse-eared bat, *Myotis myotis* (Borkhausen, 1797), which typically hunts by listening sounds of its prey on the ground. It is expected that the areas close to the motorway and on its buffer zone of 100 m will be unattractive for bat species and that it will cause the absence of bat species in that area. This is especially important if motorway crosses or cuts important as foraging areas. However, there are no published field studies that have assessed the effect of traffic noise on bat diversity, abundance or breeding success. As described below, traffic noise and light, is only likely to have a significant effect over relatively short distances (Altringham, J. 2015).

Chemical pollution caused by motorway traffic can be one of the significant negative factors for bat population in the motorway vicinity. So far, there is no proof of direct negative impacts of chemicals on bats, but it is proven that chemicals have negative influence on arthropods (insects) which are the main prey to bats in BiH.

Possible benefits

Possible benefits of motorway construction on bats are not yet researched enough. In terms of possible roosting sites, some bat species use artificial structures like bridges to form colonies, nesting and nursery sites. One of best examples of that is in BiH where the colonies of *Nyctalus noctula* (Schreber, 1774) species were discovered in concrete bridge in town of Capljina[5]. Effective mitigation measures and restoration (or compensation) of lost or degraded habitats will make the environment in the vicinity of motorway more attractive for bat species, which increases the risk of collision deaths (roadkill).

Other possible benefits are the lights. The night lights can benefit for some species, but may also have significant negative impact on other bat species. Species that hunt on open habitats, like fields, will benefit from the motorway lights, but species that hunt in forests will not experience the same effect. Adequate measures should be taken into account when constructing motorway to avoid light pollution on motorway part that passes water bodies and forest ecosystems.

4.2 Mitigation and monitoring measures

Before the commencement of the construction phase, and even before design phase is completed, it is recommended to do a 1-year full monitoring of bat populations in the area.

According to the field research undertaken as part of this assignment, part of the project area (T2-T3) together with the northern part (T6-T7) can be considered to be at high risk for bat populations due to the facts that part of this area is covered by scrubland and trees vegetation and that the area is used as foraging sites for multiple bat species. In addition, on T2 point it was observed that bat species daily move from lower to the higher altitudes crossing the planned highway route likely in search for foraging ground.

Other project areas (near T1, T4 and T5) can be considered as medium risk due to the open, mainly anthropologically changed habitats (Figure 4).

The 1-year period monitoring of bat species in the area which will include all known methods of monitoring (ultrasound recording, mist-netting etc.) and inspection of other potential bat sites (roost, hibernation etc.) is needed to prevent potential negative long-term impacts on bats and their habitats.

[5] http://www.centarzakrs.ba/bats/37-u-bosni-i-hercegovini-prvi-put-obiljezena-manifestacija-evropska-noc-sismisa-saopcenje-za-medije.html

4.2.1 Preconstruction phase

Impact	*Impact measure*	*Impact significance after conduction on mitigation measures*
Inadequate planning of construction. Inadequate planning may lead to the disturbance in terms of habitat loss, foraging sites loss, fly corridor barrier, roost sites loss etc.	The motorway planning should not be completed before adequate field researches are undertaken. Bat surveys should be undertaken at least one-year period to observe bat corridors, roost sites and foraging grounds to have adequate insight which areas need to be avoided for construction. Bat research should include: echolocation recording and identification, mist-net research, speleological objects research, roost sites examined and winter hibernation sites mapped.	Low
Unknown qualitative and quantitative composition of bat species in the project affected area. Unknown roost sites, foraging grounds, flight corridor paths. Lack of field research may cause long term negative impacts on bat population, and even cause their disappearing from the area.		Low

4.2.2 Construction phase

Impact	*Mitigation measure*	*Impact significance after conduction on mitigation measures*
Habitat degradation Destruction of roost sites.	The habitat restoration – should be undertaken after construction phase is completed. Alternative roost sites in the vicinity should be planned if one is accidentally destroyed by construction works. Before the work starts, a bat expert to check the abandoned artificial facilities (houses etc.) which must be removed for the bat colonies.	Moderate (even if mitigation measures are well taken, there is no guarantee that bat species will use this restored habitats or new roost sites)
Noise pollution.	Construction during night period and during spring, summer and autumn seasons should be avoided in forest habitats. Night work during the winter and hibernation period in these areas is allowed. Adherence to implementation of these measures should be monitored.	Low
Chemical pollution.	There is no significant research on how chemical pollution can affect bat species. This pollution type has much more influence on bat prey (arthropods), with emphasis on forest and water habitat type. Adherence to implementation of good construction practices with regard to spillage prevention should be monitored.	Low
Vibration pollution.	Avoid the motorway construction on roost and hibernation sites. Adherence to implementation of these measures should be monitored.	Low

4.2.3 Operation phase

Impact	*Mitigation measure*	*Impact significance after conduction on mitigation measures*
Noise pollution.	During this phase, noise pollution is hard to avoid and mitigate. Different type of vehicles will generate different levels of noise. However, it is expected that frequency of traffic will be lower during the night period so it is not expected that noise pollution resulting from the vehicle traffic will affect bat species, which are also active during the night.	Low
Light pollution.	Avoiding construction of artificial street lights, tunnel lights and lightened	Low

Impact	*Mitigation measure*	*Impact significance after conduction on mitigation measures*
	traffic signs on part of motorway that cross forest and water habitats. Avoid the construction of auxiliary facilities, such as gas stations, resting places, billboards etc. Preferably use only red lights for signalization which will not attract insects.	
Chemical pollution.	Potential impacts caused by potential accidental situations (spillages due to accidents) would not pose a significant risk due to the fact that motorway construction involves the installation of separators for removal of impurities. Regular cleaning of oil separators and implementation of these measures should be monitored.	Low

5 ANNEXES

5.1 Maps

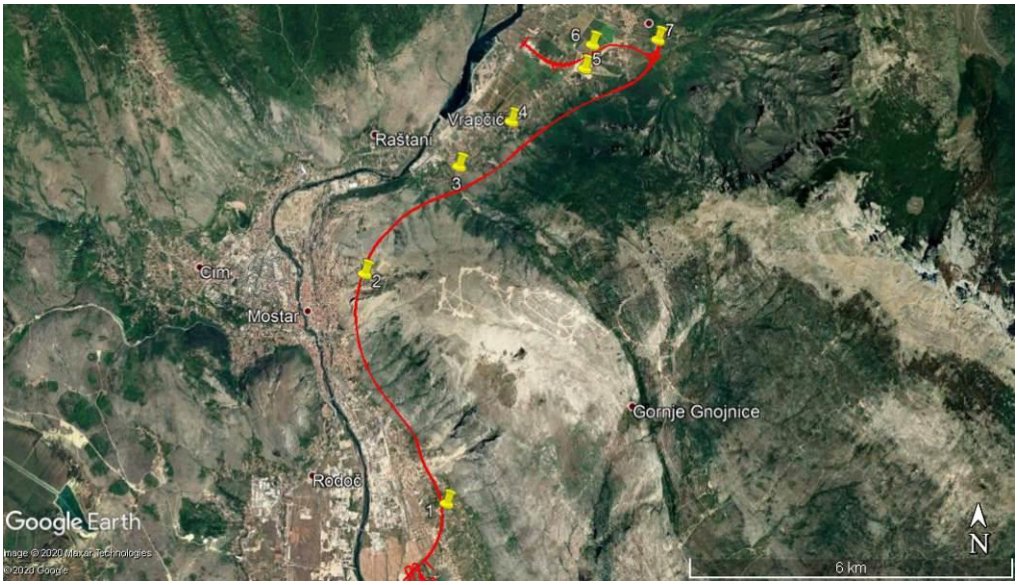

Figure 3: Observation points (T1 - T7) – Source: Google Earth

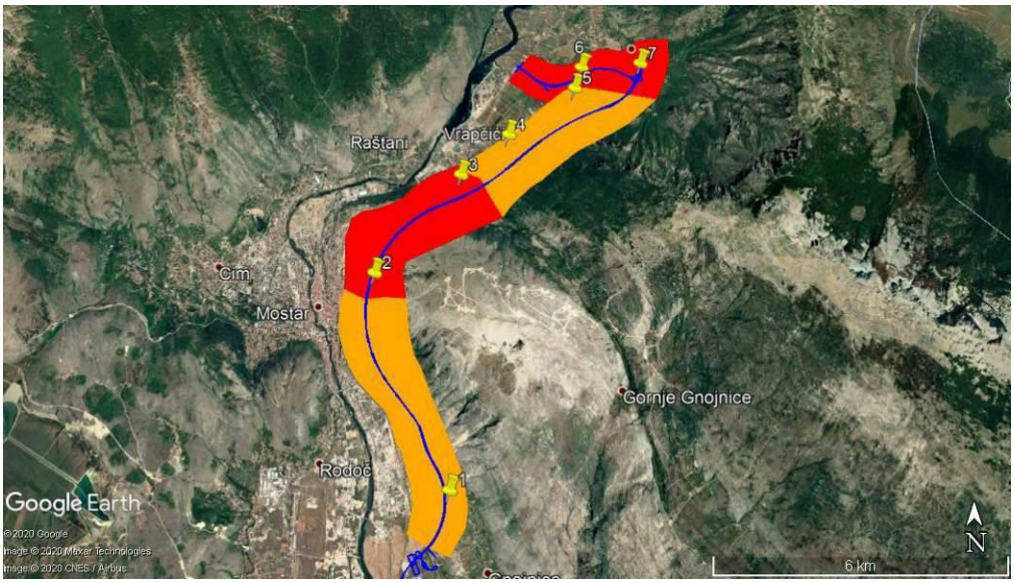

Figure 4: Map of the risk zones (risk zone is approx. 500 m-1 km left and right from the planned motorway route) (Source: Google Earth)

5.2 Photographs

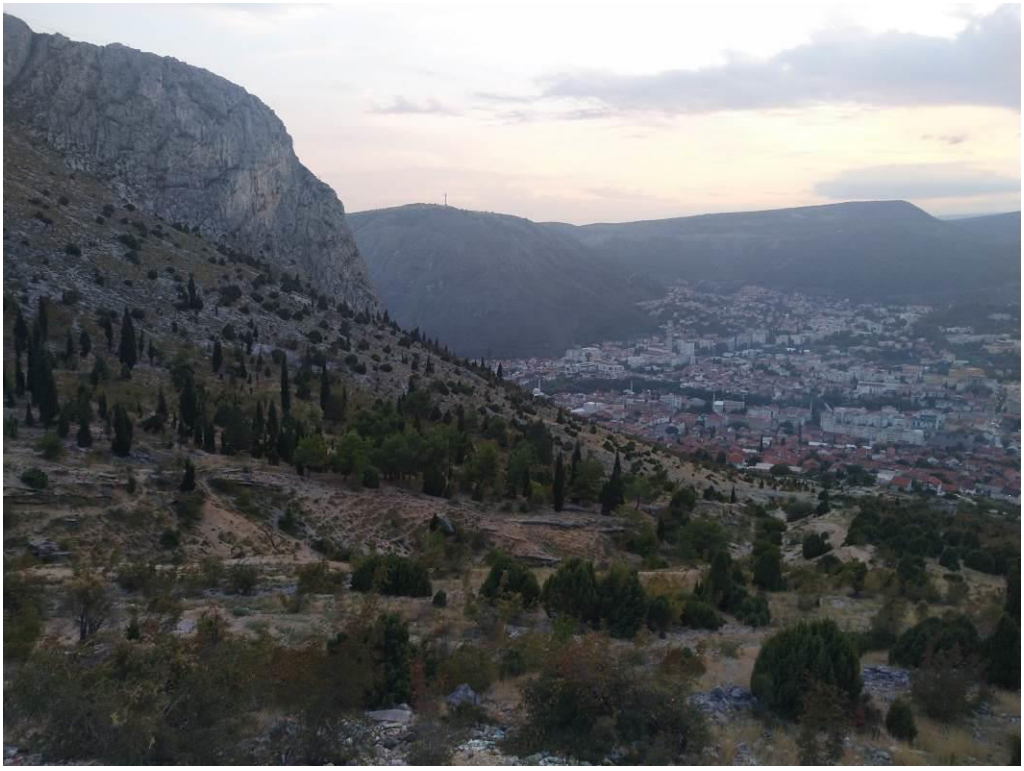

Figure 5: Scrubland vegetation at planned construction site – area on T2 recording point; In background – City of Mostar (Photo: Admir Aladzuz)

Figure 6: Typical mixed mid-sized trees and orchard vegetation – Location near T3 recording point (Photo: Admir Aladzuz)

Figure 7: One of the settlements in project route – settlement Opine (Photo: Admir Aladzuz)

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CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

Environmental and Social Impact Assessment
Mostar North-Mostar South

ANNEX C-5: LARGE MAMMALS

May 2021

Table of Contents

1 INTRODUCTION

1.1 Project background

During 2020 ENOVA was commissioned to undertake Environmental and Social Assessment relating to the Corridor Vc section Mostar North-Mostar South. The results of the previous gap analysis for biodiversity found that supplementary biodiversity information would be required, so that an informed assessment of sensitive habitats and biodiversity features could be undertaken. The supplementary information has been gathered through both field surveys and an up to date desk study. The following field surveys have been undertaken and will form an Annex to the final Environmental and Social Assessment study:

- Annex A: Habitats, vegetation and invasive species
- Annex B: Invertebrates[1]
- Annex C: Vertebrates
    - Annex C-1: Herpetofauna (amphibians and reptiles)
    - Annex C-2: Ornithofauna
    - Annex C-3: Mammals - bats
    - **Annex C-4: Large mammals.**

This report provides the results of the large mammals desk and field study.

1.2 Site locations

The 14.2 km long section Mostar North-Mostar South begins 500 m before the Mostar North Interchange in the Kutilivac settlement, east of Vrapcici, and ends just before the Mostar South Interchange near the Mostar Airport. After the interchange, the alignment extends towards the settlement of Suhi Do, where the route is moved to the east ("up the hill"), in order to avoid houses.

After Suhi Do, the section enters the Tunnel Ostri Rat (L=3,380 m), turning towards the south and bypassing the City of Mostar. In the area east of Luke settlement, the alignment exits the tunnel and passes the slopes above the settlements and extends south towards the Buna valley. The section crosses the relatively uneven terrain between Ostri Rat and Gnojnice viaducts and tunnels. In Kocine settlement the alignment passes through a tunnel (L=2,600 m). After exiting this tunnel, the alignment descends towards the Mostar South Interchange.

The section ends at the Mostar South Interchange, which enables the connection between the motorway and main road M6.1 and it is located east of Mostar Airport. This location provides direct connection between the City of Mostar, the Airport and western Herzegovina via the planned southern bypass of the City to the motorway on Corridor Vc.

On this section the total length of the tunnels is 8,110 m, and the total length of the bridges is 940 m. The alignment passes mainly through hilly and mountainous terrain with significant spatial limitations, so along the section, cuts and embankments with a larger number of buildings alternate.

1.3 Report aim and objectives

The main aim of this assignment is to provide a written report to inform the ESIA Disclosure Package and Biodiversity Management Plan. In order to achieve this aim, this report has been written to satisfy the following objectives:

- Provide the methodology and results of the desk and field survey
- Evaluate project area and project area of influence for the likely presence of sensitive species/species of conservation concern

[1] Only of conservation concern

- Recommend preconstruction surveys, additional mitigation and/or monitoring only if required.

2 METHODOLOGY

2.1 Survey background

Desk research study and field survey of the planned Project area was conducted by by Doc. dr. Adi Vesnic, who has more than 10 years of experience as an ecologist, environmental biologist and independent expert for biodiversity surveys for designation of new protected areas as well as for environmental impact assessments. He is an experienced researcher in the field of zoology, systematic (taxonomy) and ecology.

A field survey of the area from the Mostar North interchange to Mostar South interchange has been undertaken during four field visits: 1) 1-2 September 2020, 2) 13-14 September 2020, 3) 21-22 September 2020, 4) 5-6 October 2020. The survey has been carried out in optimal weather (daily temperatures 16-32^{o}C).

2.2 Methodology

The desk research was undertaken to analyze the relevant literature (e.g. previous and ongoing assessments, papers and reports) and has been reviewed with regard to the presence of large mammal species of conservation concern in the project area, as well as the ecological conditions of the project area and area of influence.

The research was conducted to collect and analyze all information available on published documents regarding the biodiversity of the area comprising the motorway sections of the Corridor route Vc and hunting areas that are located in the Project area. The hunting organization that manages the hunting area in the area of influence of the future motorway is the Hunting Association “Jarebica” Mostar which was contacted for additional data on large mammals.

The list of the species of international conservation concern given within this report is based on the publications and documents given in Chapter 5 Literature.

The field survey was conducted during period of four field trips: 1) 1-2 September 2020, 2) 13-14 September 2020, 3) 21-22 September 2020, 4) 5-6 October 2020. During field surveys indirect evidence of the presence of the large mammal species was sought such as: faeces, traces, dens. Consultative conversations have been held with the inhabitants with regard to the presence of predators and potential harm to domestic animals.

Table 1: The coordinates, location name, general observations regarding sampling points along the Vc corridor

Coordinates		*Sampling point name*	*General observations regarding sampling points*
Lon.	Lat.		
17.90376	43.39199	L1_petlja (interchange)	Residential buildings of villages and urban peripheries with hedgerow
17.90183	43.38049	L1_tocilo (scree)	Oak forests with macchia
17.88747	43.38068	L2_tunel_T1 (tunnel t1)	Oak stump forests
17.86261	43.37437	L3_vijadukti (viaducts)	Sipar
17.85117	43.36307	L4_vijaduktM2 (viaduct M2)	Cliffs and forests of pine and oak
17.82615	43.35193	L5_tunel_T4 (tunnel T4)	Thermophilic meadows and garrigue
17.82996	43.32564	L6_vijadukt_M6 (viaduct M6)	Macchia
17.84213	43.31651	L7_tunel _T6 (tunnel M6)	Macchia
17.84695	43.30592	L8_cvoriste_Jug (interchange south)	Residential buildings of villages and urban peripheries

2.3 Assumptions and limitations

During undertaking of the desk research, the Consultant assumed no assumptions or limitations except the scarce data of the project area regarding large mammals.

2.4 Project area of influence

Large mammals usually inhabit a wide area which may stretch to e.g. 50 km or more for some species. Considering the present conditions of the habitats in the project area and the existing fragmentation of habitats due to the local roads, settlements and other infrastructure, it is considered that the project area has no potential to sustain large mammals as most natural habitats are already degraded and due to traffic noise of nearby urban and semi-urban areas.

3 RESULTS

The project area passes near the settlements: Zeljusa, Kutilivac, Vrapcici, Mostar and other infrastructures such as the main road, railway, local roads, electrical infrastructure, and fence partitioned meadows.
During field research of the motorway route, no hunting technical facilities were found on site: tree stands, baiting areas for carnivores or other hunting facilities that would indicate an intensive approach to hunting. Considering that the route passes along the edge of settlements that already fragment game (hunting) habitats and does not enter high forest habitats, during the field surveys it was determined that along the route there are suitable habitats for *Capreolus capreolus*, *Lepus europaeus*, *Vulpes vulpes*, *Canis aureus*, *Martes foina*, *Mustela nivalis*, *Mustela putorius* and *Herpestes ishneumon*. During field research, indirect evidence was found in the form of faecal matter and prints for: *Capreolus capreolus*, *Lepus europaeus* and *Vulpes vulpes*. Findings of species *Martes foina* and *Erinaceus roumanicus* are based on the noticed individual road kill specimens along the existing road in the project area.

A summary of the desk and field study results are shown below in Table 2. The next section shows the results of the research in tabular format and summarizes the species of conservation concern and identifies key potential species and their habitats. The evaluation is based on the research of threatened species/habitats of the species of large mammals at the selected localities.

The following abbreviations have been used:

IUCN – International Union for Conservation of Nature

FBiH – Federation of Bosnia and Herzegovina Red List

- CR – Critically Endangered
- EN – Endangered
- VU – Vulnerable
- NT – Near Threatened
- LC – Least Concern
- DD – Data Deficient

HD – European Habitats Directive

- II – Annex II
- IV – Annex IV.

BC – Bern Convention

- II – Annex II
- III – Annex III

Table 2: Desk survey results

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Desk Area?*	*Desk Finding – was species Found?*	*Location (where?)*	*Source of information*
Beech marten	*Martes foina*	IUCN LC, FBiH LC, BC III	Yes	Yes, roadkill. Suitable habitats for the species, species enters rural and suburban habitats in search for food.	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.
Fox	*Vulpes vulpes*	IUCN LC, FBiH LC	Yes	Habitats suitable for life and reproduction Species enters rural and suburban habitats in search for food.	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.
Golden jackal	*Canis aureus*	IUCN LC, FBiH LC	No	Habitats suitable for life and reproduction Species enters rural and suburban habitats in search for food.	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.
Mongoose	*Herpestes ishneumon*	IUCN LC, FBiH LC	Yes	Yes, can be found in the Project area, Habitats suitable for life, reproduction	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.
Rabbit	*Lepus europeaus*	IUCN LC, FBiH LC, BC III,	Yes	Yes, can be found in the Project area, Habitats suitable for life, reproduction	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.
Roe deer	*Capreolus capreolus*	IUCN LC, FBiH LC, BC III	Yes	Yes, can be found in the project area. Habitats suitable for life, reproduction	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Desk Area?*	*Desk Finding – was species Found?*	*Location (where?)*	*Source of information*
Stoat	*Mustela erminea*	IUCN LC, FBiH LC, BC III	Yes	Yes, can be found in the project area. Habitats suitable for life, reproduction	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.
Wild boar	*Sus scrofa*	IUCN LC, FBiH LC	Yes	In Kutijevo Habitats suitable for life and reproduction in open habitats used as feeding areas and in transit	Kutijevo	Field surveys and literature data ESMP 2006 based on the hunting management plans for Mostar, Capljina, Ljubuski. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006.
Brown bear	*Ursus arctos*	IUCN LC, FBiH VU, HD II (*), BC II,	No	No, habitats farmed and disturbed	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
Chamois	*Rupicapra rupicapra*	IUCN LC, FBiH VU, BC III	No	No, the species inhabits high forests and mountain habitats	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
Eurasian otter	*Lutra lutra*	IUCN NT, FBiH EN, HD II, IV, BC II	No	No suitable habitats due to absence of permanent water cources	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Desk Area?*	*Desk Finding – was species Found?*	*Location (where?)*	*Source of information*
						the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
European badger	*Meles meles*	IUCN LC, FBiH LC, BC III	No	No suitable habitats for the species in the project area	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
European pine marten	*Martes martes*	IUCN LC, FBiH LC, BC III	No	No, habitats farmed and disturbed	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
Polecat	*Mustela putorius*	IUCN LC, FBiH LC, BC III	No	No, habitats farmed and disturbed	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
Squirrel	*Scirius vulgaris*	IUCN LC, FBiH LC, BC III	No	No, habitats farmed and disturbed	No data	Ministry of Communication and Transport. Environmental Impact

Species English Name	*Scientific Name*	*Conservation Status*	*Suitable Habitat in Desk Area?*	*Desk Finding – was species Found?*	*Location (where?)*	*Source of information*
						Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
Wildcat	*Felis silvestris*	IUCN LC, FBiH LC, HD IV, BC II	No	No, habitats farmed and disturbed	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
Wolf	*Canis lupus*	IUCN LC, FBiH EN, HD II, IV(*), BC II	No	No, habitats farmed and disturbed	No data	Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4 (Civil Engineering Institute of Croatia), 2006. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.

4 DISCUSSION AND RECOMMENDATIONS

4.1 Summary of main findings

Based on the desk research results, 17 species of large and medium-sized mammals have been found in the previous studies. Based on the site visits in September and October 2020, the habitats have been assessed as suitable for sustaining **of the nine species**. Habitats most suitable for large mammals are in the area of Kutilivac and forests along the mountain edge. Given the high prevalence of degraded habitats, the area is dominated by low game species represented by rabbit, fox, jackal and other species that enter villages such as martens and weasels.

The habitats along the route are not suitable for large species such as Chamois (*Rupicapra rupicapra*), Bear (*Ursus arctos*) or wolf (*Canis lupus*). This is due to the state of the habitats, which are modified and semi-modified by human activity over the years. Other infrastructure is also present in the settlements, such as: main, road, railway road and electrical infrastructure. The area of Kutilivac is also suitable for big game, it is represented with roe deer (*Capreolus capreolus*), and wild boar (*Sus scrofa*) passing along the edge of the settlements.

In the territory of the Federation of Bosnia and Herzegovina, hunting is legally regulated by the *Law on Hunting* ("Official Gazette of the Federation of Bosnia and Herzegovina", No. 4/06, and 8/10) and the *Law on Amendments to the Law on Hunting* ("Official Gazette of the Federation of Bosnia and Herzegovina", No. 81/14). The hunting organization that manages the hunting area in the area of influence of the future motorway is the Hunting Association "Jarebica" Mostar.

The following Table 3 shows the approximate numerical state of the game (the numbers given are not an excerpt from the management plans, so they should be expected to deviate (10-15%) from the actual numerical status in the field). The data on the number of wildlife in Mostar Hunting area is outdated and was recorded in 2007. Unfortunately no new data is available.

Table 3: The approximate number of main hunting game for hunting organization Mostar

Mostar hunting area

Species	**Number**
Chamois	210
Roe deer	200
Wild boar	700
Bear	4
Wolf	70
Wildcat	70
Rabbit	1308
Fox	200
Marten	800

Source: Motorway Environmental Impact Study on Corridor Vc Lot 4 Mostar North – South Border

4.1.1 Sensitive species

Brown bear (*Ursus arctos*), Wolf (*Canis lupus*), and Eurasian otter (*Lutra lutra)* are among the most sensitive species identified as part of the desk study, since the species are classified as vulnerable or endangered, respectively, on the Red List of FBiH. Eurasian otter is also classified as near-threatened on the IUCN Red List. Other species of large mammals identified in the literature review as part of this report are not on the IUCN Red List of critically endangered, endangered and vulnerable species.

The three mentioned species are listed on Annex II of the Habitat Directive, while the brown bear and wolf are also being classified as priority species. Annex II of the Habitats Directive requires the establishment of a consistent network

of special areas of conservation; the sites should be managed in accordance with the ecological requirements of the species. A strict protection regime must be applied for species and subspecies of community interest listed in Annex IV. **Based on the existing conditions of the habitats, the area has no potential to sustain the brown bear and wolf, whereas the presence of Eurasian otter cannot be expected due to absence of permanent water bodies** which would are suitable habitats for Eurasian otter.

During the desk study conducted as part of this assignment, in addition to these findings, three species from the Habitat Directive i.e. strictly protected species listed in Annex IV have been recorded in previous studies, as given in Table 2. However, based on the existing conditions of the habitats, the area has **no potential to sustain wolf, bear and wildcat.**

The impact on wildlife and hunting needs to be considered through several factors that are crucial for its assessment, the most important of which are: habitat fragmentation (it affects migration and basic needs of fauna), inorganic waste (poses a potential risk to game due to injury) and organic waste (predators gather due to easily accessible food and thereby lose their innate fear of humans, which represents danger to the possible occurrence of disease).

An increase in casualties of people and animals (traffic accidents) can also be expected it is therefore necessary to apply measures acceptable in terms of game and hunting.

4.2 Mitigation measures

4.2.1 Preconstruction phase

All species of large mammals found in the Project area and identified in the previous studies have been scoped out due to the current condition of the area.

Regarding the protection of wild game, project bridges and planned construction activities should be designed and implemented in a way to avoid any additional and unnecessary destruction of natural habitats (e.g. for construction of auxiliary access roads).

4.2.2 Construction phase

Construction activities will include the use of heavy machinery, which generate noise and vibration that will disturb the mammals, forcing them to search for other more quiet and safer places. This impact is considered to be temporary and not significant.

Protection measures must be imposed to protect mammals from accidents during this phase. All surplus material that will not be used in the construction works must be stored on previously planned locations for. The construction waste must be systematically managed and transported away from the construction site to a construction waste landfill to prevent fatalities of fauna. Waste disposal along the route should be avoided.

A safety fence shall be placed along the construction site and the construction site as part of the construction site organisation. Some waste types e.g. inorganic waste (that could trigger possible injuries) and organic waste (because of accessible food source, this represents a threat of possible diseases) need to be adequately managed, as given in the Waste Management Plan and Construction Waste Management Plan.

4.2.3 Operation phase

Accidents of with animals with traffic may occur during the attempt of individuals to cross over the motorway. Therefore, the motorway needs to be fenced and the fence maintained properly throughout the operation phase.
The fence must be fixed to the ground.
The route passes along the edge of the settlement. Certain species of large mammals have a tendency to approach human settlements, therefore it is necessary to secure the highway fence and undertake regular examinations and maintenance of the fence during operation phase.

4.3 Monitoring measures

4.3.1 Construction phase

It is necessary to inspect the route and remove any species individuals out of the motorway area after the fencing of the motorway is completed and prior to the commencement of the operation phase. The viaducts along the motorway route and fence should be constructed as open passages for wildlife.

4.3.2 Operation phase

A permanent monitoring system of access roads and the motorway should be conducted after construction, in order to determine any deaths by possible run over. These activities shall be conducted by a skilled biologist.

If road-kills are registered, frequency and distribution of animals must be done in a period of one year, with an analysis of the places of accidents and the taxonomic belonging of the killed animals. The applicable mitigation measures to avoid road-kills are: placing of prismatic mirrors, and more important, regular maintenance of the safety fence along the motorway. If all given measures of protection are followed, a significant negative effect of the motorway on the fauna is not expected.

5 LITERATURE

1. PC FBiH Motorways. Additions to the Environmental Impact Assessment. Motorway in the Corridor Vc, Mostar jug-Buna section Mostar jug- Kvanj tunnel subsection (Institut za gradevinarstvo „IG“ Banja Luka), 2020.
2. Ministry of Communication and Transport. Environmental Impact Study for the Corridor Vc Motorway Mostar north-south border for LOT 4(Civil Engineering Institute of Croatia), 2006.
3. PC FBiH Motorways. Study on Environmental Impact Assessment for Motorway for LOT 5, 6: Section Mostar north – Mostar south – Pocitelj, Mostar South - Buna (CETEOR Ltd.), 2017.
4. Environmental and Social Assessment for EBRD. Gap Analysis Report. Category A road project: Corridor Vc in FBiH - Part 3 (Tranche II). Ecoplan & Solutions for a Small Planet, 2019.

6 ANNEXES

6.1 Maps

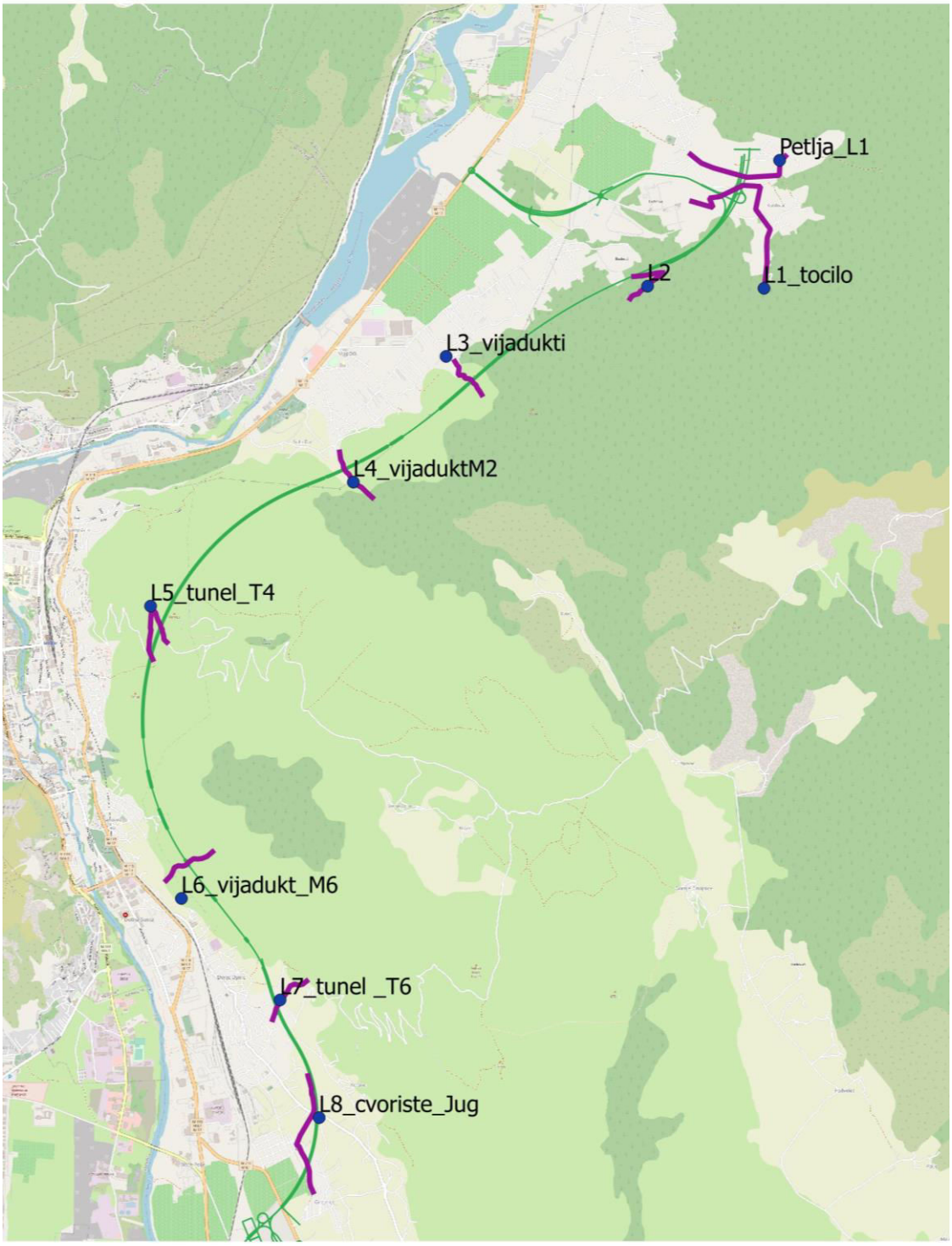


Figure 1: Distribution of the transect points along the motorway route

6.2 Photographs

Figure 2: L1_petlja Residential buildings of villages and urban peripheries with hedgerow

Figure 3: L1_petlja Residential buildings of villages and urban peripheries with hedgerow

Figure 4: L1_tocilo Oak forests and macchia

Figure 5: L1_tocilo Oak forests and macchia

Figure 6: L2_tunel_T1 Oak stump forests

Figure 7: L2_tunel_T1 Oak stump forests

Figure 8: L3_vijadukti Sipar

Figure 9: L3_vijadukti Sipar

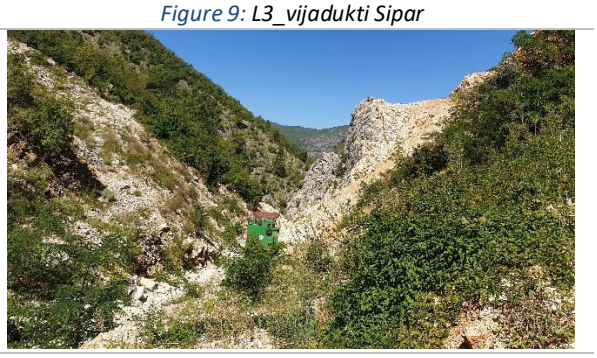


Figure 10: L4_vijaduktM2 Cliffs and forests of pine and oak

Figure 11: L4_vijaduktM2 Cliffs and forests of pine and oak

Figure 12: L5_tunel_T4 Thermophilic meadows

Figure 13: L5_tunel_T4 Thermophilic meadows

Figure 14: L6_vijadukt_M6 Macchia

Figure 15: L6_vijadukt_M6 Macchia

Figure 16: L7_tunel _T6 Macchia

Figure 17: L7_tunel _T6 Macchia

Figure 18: L8_cvoriste_Jug Residential buildings of villages and urban peripheries

Figure 19: L8_cvoriste_Jug Residential buildings of villages and urban peripheries

CATEGORY A PROJECT
Bosnia and Herzegovina Corridor Vc in FBiH
Mostar Motorway

Environmental and Social Impact Assessment
Mostar North-Mostar South

ANNEX D: CRITICAL HABITAT ASSESSMENT

May 2021

Table of Contents

1 CRITICAL HABITAT ASSESSMENT

1.1 Project background

During 2020 ENOVA was commissioned to undertake Environmental and Social Assessment relating to the Corridor Vc section Mostar North-Mostar South. The results of the previous gap analysis for biodiversity found that supplementary biodiversity information would be required, so that an informed assessment of sensitive habitats and biodiversity features could be undertaken. The supplementary information has been gathered through both field surveys and an up to date desk study.

Annex D: Critical habitat assessment evaluates sensitive species against criteria for Critical Habitat and Priority Biodiversity Features set by EBRD's Performance Requirement 6.

2 METHODOLOGY

2.1 Introduction

Assessment of potential impact upon sensitive biodiversity features that could be considered "Critical Habitat" and/or "Priority Biodiversity Feature" is done in accordance to EBRD Performance Requirement 6.

Critical Habitat (CH) is a description of the most significant and highest priority areas of the planet for biodiversity conservation. It takes into account both global and national priority setting systems and builds on the conservation biology principles of 'vulnerability' (degree of threat) and 'irreplaceability' (rarity or uniqueness). Determination of CH is based upon quantitative thresholds of biodiversity priority which are largely based on globally accepted precedents such as IUCN Red List (IUCN, 2020[1]) criteria, local Red Lists (FBiH Red List in this case) and Key Biodiversity Area (KBA) thresholds. The definition of the critical habitat is based on the presence of high biodiversity values whether or not a project is to be undertaken in that habitat.

Under EBRD PR6 the most sensitive biodiversity features are defined as critical habitat and include the following:

i. Highly threatened or unique ecosystems
ii. Habitat of significant importance to endangered or critically endangered species
iii. Habitats of significant importance to endemic or geographically restricted species
iv. Habitats supporting globally significant (concentrations of) migratory or congregatory species
v. Areas associated with key evolutionary processes
vi. Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features).

EBRD PR6 also uses the concepts of vulnerability and irreplaceability to define areas that, whilst not as globally important as Critical Habitat, are still of significant ecological importance often at a regional level. Such areas are referred under the EBRD PR6 Guidance[2] as Priority Biodiversity Features (PBF).

Priority Biodiversity Features are defined as "a subset of biodiversity that is particularly irreplaceable or vulnerable, but at a lower priority level than critical habitats" by EBRD. They may include areas that contain:

[1] All references to the IUCN Red List have been taken from the most recent update (Version 2020-1) which can be found at: http://www.iucnredlist.org/ (last accessed 30 June 2020)
[2] EBRD (2016). Guidance Note: EBRD Performance Requirement 6. European Bank for Reconstruction and Development

i. Threatened habitats
ii. Vulnerable species
iii. Significant biodiversity features identified by a broad set of stakeholders or governments
iv. Ecological structure and functions needed to maintain the viability of priority biodiversity features.

Both CH and PBF are determined using criteria set by EBRD PR6, and the comparison of the two is provided in Table 1 below.

Critical Habitat Assessment (CHA) identifies the potential of the Project to impact species and habitats that could trigger Critical Habitat and/or Priority Biodiversity Feature criteria. This Critical Habitat Assessment has been undertaken separately to the ESIA, but used the information from the ESIA to focus attention on areas where critical habitat trigger species were present or potentially present. This involved both the primary data and secondary data collected for the ESIA, plus the opinion of the local experts collecting and interpreting the ESIA data. The supplementary information has been gathered through both field surveys and an up to date desk study. Field studies of habitats, vegetation, invasive plant species, invertebrates of conservation concern and vertebrates (herpetofauna, ornithofauna, large mammals and bats) were undertaken during summer and early autumn. Detailed survey findings have been presented in standalone reports, namely Annexes A-C.

Table 1: Comparison of Critical Habitat and Priority Biodiversity Features triggers as per EBRD PR6 Guidance Note (2016)

Critical Habitat	*Priority Biodiversity Feature*
Highly threatened or unique ecosystems Ecosystems that are at risk of significantly decreasing in area or quality; have a small spatial extent; and/or contain concentrations of biome restricted species. For example: i) Ecosystems listed as, or meeting criteria for, Endangered or Critically Endangered by the IUCN Red List of Ecosystems ii) Areas recognised as priorities in official regional or national plans, such as National Biodiversity Strategy and Action Plans iii) Areas determined to be of high priority/significance based on systematic conservation planning carried out by government bodies, recognised academic institutions and/or other relevant qualified organisations (including internationally-recognised NGOs).	**Threatened habitats** Habitats considered under pressure by national, regional or international assessments. These include natural and priority habitats identified under the EU Habitats Directive (Annex I).
Habitats of significant importance to endangered or critically endangered species Areas supporting species at high risk of extinction (Critically Endangered or Endangered) on the IUCN Red List of Threatened species (or equivalent national/regional systems). For example: Alliance for Zero Extinction sites; Animal and plant species of community interest in need of strict protection as listed in EU Habitats Directive (Annex IV).	**Vulnerable species** Species listed by the International Union for Conservation of Nature (IUCN) or any other national/regional lists (such as national Red Lists) as Vulnerable (VU) or equivalent. These include animal and plant species of community interest identified under the EU Habitats Directive (Annex II).
Habitats of significant importance to endemic or geographically restricted species Areas holding a significant proportion of the global range or population of species qualifying as restricted range under Birdlife or IUCN criteria. For example: Alliance for Zero Extinction sites or Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for restricted-range species.	**Significant biodiversity features identified by a broad set of stakeholders or governments** Eg. Key Biodiversity Areas and Important Bird and Biodiversity Areas; nationally and internationally important species or sites for conservation of biodiversity; many areas meeting natural habitat definitions of other international financial institutions.
Habitats supporting globally significant (concentrations of) migratory or congregatory species Areas that support a significant proportion of a species' population,	No equivalent

Critical Habitat	*Priority Biodiversity Feature*
where that species cyclically and predictably moves from one geographical area to another (including within the same ecosystem), or areas that support large groups of a species' population that gather on a cyclical or otherwise regular and/or predictable basis. For example, Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for congregatory species Wetlands of International Importance designated under criteria 5 or 6 of the Ramsar Convention.	
Areas associated with key evolutionary processes Areas with landscape features that might be associated with particular evolutionary processes or populations of species that are especially distinct and may be of special conservation concern given their distinct evolutionary history. For example, Isolated lakes or mountaintops or Populations of species listed as priorities by the Edge of Existence programme.	No equivalent
Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features) Ecological functions without which critical biodiversity features could not persist. For example, Where essential for critical biodiversity features, riparian zones and rivers, dispersal or migration corridors, hydrological regimes, seasonal refuges or food sources, keystone or habitat-forming species.	**Ecological structure and functions needed to maintain the viability of priority biodiversity features** Where essential for priority biodiversity features, riparian zones and rivers, dispersal or migration corridors, hydrological regimes, seasonal refuges or food sources, keystone or habitat-forming species.

2.2 Methodology

In line with EBRD Guidance Note 6, the identification and characterisation of critical habitat should include the following steps:

1. Definition of the study area
2. Stakeholder consultation and initial literature review
3. In-field data collection and verification of available information
4. Confirmation of biodiversity likely to meet critical habitat and
5. Determination of critical habitat status (of each study area).

In order to conduct a CHA, a study area needs to be defined. The extent of this is dependent on the biodiversity features of interest and ecological functions that support them which can be different for each feature. The CHSA is independent of the Project Area and zone of project influence, and can include a larger geographical area in which most of the impacts to biodiversity are expected.

Critical Habitat Assessment process starts along with initial screening and scoping to identify biodiversity features that might trigger CH or PBF. With the aim of supplementing rapid field assessment, review of publicly available studies and data regarding the ecological characteristics of the study area has to be undertaken as well. Since this document relies on findings presented in Annexes A-C, all publications used for reference in this CHA have been noted in each Annex and therefore are not listed in this document.

Species found on-site or in literature were assessed with regard to CH and PBF criteria (Table 1). Species that initially had the potential to trigger CH and PBF were brought forward for further assessment. Criteria used to select sensitive biodiversity features, namely species that need further assessment as part of the CHA, are as following:

1. EU Habitats Directive[3] – Species listed in Annex II or IV
2. EU Birds Directive[4] – Species listed in Annex I
3. IUCN[5] Red List – Species with EN, CR or VU conservation status

On the other hand, threatened habitats are habitats considered under pressure by national, regional or international assessments. These include natural and priority (*) habitats identified under the EU Habitats Directive (Annex I).

During 2013, the conservation status of part of the species has been assessed and published within The Red List of Flora and Fauna of FBiH[6] in 2014. The assessment for the FBiH Red List has been determined based on the outdated literature data for most species. Although the categories used to determine the endangered status of species are complaint with the IUCN Red List categories, they were not adequately considered in accordance with the IUCN Red List Criteria or IUCN guidelines during development of the Red List of FBiH, due to the lack of spatial distribution of species and the status of the populations of species.

This issue has been recognized by the local authorities, and Federal Ministry of Environment and Protection has adopted the *Decision on Initiating the Public Procurement Procedure for Revision of the Red List of Flora, Fauna and Fungi of the Federation of Bosnia and Herzegovina* in September 2019.[7]

During November 2019, an intensive Red List Assessor training workshop was conducted in Sarajevo, Bosnia and Herzegovina. The workshop was organized by UN Environment Programme in the frames of the GEF-6 MSP project "Achieving biodiversity conservation through creation, effective management and spatial designation of protected areas and capacity building" in Bosnia and Herzegovina, **including the Revision and establishment of the Red List Index(es) in the country.** Due to these reasons, the FBiH RL statuses for specific species (Table 2, CR and EN categories) could not have been considered as the sole criterion that may trigger critical habitat (CH), however the FBiH RL has been assessed with regard to the criterion of the priority biodiversity features (PBF) – *Significant biodiversity features identified by the broad set of stakeholders or governments.*

It is also important to note that, in BiH, there is no regular and systematic monitoring of biodiversity that could enable up-to date status of the populations for a range of categories of living world and no databases are available with regard to distribution of the populations. This gap has been bridged by engaging and consulting the relevant local biodiversity experts that are/were included in various biodiversity surveys in the project area, wider region of Herzegovina and continental areas of BiH. The expert judgment of the distribution of species and often their own personal experience has been included (particularly for ornithology, invertebrates, amphibians and reptiles, whereas the presence of mammal species has been assessed based on the consultative meetings with hunting society and assessment of potential habitats to sustain species of large mammals. The precautionary principle is applied for endemic species. Additional monitoring during pre-construction is required during spring and early summer for: endemic flora species, ornithofauna, amphibians and bats considering the time of the field surveys undertaken as part of this assignment have only covered summer and autumn.

The project type, impacts and proposed mitigation are not considered relevant in the identification of CH/PBF and both natural and modified habitats may contain areas that could qualify as critical habitat (CH). However, when a project could have significant, adverse and irreversible impacts to priority biodiversity features, it

[3] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
[4] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009
[5] IUCN 2020. The IUCN Red List of Threatened Species. Version 2020-1
[6] Official Gazette of FBiH, No. 7/14
[7] Web site of the Federal Ministry of Environment and Tourism, available https://www.fmoit.gov.ba/bs/javne-nabavke/odluke/odluka-o-pokretanju-postupka-javne-nabavke-revizija-crvenih-lista (last accessed on July 7, 2020)

should only go ahead if appropriate mitigation measures are put in place, in accordance with the mitigation hierarchy, to ensure no net loss and preferably a net gain of priority biodiversity features over the long term, to achieve measurable conservation outcomes. Proposed mitigation measures are provided in ESIA and BMP.

2.3 Species for further assessment

Based on the field findings presented in Annexed A-C and the desk search studies that supplemented it, a total of **81 species of some level of sensitivity or conservation concern** have been brought forward for further assessment.

The species in the Table 2 below are those which are listed on Annex II or IV of the EU Habitats Directive, Annex I of the EU Birds Directive, or are listed as EN, CR or VU on either the IUCN[8] or FBiH Red List, and are considered likely to be subject to impacts from the project. Species that have not been confirmed during field surveys have been noted in literature and experts found suitable habitats in the area. Their presence can be considered likely; therefore, they are also included in this assessment.

Table 2: Species brought forward for further assessment

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Species presence confirmed*
	FLORA			
1.	Butcher's-Broom	*Ruscus aculeatus*	IUCN NE, FBiH VU	Yes
2.	Dalmatian Laburnum	*Petteria ramentacea*	IUCN LC, FBiH NT	No
3.	Grassy bells	*Edraianthus tenuifolius*	IUCN NE, FBiH NT	No
4.	Dyer's Alkanet	*Alkanna tinctoria*	IUCN LC, FBiH CR	No
5.		*Anthyllis vulneraria* subsp. *praepropera*	IUCN NE, FBiH CR	No
6.	Round-Leaved Birthwort	*Aristolochia rotunda*	IUCN NE, FBiH EN	No
7.		*Asperula scutellaris*	IUCN NE, FBiH EN	No
8.	Red Helleborine	*C. rubra*	IUCN LC, FBiH VU	No
9.		*Cardamine graeca*	IUCN NE, FBIH CR	No
10.		*Cardamine maritima*	IUCN NE, FBiH CR	No
11.	Oriental Hackberry	*Celtis tournefortii*	IUCN LC, FBiH VU	No
12.		*Centaurea glaberrima*	IUCN NE, FBiH EN	No
13.	Narrow-Leaved Helleborine	*Cephalanthera longifolia*	IUCN LC, FBiH VU	No
14.		*Chaerophyllum coloratum*	IUCN NE, FBiH EN	No
15.	Ivy-leaved Cyclamen	*Cyclamen neapolitanum*	IUCN LC, FBiH CR	No
16.	Spring Sowbread	*Cyclamen repandum*	IUCN NE, FBiH CR	No
17.	False Yellowhead	*D. viscosa*	IUCN NE, FBiH EN	No
18.		*Dianthus sylvestris subsp. tergestinus*	IUCN NE, FBiH VU	No
19.	Stinkwort	*Dittrichia graveolens*	IUCN NE, FBiH EN	No
20.		*Ephedra major*	IUCN LC, FBiH EN	No
21.	Snake's Head Iris	*Hermodactylus tuberosus*	IUCN NE, FBiH CR	No
22.	Violet Bird's-Nest Orchid	*Limodorum abortivum*	IUCN LC, FBiH VU	No
23.		*Micromeria kerneri*	IUCN NE, FBiH CR	No
24.	Lady Orchid	*Orchis purpurea*	IUCN LC, FBIH VU	No
25.	Monkey Orchis	*Orchis simia*	IUCN LC, FBiH VU	No
26.	Greek Oregano	*Origanum heracleoticum*	IUCN NE, FBiH CR	No
27.		*Rhamnus intermedius*	IUCN LC, FBiH EN	No
28.		*Scutellaria orientalis*subsp. *pinnatifida*	IUCN NE, FBiH VU	No
29.	Autumn Lady's-Tresses	*Spiranthes spiralis*	IUCN LC, FBiH EN	No
30.	Winter Daffodil	*Sternbergia lutea*	IUCN LC, FBiH CR	No
	INVERTEBRATES			

[8] IUCN 2020. The IUCN Red List of Threatened Species. Version 2020-1

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Species presence confirmed*
31.	Southern festoon	*Zerynthia polyxena*	FBiH NT, HD IV	No
32.	Jersey tiger	*Euplagia quadripunctaria*	HD II (*)	Yes
33.	European stag beetle	*Lucanus cervus*	IUCN NT, FBiH VU, HD II	Yes
34.	Cerambyx Longicorn	*Cerambyx cerdo*	IUCN VU, HD II, IV	No
35.	Tree grayling	*Hipparchia statilinus*	FBiH VU	Yes
	AMPHIBIANS			
36.	Yellow-bellied Toad	*Bombina variegata*	IUCN LC, FBiH NT, HDII,IV	No
37.	Green Toad	*Bufo viridis*	IUCN LC, FBiH LC, HDIV	No
38.	Common Tree Frog	*Hyla arborea*	HDIV	No
39.	Agile Frog	*Rana dalmatina*	IUCN LC, FBiH LC, HD IV	No
	REPTILES			
40.	The Hermann's Tortoise	*Testudo hermanni*	IUCN NT, FBiH VU HDII, IV	Yes
41.	Glass Lizard	*Pseudopus apodus*	IUCN LC, FBiH LC HDIV	Yes
42.	Balkan Green Lizard	*Lacerta trilineata*	IUCN LC, FBiH LC, HDIV	Yes
43.	Dalmatian Wall Lizard	*Podarcis melisellensis*	IUCN LC, FBiHLC, HDIV	Yes
44.	Sharp-snouted Rock Lizard	*Dalmatolacerta oxycephala*	IUCN LC, FBiH NT, HDIV	Yes
45.	Nose-horned Whiper	*Vipera ammodytes*	IUCN LC, FBiH LC, HDII, IV	Yes
46.	Dalmatian Algyroides	*Algyroides nigropunctatus*	IUCN LC, FBiH NT, HDIV	No
47.	Eastern Green Lizard	*Lacerta viridis*	IUCN LC, FBiH LC, HDIV	No
48.	Common Wall Lizard	*Podarcis muralis*	IUCN LC, FBiH LC, BC II, HD IV	No
49.	Dahls Whip Snake	*Platyceps najadum*	FBiH LC, HDIV	No
	ORNITHOFAUNA			
50.	Eurasian Eagle-Owl	*Bubo bubo*	IUCN LC, FBiH VU, BD I	Yes
51.	Red-rumped Swallow	*Cecropis daurica*	IUCN LC, FBiH VU	Yes
52.	Red-backed Shrike	*Lanius collurio*	IUCN LC, FBiH LC, BD I	Yes
53.	Bee-eater	*Merops apiaster*	IUCN LC, FBiH NT	Yes
54.	Western Rock Nuthatch	*Sitta neumayer*	IUCN LC, FBiH DD	Yes
	MAMMALS			
55.	Lesser horseshoe bat	*Rhinolophus hipposideros*	IUCN LC, FBiH EN, HD II, IV	Yes
56.	Greater horseshoe bat	*Rhinolophus ferrumequinum*	IUCN LC, FBiH VU, HD II, IV	Yes
57.	Blasius's horseshoe bat	*Rhinolophus blasii*	IUCN LC, FBiH VU, HD II, IV	Yes
58.	Mediterranean horseshoe bat	*Rhinolophus euryale*	IUCN NT, FBiH EN, HD II, IV	No
59.	Common pipistrelle	*Pipistrellus pipistrellus*	IUCN LC, FBiH VU, HD IV	Yes
60.	Soprano pipistrelle	*Pipistrellus pygmaeus*	IUCN LC, HD IV	Yes
61.	Kuhl's pipistrelle	*Pipistrellus kuhlii*	IUCN LC, FBiH VU, HD IV	Yes
62.	Nathusius's pipistrelle	*Pipistrellus nathusii*	IUCN LC, HD IV	Yes
63.	Savi's pipistrelle	*Hypsugo savii*	IUCN LC, FBiH VU, HD IV	Yes
64.	Serotine bat	*Eptesicus serotinus*	IUCN LC, HD IV	Yes
65.	Common noctule	*Nyctalus noctula*	IUCN LC, FBiH EN, HD IV	Yes
66.	Lesser noctule	*Nyctalus leisleri*	IUCN LC, HD IV	Yes
67.	Common bent-wing bat	*Miniopterus schreibersii*	IUCN NT, FBiH EN, HD II, IV	Yes
68.	Long-fingered bat	*Myotis capaccinii*	IUCN VU, FBiH VU, HD II, IV	No
69.	Pond bat	*Myotis dasycneme*	IUCN NT, HD II, IV	No
70.	Daubenton's bat	*Myotis daubentonii*	IUCN LC, HD IV	No
71.	Lesser mouse-eared bat	*Myotis oxygnathus*	IUCN LC, FBiH EN, HD II, IV	No
72.	Greater mouse-eared bat	*Myotis myotis*	IUCN LC, FBiH EN, HD II, IV	No
73.	Bechstein's bat	*Myotis bechsteinii*	IUCN NT, HD II, IV	No
74.	Natterer's bat	*Myotis nattereri*	IUCN LC, HD IV	No
75.	Whiskered bat	*Myotis mystacinus*	IUCN LC, FBiH VU, HD IV	No
76.	Brandt's bat	*Myotis brandtii*	IUCN LC, HD IV	No
77.	European free-tailed bat	*Tadarida teniotis*	IUCN LC, HD IV	Yes

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Species presence confirmed*
78.	Brown long-eared bat	*Plecotus auritus*	IUCN LC, FBiH VU, HD IV	No
79.	Grey long-eared bat	*Plecotus austriacus*	IUCN LC, FBiH VU, HD IV	No
80.	Kolombatovic's long-eared bat	*Plecotus kolombatovici*	IUCN LC, HD IV	No
81.	Western barbastelle	*Barbastella barbastellus*	IUCN NT, HD II, IV	No

**priority species*

2.4 Definition of Critical Habitats Study Area

Where trigger species were known, or likely, to be present (based on habitat suitability and the presence of field signs nearby or historic records), attempts were made to define appropriate and relevant study area. CHSA was assigned based on habitats present, species survey data, an understanding of the project and the opinion of the experts who collected the data, building on the importance already assigned to the areas in the ESIA.

For the critical habitats assessment, the area of the assessment (Critical Habitats Study Area - CHSA) has been limited to an area which includes the road alignment as well as **additional nearby areas** in which most of the impacts are expected, as given in Figure 1. Even though habitats of large mammals have not been confirmed, CHSA was enlarged so impacts on birds and bats can be adequately assessed because of their larger range.

In addition to this area, the CHSA envisaged further to include:

- **Stolac Hill** due to its potential to sustain one flora species as where this area is mentioned as the last known locality for *Scutellaria orientalis* subsp. *pinnatifida* in BiH. Since this is a vulnerable species in FBiH it is important to maintain this population. However, data on this locality is available in Maslo (2014) which cannot be considered completely up-to-date. It will be necessary to conduct further surveying of the area in order to confirm species' presence. Due to the high value of this locality as shown in literature, it has been included in CHSA.
- **nesting sites of Eurasian Eagle-Owl** at Suhi Do (near chainage 5+300+000 m) and between T4 tunnel and T5 tunnels (near chainage 9+000+000 m). Nesting site between tunnels T4 and T5 is located 20 m from the route and is therefore included in the CHSA. Nesting site at Suhi Do locality is 500-600 m east from the motorway route, which is why it is necessary to take protective measures and assess it as a part of the CHSA.
- **potential bat roosting sites** and their potential migration routes from/to Podvelezje plateau. According to the field survey, there were no speleological objects in the vicinity of the future motorway. Abandoned houses are rare and can provide a shelter for the bats, but inspection of few abandoned houses showed no active resting or roosting places of bat species. The only known potential roost sites are situated at Podvelezje: Svabinja cave (1.3 km east), Krasnica cave (2.9 km east-southeast), Krmljesina cave (3.5 km east-southeast) and Jama na Vlakama (6 km east) have been encompassed by CHSA. No impact on maternity colony of *Myotis blythii* in Jama na Vlakama is expected and this species was not registered in project area but it was included due to precautionary principle and possible daily or seasonal migrations. No regular monitoring of biodiversity and bats in particular is available in BiH, therefore this is to be analyzed during the additional pre-construction bat surveys.

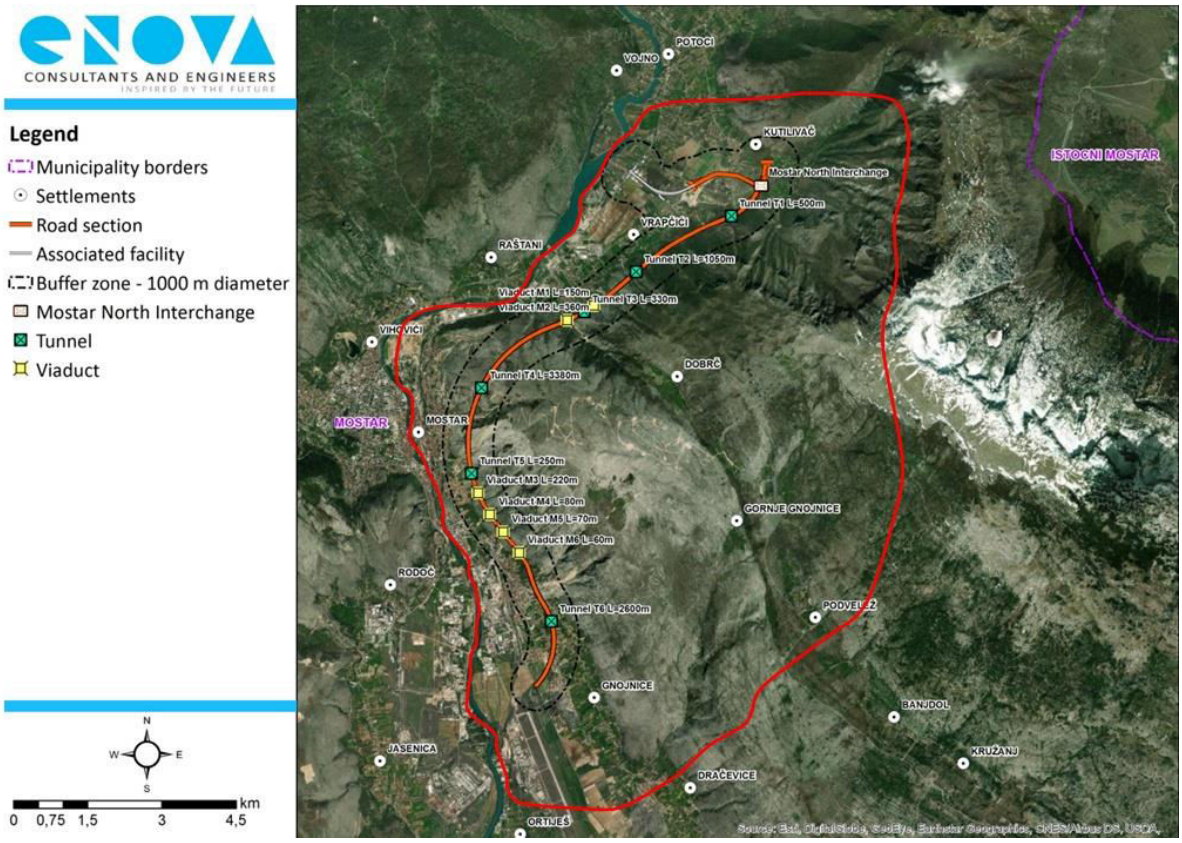


Figure 1: Critical habitat study area (CHSA – red line) including (i) Stolac Hill, (ii) Eurasian Eagle-Owl nesting sites, and (iii) possible bat roosting areas

2.5 Critical Habitats Assessment Outcome

To determine whether the Project is located within critical habitat, a literature review supported by field surveys was undertaken by biodiversity experts. An assessment of potential priority species which may trigger critical habitat for the above mentioned criteria: habitat of significant importance to endangered or critically endangered species, endemic or geographically restricted species and habitats supporting globally significant (concentrations of) migratory or congregatory species is presented in Table 3. Due to the lack of permanent water bodies in the study area, this assessment is focused on the terrestrial species only.

A summary of the biodiversity features which are assessed for the potential to trigger critical habitat as well as conditions which meet the following criteria is presented in Table 4 below, including the main findings from the Table 3 as well as conclusions with regard to the criteria:

- Highly threatened ecosystems
- Areas associated with key ecological processes
- Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features).

During the survey, **no sensitive or Annex I habits from Habitat Directive or *priority habitats from Habitat Directive were found**, therefore no habitats have met the criteria shown in Table 1. It has been noted that most natural habitats of the project area of influence have already been modified and degraded.

As previously mentioned, the EBRD guidance on implementation of PR 6 also states that the identification of Priority Biodiversity Features also includes “significant biodiversity features identified by a broad set of

stakeholders or governments (such as Key Biodiversity Areas or Important Bird Areas)". **No IBA, Ramsar, KBA, present or planned protected areas, Emerald sites are present in CHSA.** Potential Natura 2000 site Velez (FBiH) (BA8200088) is included in the CHSA. Due to the fact that no construction or operations will be done in this area, this criterion was not triggered and precautionary approach will not be needed.

Table 3: Terrestrial species of conservation interest that can occur in CHSA

No.	Species English Name	Scientific Name	Conservation Status	Endemic or range restricted	Species presence confirmed	Potential for CH	Comment
	FLORA						
1.	Butcher's-Broom	*Ruscus aculeatus*	IUCN NE, FBiH VU	Yes	Yes	No	Species is a widely distributed European native plant from Western Europe. Although the population of this species is NE, the species is considered to be widespread outside of BiH. Due to these reasons the habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
2.	Dalmatian Laburnum	*Petteria ramentacea*	IUCN LC, FBiH NT	Yes	No	No	This species is native to northwestern Albania, Croatia, Bosnia and Herzegovina, and Montenegro. It is commonly found in sub-Mediterranean areas and also found in Mediterranean areas. The altitude of its habitats ranges from 10 to 700 m asl. The species is considered to be widespread outside of BiH and considered to be of least concern. Due to these reasons the habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
3.	Grassy bells	*Edraianthus tenuifolius*	IUCN NE, FBiH NT	Yes	No	No	Presence was not confirmed during surveys. Species is an endemic plant of the western Balkan Peninsula inhabiting rocky (sub)Mediterranean grasslands from the Istrian Peninsula (Slovenia and Croatia) to northern Albania. Although the population of this species is NE, the species is considered to be widespread outside of BiH. Due to these reasons the habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
4.	Dyer's Alkanet	*Alkanna tinctoria*	IUCN LC, FBiH CR	Yes	No	No	Presence has not been confirmed during the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This species is endemic to the Mediterranean and has a wide geographical distribution; in particular, it grows in arid maritime areas of southern Europe. Habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species. However, according to Maslo (2014), last known locality of this species in BiH is on the banks of river Neretva that is outside of project area, buffer zone and CHSA.
5.		*Anthyllis vulneraria* subsp. *praepropera*	IUCN NE, FBiH CR	No	No	No	Presence has not been confirmed during the surveys, therefore it is necessary to undertake additional and more detailed surveys before the beginning of construction phase, preferably in late spring. It can be found in France, Italy, the Balkan Peninsula, Turkey and the Middle East. Due to other localities in FBiH and wide distribution outside of BiH, habitats

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							present within the CHSA cannot be considered critical to maintain the conservation status of this species.
6.	Round-Leaved Birthwort	*Aristolochia rotunda*	IUCN NE, FBiH EN	No	No	No	Presence has not been confirmed during the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This plant is native to and common in Mediterranean countries. Due to other localities in FBiH and wide distribution outside of BiH habitats present within the CHSA cannot be considered critical to maintain the conservation status of this species.
7.		*Asperula scutellaris*	IUCN NE, FBiH EN	Yes	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. It is endemic to former Yugoslavia and Albania and prefers rocky karst habitats in (sub)Mediterranean area. Due to these reasons the habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
8.		*Cardamine graeca*	IUCN NE, FBIH CR	No	No	No	Presence has not been confirmed in the surveys therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This species is native to Southern Europe, from Corsica eastwards to Syria. Due to other localities in FBiH and wide distribution outside of BiH habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species. Additionally, the species prefers pristine habitats and it is not expected due to degraded habitats in project area.
9.		*Cardamine maritima*	IUCN NE, FBiH CR	Yes	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This species is endemic to western Balkans (BiH, Croatia, Serbia and Montenegro). However, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
10.	Oriental Hackberry	*Celtis tournefortii*	IUCN LC, FBiH VU	No	No	No	Not confirmed during field surveys. *Celtis tournefortii* is a shrub found in southeastern Europe from Sicily through to Ukraine. The species areal range is large; however, this is a generally rare and relict species and is scattered where found occupying around 200km^2. Besides being VU in FBiH, it is EN in Cyprus and VU in Albania as well. However, its presence in CHSA has not been validated and habitats within the CHSA are not considered to be critical to maintain the conservation status of this species.
11.		*Centaurea glaberrima*	IUCN NE, FBiH EN	Yes	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase,

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							preferably in late spring. It's endemic to Western Balkans region. Habitats within the CHSA are not considered to be critical to maintain the conservation status of this species.
12.	Narrow-Leaved Helleborine	*Cephalanthera longifolia*	IUCN LC, FBiH VU	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. *Cephalanthera longifolia* is found throughout temperate and Mediterranean Eurasia, from the Atlantic to the Himalayas. It is widespread and often abundant. The existing threats for the species and the habitat are unlikely to cause the populations to decline severely in the near future. Due to other localities in FBiH and wide distribution outside of BiH habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species
13.	Red Helleborine	*C. rubra*	IUCN LC, FBiH VU	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This is an orchid found in Europe, North Africa and southwest Asia. Although reasonably common in parts of its range, it has EN status in BiH. Due to its big areal the habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
14.		*Chaerophyllum coloratum*	IUCN NE, FBiH EN	Yes	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. It is endemic to Dinaric Alps from Croatia to Albania and prefers degraded karst habitats, therefore significant adverse impact on this species, if confirmed, is not expected. Habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
15.	Ivy-Leaved Cyclamen	*Cyclamen neapolitanum*	IUCN LC, FBiH CR	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional and more detailed surveys before the beginning of construction phase, preferably in late spring. The species is native to southern and south-eastern parts of Europe, and has long been introduced elsewhere. It has a large distribution and it does not qualify for a threatened category in Europe. Due to the big areal and multiple localities in BiH, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
16.	Spring Sowbread	*Cyclamen repandum*	IUCN NE, FBiH CR	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. It is native to area from Southern France to the

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							Greek Islands and North Africa. Due to big areal and multiple localities in FBiH, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
17.		*Dianthus sylvestris* subsp. *tergestinus*	IUCN NE, FBiH VU	Yes	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. Species' native range is W. Balkan Peninsula. It can be found all along the Adriatic coast, therefore habitats present within the CHSA cannot be considered to be critical to maintain the conservation status of this species.
18.	Stinkwort	*Dittrichia graveolens*	IUCN NE, FBiH EN	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. The species is native to Europe, North Africa and western Asia, but it has also become naturalized in all continents bar Southern America. Due to the big areal and the fact it has been found in multiple localities in FBiH, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
19.	False Yellowhead	*D. viscosa*	IUCN NE, FBiH EN	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. *Dittrichia viscosa* is a perennial common throughout the Mediterranean Basin. Nowadays it is quite common in roadsides and ruderal habitats, even in urban areas. It is considered very resistant to adverse conditions and degraded environments. It is found on many localities in BiH. Due to the big areal, and plant's toughness, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
20.		*Ephedra major*	IUCN LC, FBiH EN	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This is a widespread shrub common from the Mediterranean to the Himalayas. Due to other localities in FBiH and wide distribution outside of BiH habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
21.	Snake's Head Iris	*Hermodactylus tuberosus*	IUCN NE, FBiH CR	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. The species is found from southeast France and North Africa to Israel. It grows on poor shallow soil that is rocky and well-drained. Although the population of this species is NE, the species is considered to be widespread outside of BiH. Due to these reasons the

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
22.	Violet Bird's-Nest Orchid	*Limodorum abortivum*	IUCN LC, FBiH VU	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This is a Mediterranean-Atlantic species, occurs east to Iran and the Caucasus and reaching Belgium in the north. Despite being VU in FBiH, due to the high abundance outside of BiH, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
23.		*Micromeria kerneri*	IUCN NE, FBiH CR	Yes	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This is an endemic Illyric-Balcanic species distributed in Bosnia and Herzegovina, Croatia, and Montenegro at altitudes of 5–250 m. Habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
24.	Lady Orchid	*Orchis purpurea*	IUCN LC, FBIH VU	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This orchid can be found in most parts of Europe, northern Africa, Turkey and the Caucasus. Main threats to its survival are consumption by animals and human exploitation. Due to these main threats not being applicable in this project and the species' wide distribution in FBiH and outside of it, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
25.	Monkey Orchis	*Orchis simia*	IUCN LC, FBiH VU	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. The species ranges from southern Europe, north to England. In the east it extends to Turkmenistan, and southwards into North Africa. *Orchis simia* has a large distribution area that is beyond any of the thresholds for a threatened category. Despite being VU in FBiH, due to high abundance outside of BiH, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
26.	Greek Oregano	*Origanum heracleoticum*	IUCN NE, FBiH CR	No	No	No	Presence has not been confirmed in the surveys. This is an illegitimate name of two species that are accepted as *Origanum vulgare* subsp. *hirtum* and *Origanum onites* in modern botanical nomenclature. However, based on distribution data on these species, we can conclude this species name is used as a synonym of *Origanum vulgare* subsp. *hirtum* that is present in BiH, since *O. onites* is found in Sicily, Greece and Turkey only. Due to high

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							abundance outside of BiH, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
27.		*Rhamnus intermedius*	IUCN LC, FBiH EN	Yes	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This species is endemic to the Balkan Peninsula, where it is recorded from Albania (restricted to north and north-western parts), Bosnia and Herzegovina (central Herzegovina and wider area of Mt. Dinara), Montenegro, and Croatia, with recent records from Slovenia. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
28.		*Scutellaria orientalis* subsp. *pinnatifida*	IUCN NE, FBiH VU	Yes	No	Yes	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This species is endemic to Balkans. A small population of the taxon *Scutellaria orientalis* subsp. *pinnatifida* on the slopes of Stolac Hill is the last known locality in Bosnia and Herzegovina based on literature (Maslo, 2014). Data on this locality cannot be considered completely up-to-date. Based on the planned route of the motorway as given in the Spatial Plan for the Motorway on Corridor Vc in FBiH (2017), and facilitates, planned in the conceptual solution of the motorway as per Preliminary Expropriation Study, Tunnel T4 is planned through the hill Ostri Rat and Stolac Hill, which will minimize the impact on habitat of this species. It will be necessary to conduct further field survey of the area in order to check for species' presence with regard to the southern portal of the tunnel and suggest mitigation measures in due time.
29.	Autumn Lady's-Tresses	*Spiranthes spiralis*	IUCN LC, FBiH EN	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional and more detailed surveys before the beginning of construction phase, preferably in late spring. *Spiranthes spiralis* is a Mediterranean-Atlantic species, almost confined to Europe with some outposts in North Africa. It is widespread but rare throughout its range. The trend of the population remains unknown but the species is able to colonise new sites. However, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
30.	Winter Daffodil	*Sternbergia lutea*	IUCN LC, FBiH CR	No	No	No	Presence has not been confirmed in the surveys, therefore it is necessary to undertake additional surveys before the beginning of construction phase, preferably in late spring. This species is assessed least concern due to its wide distribution, stable populations and its ability to live in a wide variety

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							of habitats. It's native to Europe, North Africa and West Asia. Due to species' wide range, habitats present within the CHSA are not considered to be critical to maintain the conservation status of this species.
	INVERTEBRATES						
31.	Southern Festoon	*Zerynthia polyxena*	FBiH NT, HD IV	No	No	No	Not confirmed during field surveys, but was found previously by the engaged expert. The species is considered to be widespread outside of BiH. Distribution in BiH is unknown and only localities south of Mostar (Zitomislici) are well known in literature in terms of the presence of this species. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
32.	Jersey Tiger	*Euplagia quadripunctaria*	HD II (*)	No	Yes	No	Presence was confirmed during field surveys. This is a widely distributed species in Europe and West Asia. It is a common and abundant species in BiH and it is known to inhabit many localities around the country. Anticipated loss of habitats unlikely to significantly impact the long-term survival of the species.
33.	European Stag Beetle	*Lucanus cervus*	IUCN NT, FBiH VU, HD II	No	Yes	No	Presence was confirmed during field surveys. The stag beetle *Lucanus cervus* is widely distributed in Europe and BiH. Habitat loss and fragmentation has led to significant reductions in numbers of this species. However, anticipated loss of habitats unlikely to significantly impact the long-term survival of the species.
34.	Cerambyx Longicorn	*Cerambyx cerdo*	IUCN VU, HD II, IV	No	No	No	Not confirmed during field surveys, but was found previously by the engaged expert near the buffer zone and outside of the project area of influence. The species is considered to be widespread outside of BiH, as well as in BiH. Anticipated loss of habitats unlikely to significantly impact the long-term survival of the species.
35.	Tree Grayling	*Hipparchia statilinus*	FBiH VU	No	Yes	No	Presence was confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. It is known to inhabit many localities in Herzegovina, including Mt. Velez, Mostar, Jablanica, Blagaj, Zitomislici, Popovo polje. Anticipated loss of habitats unlikely to significantly impact the long-term survival of the species.
	AMPHIBIANS						
36.	Yellow-Bellied Toad	*Bombina variegata*	IUCN LC, FBiH NT, HDII,IV	No	No	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. It is widespread in whole BiH. It is usually found near water bodies and wetlands.

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							Anticipated loss of habitats unlikely to significantly impact the long-term survival of the species.
37.	Green Toad	*Bufo viridis*	IUCN LC, FBiH LC, HDIV	No	No	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. It is common and present on the whole BiH territory. Anticipated loss of habitats unlikely to significantly impact the long-term survival of the species.
38.	Common Tree Frog	*Hyla arborea*	HDIV	No	No	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. It is common in humid areas and present on the whole BiH territory. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
39.	Agile Frog	*Rana dalmatina*	IUCN LC, FBiH LC, HD IV	No	No	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. It is common and present on the whole BiH territory. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
	REPTILES						
40.	The Hermann's Tortoise	*Testudo hermanni*	IUCN NT, FBiH VU HDII, IV	Yes	Yes	No	Confirmed during field surveys even in modified habitats. It prefers open patchy evergreen Mediterranean oak forest, but in its absence inhabits maquis, garrigue, dune scrub and maritime grassland, as well as agricultural and railway edge habitats, thus showing the adaptability to various range of habitats. The species is endemic to southern Europe. It is very common and widespread in Herzegovina. CHSA considered unlikely to support regionally important concentrations of the species and loss of habitat unlikely to significantly impact the long-term survival of the species.
41.	Glass Lizard	*Pseudopus apodus*	IUCN LC, FBiH LC HDIV	No	Yes	No	Confirmed during field surveys. Although lacking in some parts of the Europe, the species is considered to be widespread outside of BiH and considered to be of least concern. Due to preferring warmer habitats it is present in southern BiH. It is a very common species. CHSA considered unlikely to support regionally important concentrations of the species. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
42.	Balkan Green Lizard	*Lacerta trilineata*	IUCN LC, FBiH LC, HDIV	Sub-endemic	Yes	No	Confirmed during field surveys. Stable population and considered to be of least concern. This species is present from coastal Croatia, Bosnia-Herzegovina, Serbia,

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							Montenegro, east to Bulgaria, south-eastern Romania, Albania, Macedonia, Greece (including the Ionian Islands and many Aegean Islands including Crete, Lesvos and Rhodes), and western and central Turkey. It ranges from sea level to at least 1,600 m a.s.l. In BiH, it inhabits submediterranean parts of BiH where it is very common. CHSA considered unlikely to support regionally important concentrations and loss of habitat unlikely to significantly impact the long-term survival of the species.
43.	Dalmatian Wall Lizard	*Podarcis melisellensis*	IUCN LC, FBiHLC, HDIV	Yes	Yes	No	Confirmed during field surveys. Stable population and considered to be of least concern. This species occurs in Mediterranean and sub-Mediterranean zones from extreme north-eastern Italy through southwestern Slovenia, Croatia, southern Bosnia-Herzegovina, and southern Montenegro to north-western Albania. It is present on many Adriatic islands. The species habitats range from sea level up to 1,400 m a.s.l. This is very common and numerous in warmer regions within BiH: Herzegovina and western Bosnia. CHSA considered unlikely to support regionally important concentrations and loss of habitat unlikely to significantly impact the long-term survival of the species.
44.	Sharp-Snouted Rock Lizard	*Dalmatolacerta oxycephala*	IUCN LC, FBiH NT, HDIV	Yes	Yes	No	Confirmed during field surveys. Stable population and considered to be of least concern in most of its range. The sharp-snouted rock lizard is endemic to the former country of Yugoslavia and possibly also part of Albania. It is found in rocky places, on cliffs, boulders, rock pavements, walls, piles of stones, buildings and sometimes the trunks of trees, at altitudes of up to 1,600 metres. It is quite an adaptable species. In BiH, it is found in Herzegovina. Western areal limit in BiH is Livanjsko polje and on the east distribution reaches Mt. Maglic. CHSA considered unlikely to support regionally important concentrations and loss of habitat unlikely to significantly impact the long-term survival of the species.
45.	Nose-Horned Whiper	*Vipera ammodytes*	IUCN LC, FBiH LC, HDII, IV	No	Yes	No	The species is considered to be widely spread in Mediterranean and South Europe as well as East Asia and of least conservation concern. It is common and widespread in whole BiH. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
46.	Dalmatian Algyroides	*Algyroides nigropunctatus*	IUCN LC, FBiH NT,	Sub-endemic	No	No	Species has not been confirmed during field surveys. It is considered to be adaptable and of least concern in most of its range. This species ranges

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
			HDIV				along the eastern Adriatic coastal region from extreme north-eastern Italy to western Greece. When it comes to distribution in BiH, it can be found in Herzegovina. CHSA considered unlikely to support regionally important concentrations and loss of habitat unlikely to significantly impact the long-term survival of the species.
47.	Eastern Green Lizard	*Lacerta viridis*	IUCN LC, FBiH LC, HDIV	No	No	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH in areas of Southeast and East Europe and of least conservation concern. In BiH, it is very common in whole BiH excluding the southernmost area inhabited by *L. Trilineata*. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
48.	Common Wall Lizard	*Podarcis muralis*	IUCN LC, FBiH LC, BC II, HD IV	No	No	No	Not confirmed during field surveys. The species is considered to be widely spread in Europe and of least conservation concern. This is a very common and widespread species, well adjusted to natural and urban habitats in whole BiH, excluding very dry and warm southernmost area of Herzegovina. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
49.	Dahls Whip Snake	*Platyceps najadum*	FBiHLC, HDIV	No	No	No	Not confirmed during field surveys. The species is considered to be widely spread in Europe and BiH and of least conservation concern. It is common and inhabits southern BiH. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
	ORNITHOFAUNA						
50.	Eurasian Eagle-Owl	*Bubo bubo*	IUCN LC, FBiH VU, BD I	No	Yes	No	Confirmed during field surveys. At European scale this species is widely distributed, and the population trend appears to be increasing. It is estimated that 200-400 Eurasian Eagle-Owl pairs nest in Bosnia and Herzegovina, two thirds of which are located in the rocky parts of Herzegovina. The habitat conditions for nesting of the Eurasian Eagle-Owl are optimal at the locality of the two findings as part of this project. Two individuals of bird species Eurasian Eagle-Own have been registered in the project area of influence. The potential location of first nesting pair is 500-600 m away from the route and Viaduct Suhi do, which is why it is necessary to take specific protective measures. Based on the traces of faeces, it can be assumed that the nest of the second individual is located 20 m from the route of the motorway. Anticipated loss of habitat is unlikely to significantly impact the long-term

No.	Species English Name	Scientific Name	Conservation Status	Endemic or range restricted	Species presence confirmed	Potential for CH	Comment
							survival of the species.
51.	Red-Rumped Swallow	*Cecropis daurica*	IUCN LC, FBiH VU	No	Yes	No	Confirmed during field surveys. It breeds in open hilly country of temperate southern Europe and Asia from Portugal and Spain to Japan, India, Sri Lanka and tropical Africa. Red-rumped swallow has a huge range and a population counted in millions. It is not known to be seriously declining in range or numbers, so it is classed as Least Concern. It is common in BiH: however, mitigation measures such as bird panels will be implemented to stop preventable road kills. CHSA is considered unlikely to support regionally important concentrations and loss of habitat unlikely to significantly impact the long-term survival of the species.
52.	Red-Backed Shrike	*Lanius collurio*	IUCN LC, FBiH LC, BD I	No	Yes	No	Confirmed during field surveys. The species is considered to be widely spread in Europe, Asia and Africa and of least conservation concern. In BiH, the species is found at karst fields and grasslands of altitudes above 500 m. A total of 6 Red-backed Shrikes were found in 5 segments, however, this species is common in the inland of the country, so the motorway will not have major negative impacts on its nesting population. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species.
53.	Bee-eater	*Merops apiaster*	IUCN LC, FBiH NT	No	Yes	No	Confirmed during field surveys in the area of access road to M17. The species is considered to be widespread outside of BiH and considered to be of least concern. No habitat loss of this species is expected. However, the species could be impacted due to the traffic during operation phase, therefore specific mitigation is required to avoid impacts to the species in this area, specified in BMP. No impact on the long-term survival of the species is expected.
54.	Western Rock Nuthatch	*Sitta neumayer*	IUCN LC, FBiH DD	No	Yes	No	Western Rock Nuthatch also stands out for its protection. According to the Red List of FBiH, this species has the status of Data Deficient (DD). Recent ornithological researches shows that this species has a narrow distribution in Bosnia and Herzegovina, limited to the Mediterranean part of Herzegovina. It is closely related to rocky areas with scattered trees and shrubs and its population is stable. No impact the long-term survival of the species is expected.
	MAMMALS						
55.	Lesser Horseshoe Bat	*Rhinolophus hipposideros*	IUCN LC, FBiH EN, HD II, IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
56.	Greater Horseshoe Bat	*Rhinolophus ferrumequinum*	IUCN LC, FBiH VU, HD II, IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
57.	Blasius's Horseshoe Bat	*Rhinolophus blasii*	IUCN LC, FBiH VU, HD II, IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
58.	Mediterranean horseshoe bat	*Rhinolophus euryale*	IUCN NT, FBiH EN, HD II, IV	No	Possible	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
59.	Common Pipistrelle	*Pipistrellus pipistrellus*	IUCN LC, FBiH VU, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
60.	Soprano Pipistrelle	*Pipistrellus pygmaeus*	IUCN LC, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
61.	Kuhl's Pipistrelle	*Pipistrellus kuhlii*	IUCN LC, FBiH VU, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
62.	Nathusius's Pipistrelle	*Pipistrellus nathusii*	IUCN LC, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
63.	Savi's Pipistrelle	*Hypsugo savii*	IUCN LC, FBiH VU, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
64.	Serotine Bat	*Eptesicus serotinus*	IUCN LC, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
65.	Common Noctule	*Nyctalus noctula*	IUCN LC, FBiH EN, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
66.	Lesser Noctule	*Nyctalus leisleri*	IUCN LC, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
67.	Common Bent-Wing Bat	*Miniopterus schreibersii*	IUCN NT, FBiH EN, HD II, IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH, however with NT status. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
							monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
68.	Lesser mouse-eared bat	*Myotis oxygnathus*	IUCN LC, FBiH EN, HD II, IV	No	No	No	Not confirmed during field surveys but presence is considered to be very likely present in the area. The species is considered to be widespread outside of BiH, including in Europe and large part of Asia, and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
69.	Long-fingered bat	*Myotis capaccinii*	IUCN VU, FBiH VU, HD II, IV	No	No	No	Not confirmed during field surveys. It is very likely near water bodies; however, project area does not encompass permanent water bodies. Flyovers towards water are possible. The species is considered to be widespread outside of BiH, however with VU status. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
70.	Pond bat	*Myotis dasycneme*	IUCN NT, HD II, IV	No	No	No	Not confirmed during field surveys. It is very likely near water bodies; however, project area does not encompass permanent water bodies. Flyovers towards water are possible. The species is considered to be widespread outside of BiH, however with NT status. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
71.	Daubenton's bat	*Myotis daubentonii*	IUCN LC, HD	No	No	No	Not confirmed during field surveys. It is very likely near water bodies;

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
			IV				however, project area does not encompass permanent water bodies. Flyovers towards water are possible. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
72.	Greater mouse-eared bat	*Myotis myotis*	IUCN LC, FBiH EN, HD II, IV	No	No	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
73.	Bechstein's bat	*Myotis bechsteinii*	IUCN NT, HD II, IV	No	Possible	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
74.	Natterer's bat	*Myotis nattereri*	IUCN LC, HD IV	No	Possible	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
75.	Whiskered bat	*Myotis mystacinus*	IUCN LC, FBiH VU, HD IV	No	Yes	No	The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
76.	Brandt's bat	*Myotis brandtii*	IUCN LC, HD IV	No	Possible	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
77.	European Free-Tailed Bat	*Tadarida teniotis*	IUCN LC, HD IV	No	Yes	No	Presence was confirmed during field survey. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
78.	Brown long-eared bat	*Plecotus auritus*	IUCN LC, FBiH VU, HD IV	No	Possible	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
79.	Grey long-eared bat	*Plecotus austriacus*	IUCN LC,	No	Possible	No	Not confirmed during field surveys. The species is considered to be

No.	*Species English Name*	*Scientific Name*	*Conservation Status*	*Endemic or range restricted*	*Species presence confirmed*	*Potential for CH*	*Comment*
			FBiH VU, HD IV				widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
80.	Kolombatovic's long-eared bat	*Plecotus kolombatovici*	IUCN LC, HD IV	No	Possible	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH and considered to be of least concern. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.
81.	Western barbastelle	*Barbastella barbastellus*	IUCN NT, HD II, IV	No	Possible	No	Not confirmed during field surveys. The species is considered to be widespread outside of BiH, however with NT status. Anticipated loss of habitat unlikely to significantly impact the long-term survival of the species. Additional surveys needed during pre-construction phase to avoid any roosts during development of the Preliminary and Main Designs. Should any important findings arise during the pre-construction monitoring with regard to roost sites, foraging sites or migration corridors of the species, the BMP needs to be updated and agreed with the Lender to ensure proper implementation of all PR 6 requirements.

Table 4: Summary of CHA conclusions within CHSA

CH as per EBRD PR6	*Habitats and Species*	*CH requirements triggered under this criterion*	*Justification*
(i) Highly threatened or unique ecosystems	Regarding the habitats of the Project area, no sensitive or Annex I habitats from Habitat Directive or priority habitats from Habitat Directive were found during the field survey. Habitats present within the CHSA are considered to be non-natural and, at least semi-modified habitats, if not already heavily degraded by anthropogenic activity. The route passes through the edge of the plenty of settlements and other infrastructures such as the main road, railway, local roads, electrical infrastructure, and fence partitioned meadows.	No	No habitats that fit these criteria were identified in the CHSA. CHSA is considered not to contain highly threatened or unique ecosystems.
(ii) Habitats of significant importance to endangered or critically endangered species	No species with EN or CR status on IUCN Red list were recorded in the project area therefore CH is not triggered. Presence of ten species classified as critically endangered by FBiH RL, all of them plants, was described in literature. Eight more plant and six bat species have EN conservation status in FBiH RL. None of those species were confirmed during field research which is why additional surveys in late spring are suggested. Many of the species are widespread outside of BiH. In addition to this, the Red List Index(es) given in FBiH RL needs to be revised, as decided by the Federal Ministry of Environment and Tourism during September 2019 and recommended by the IUCN experts during November 2019 because of inaccurate and outdated information on species. EAAA for species listed in Annex IV of Habitats Directive supports less than 0.5% of global population; however, for many species the population size for total distribution is not estimated. Local populations of these species are not to be considered as habitats of significant importance for the persistence of said species at the (inter)national level.	No	No habitats found during field surveys meet the criteria of significance to endangered or critically endangered species. Species with EN or CR status on FBiH Red List do not trigger CH due to the need of its revision. These conservation statuses are not based on up-to-date information.
(iii) Habitats of significant importance to endemic or geographically	A total of 12 plant potentially present species and five reptile species found in the project area are endemic. However, data on endemic plants is based on literature only and their presence has not yet been confirmed. **Only one species triggers CH since it is the geographically restricted species in**	Yes	Results of desk study indicate that endemic species *Scutellaria orientalis* subsp. *pinnatifida* only territory in BiH is found at Stolac Hill, and aboveground of the Tunnel T4 of the motorway.

CH as per EBRD PR6	*Habitats and Species*	*CH requirements triggered under this criterion*	*Justification*
restricted species	**BiH: *Scutellaria orientalis* subsp. *pinnatifida*.** It's endemic to Balkans and it's vulnerable in FBiH RL. It has not been confirmed during field surveys of project area but a small population of the taxon on the slopes of Stolac Hill is the last known locality in Bosnia and Herzegovina according to somewhat outdated literature (Maslo, 2014). Other endemic plant species do not trigger CH criterion considering that the project area and/or anticipated loss of habitat are considered unlikely to significantly impact the long-term survival of the species. When it comes to (sub)endemic reptiles found during field surveys, local populations of reptiles in the project area are not considered as habitats of significant importance for the persistence of the species. Project will not affect their long-term survival.		This species triggers CH on the basis of its habitat being the last known locality in BiH according to the literature. Since not confirmed on site during site surveys undertaken as part of the assignment, additional field work is needed in optimal season for this species. Precautionary approach triggered the CH requirement under this criterion. Other endemic plant species do not trigger CH criterion considering that the project area and/or anticipated loss of habitats are considered unlikely to significantly impact the long-term survival of the species.
(iv) Habitats supporting globally significant (concentrations of) migratory or congregatory species	Although portions of BiH (e.g. karst fields and wetlands) participate in the Adriatic Flyway corridor for birds, the project area is not the core area of the Adriatic Flyway, where migratory species tend to aggregate. No significant movements or congregations of land animals are known to occur in the area.	No	-
(v) Areas associated with key evolutionary processes	No areas associated with key evolutionary processes were identified.	No	-
(vi) Ecological functions that are vital to maintaining the viability of biodiversity features described (as critical habitat features)	No ecological functions that are vital to maintaining the viability of biodiversity features described are identified.	No	-

3 RESULTS AND RECOMMENDATIONS

3.1 Critical habitats

The project is considered to trigger critical habitat considerations for plant species based on the following criteria:

- **habitats of significant importance to endemic or geographically restricted species**. Only one species triggers CH: *Scutellaria orientalis* subsp. *pinnatifida.* It has not been confirmed in project AOI but a small population of the taxon on the slopes of Stolac Hill is the last known locality in Bosnia and Herzegovina based on the findings from 2014. This data can be considered outdated and the habitats of the area could be already modified. However, precautionary approach triggered the CH requirement under this criterion, requiring additional field work to confirm/exclude the presence of the species in optimum research conditions and to suggest additional mitigation measures to avoid any impacts if deemed necessary.

No rivers or other water bodies are encompassed by the project; therefore, this assessment was only done regarding terrestrial species.

3.2 Priority Biodiversity Features

Considering the priority biodiversity features (PBF), examples of features that may meet criteria for priority biodiversity features in line with PR 6 are: **threatened habitats, vulnerable species, significant biodiversity features identified by a broad set of stakeholders or governments, and ecological structure and functions needed to maintain the viability of priority biodiversity features**. Priority biodiversity features have a high, but not the highest, degree of irreplaceability and/or vulnerability. Although a level below critical habitat in sensitivity, they still require careful consideration during project assessment and impact mitigation.

Regarding the criteria determining the PBFs in the CHSA, **no threatened habitats** have been identified. No IBA or Ramsar sites are located within the project area or the area of 10 km radius. Potential Natura 2000 site Velez (FBiH) is included in the CHSA due to presence of maternal colony of *Myotis blythii* in Jama na Vlakama. It is presumed this species can be found in flyover over project area, however, it has not been recorded to date. This area is not presumed to be under impact of this project.

Vulnerable species and species requiring protection (CR, EN, VU in FBiH RL, VU in IUCN RL, Annex II and IV as well as Annex I BD species) have been identified as given in Table 1 however the species are considered to be widely present outside the CHSA, or the specific mitigation measures have been proposed to preserve the species (e.g. for amphibians, reptiles, birds, mammals). The species listed on Annex II of the Habitats Directive require the establishment of a consistent network of special areas of conservation; the sites should be managed in accordance with the ecological requirements of the species. A strict protection regime must be applied for species and subspecies of community interest listed in Annex IV.

There were no PBFs triggering significant biodiversity features identified by a broad set of stakeholders or governments, and ecological structure and functions needed to maintain the viability of priority biodiversity feature criteria.

Species meeting the criteria for Priority Biodiversity Feature as Vulnerable species are listed in Table 5. List includes not just species with VU status in IUCN Red List and species listed in Annex II of Habitats Directive, but also CR, EN and VU species from FBiH RL. Due to the fact that FBiH RL is based on inaccurate and outdated data, these categories could not be assessed as Critical Habitats. However, their current status indicates they have a certain level of endangerment; hence these are included in PBF assessment.

Table 5: Species meeting the criteria for Priority Biodiversity Features as vulnerable species

No.	*Species English Name*	*Scientific Name*	*Conservation Status*
	FLORA		
1.	Butcher's-Broom	*Ruscus aculeatus*	IUCN NE, FBiH VU
2.	Dyer's Alkanet	*Alkanna tinctoria*	IUCN LC, FBiH CR
3.		*Anthyllis vulneraria* subsp. *praepropera*	IUCN NE, FBiH CR
4.	Round-Leaved Birthwort	*Aristolochia rotunda*	IUCN NE, FBiH EN
5.		*Asperula scutellaris*	IUCN NE, FBiH EN
6.	Red Helleborine	*C. rubra*	IUCN LC, FBiH VU
7.		*Cardamine graeca*	IUCN NE, FBIH CR
8.		*Cardamine maritima*	IUCN NE, FBiH CR
9.	Oriental Hackberry	*Celtis tournefortii*	IUCN LC, FBiH VU
10.		*Centaurea glaberrima*	IUCN NE, FBiH EN
11.	Narrow-Leaved Helleborine	*Cephalanthera longifolia*	IUCN LC, FBiH VU
12.		*Chaerophyllum coloratum*	IUCN NE, FBiH EN
13.	Ivy-leaved Cyclamen	*Cyclamen neapolitanum*	IUCN LC, FBiH CR
14.	Spring Sowbread	*Cyclamen repandum*	IUCN NE, FBiH CR
15.	False Yellowhead	*D. viscosa*	IUCN NE, FBiH EN
16.		*Dianthus sylvestris subsp. tergestinus*	IUCN NE, FBiH VU
17.	Stinkwort	*Dittrichia graveolens*	IUCN NE, FBiH EN
18.		*Ephedra major*	IUCN LC, FBiH EN
19.	Snake's Head Iris	*Hermodactylus tuberosus*	IUCN NE, FBiH CR
20.	Violet Bird's-Nest Orchid	*Limodorum abortivum*	IUCN LC, FBiH VU
21.		*Micromeria kerneri*	IUCN NE, FBiH CR
22.	Lady Orchid	*Orchis purpurea*	IUCN LC, FBIH VU
23.	Monkey Orchis	*Orchis simia*	IUCN LC, FBiH VU
24.	Greek Oregano	*Origanum heracleoticum*	IUCN NE, FBiH CR
25.		*Rhamnus intermedius*	IUCN LC, FBiH EN
26.		*Scutellaria orientalis*subsp. *pinnatifida*	IUCN NE, FBiH VU
27.	Autumn Lady's-Tresses	*Spiranthes spiralis*	IUCN LC, FBiH EN
28.	Winter Daffodil	*Sternbergia lutea*	IUCN LC, FBiH CR
	INVERTEBRATES		
29.	Jersey tiger	*Euplagia quadripunctaria*	HD II (*)
30.	European stag beetle	*Lucanus cervus*	IUCN NT, FBiH VU, HD II
31.	Cerambyx Longicorn	*Cerambyx cerdo*	IUCN VU, HD II, IV
32.	Tree grayling	*Hipparchia statilinus*	FBiH VU
	AMPHIBIANS		
33.	Yellow-bellied Toad	*Bombina variegata*	IUCN LC, FBiH NT, HD II, IV
	REPTILES		
34.	The Hermann's Tortoise	*Testudo hermanni*	IUCN NT, FBiH VU, HD II, IV
35.	Nose-horned Whiper	*Vipera ammodytes*	IUCN LC, FBiH LC, HD II, IV
	ORNITHOFAUNA		
36.	Eurasian Eagle-Owl	*Bubo bubo*	IUCN LC, FBiH VU, BD I
37.	Red-rumped Swallow	*Cecropis daurica*	IUCN LC, FBiH VU
38.	Red-backed Shrike	*Lanius collurio*	IUCN LC, FBiH LC, BD I
	MAMMALS		
39.	Lesser horseshoe bat	*Rhinolophus hipposideros*	IUCN LC, FBiH EN, HD II, IV
40.	Greater horseshoe bat	*Rhinolophus ferrumequinum*	IUCN LC, FBiH VU, HD II, IV
41.	Blasius's horseshoe bat	*Rhinolophus blasii*	IUCN LC, FBiH VU, HD II, IV
42.	Mediterranean horseshoe bat	*Rhinolophus euryale*	IUCN NT, FBiH EN, HD II, IV
43.	Common pipistrelle	*Pipistrellus pipistrellus*	IUCN LC, FBiH VU, HD IV
44.	Kuhl's pipistrelle	*Pipistrellus kuhlii*	IUCN LC, FBiH VU, HD IV
45.	Savi's pipistrelle	*Hypsugo savii*	IUCN LC, FBiH VU, HD IV
46.	Common noctule	*Nyctalus noctula*	IUCN LC, FBiH EN, HD IV
47.	Common bent-wing bat	*Miniopterus schreibersii*	IUCN NT, FBiH EN, HD II, IV

No.	*Species English Name*	*Scientific Name*	*Conservation Status*
48.	Long-fingered bat	*Myotis capaccinii*	IUCN VU, FBiH VU, HD II, IV
49.	Pond bat	*Myotis dasycneme*	IUCN NT, HD II, IV
50.	Lesser mouse-eared bat	*Myotis oxygnathus*	IUCN LC, FBiH EN, HD II, IV
51.	Greater mouse-eared bat	*Myotis myotis*	IUCN LC, FBiH EN, HD II, IV
52.	Bechstein's bat	*Myotis bechsteinii*	IUCN NT, HD II, IV
53.	Whiskered bat	*Myotis mystacinus*	IUCN LC, FBiH VU, HD IV
54.	Brown long-eared bat	*Plecotus auritus*	IUCN LC, FBiH VU, HD IV
55.	Grey long-eared bat	*Plecotus austriacus*	IUCN LC, FBiH VU, HD IV
56.	Western barbastelle	*Barbastella barbastellus*	IUCN NT, HD II, IV

3.3 Mitigation measures

3.3.1 Critical habitat

As aforementioned, **one flora species** triggered Critical Habitat. Stolac Hill in the project area is the last known BiH locality for *Scutellaria orientalis* subsp. *pinnatifida* according to literature data (Maslo, 2014). Data on this locality cannot be considered completely up-to-date. As previously said, the species is vulnerable according to Red list of Flora of FBiH and it is important to maintain this population. Position of Stolac Hill in relation to the route and buffer zone is shown in Figure 2.

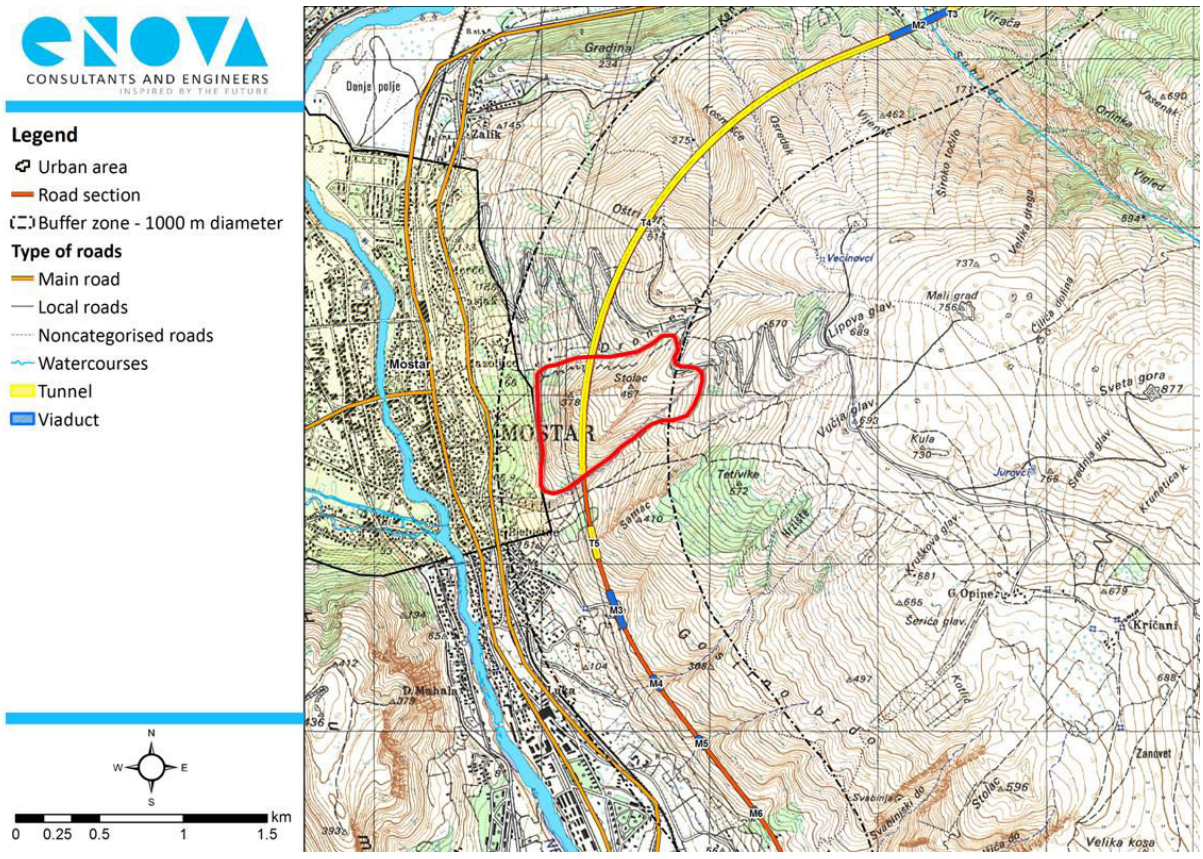


Figure 2: Position of Stolac Hill (red line) in relation to the motorway route

Based on the planned motorway route as given in the Spatial Plan for the Motorway on Corridor Vc in FBiH (2017), and facilities planned in the conceptual solution of the motorway as per Preliminary Expropriation Study, Tunnel T4 is planned through the hill Ostri Rat and Stolac Hill, which will significantly minimize the impact on habitat of this species. It is important that in this area, motorway remains underground during

development of the Preliminary Design and Main Design. It will be necessary to conduct further field survey of the area during May-June in order to check for species' presence with regard to the southern portal of the tunnel and suggest mitigation measures in due time. No vegetation clearance should start before further field surveys done by experts. In addition to this, no new access roads or construction waste disposal should be planned in this area. Implementing these recommendations in the future are essential **pre-construction mitigation measures for this species.**

During **construction phase**, the motorway route only may be used for construction activities and organisation of construction site. Should any need for additional areas to be used occur, e.g. access roads to the motorway route, natural areas need to be avoided and only already modified areas may be used (e.g. existing roads or degraded non-natural habitats).

Include findings in BMP and undertake additional mitigation measures if required in accordance with the survey results. Adverse impact on plant species *Scutellaria orientalis* subsp. *pinnatifida* can be fully mitigated and CH can be preserved if proposed measures are implemented during all project phases.

3.3.2 Priority Biodiversity Features

Main mitigation measures recommended for Priority Biodiversity Features of interest are elaborated in BMP and ESIA. Summarized measures are listed below.

Pre-construction measures include:

- Undertaking additional field surveys of flora with the aim of establishing presence/absence of endemic species known from literature, as given in ESIA and BMP. The survey needs to be performed from early spring to mid-summer, in order to record presence of early-flowering geophytes.
- Conducting pre-construction surveys for a range of fauna species in different seasons, namely invertebrates, amphibians and reptiles.

Mitigation measures that are to be implemented **during construction** are:

- Restrict the movement of construction machinery, mechanization and means of transport exclusively in the construction area for the purpose of maximal habitat protection without any additional disturbance of habitats.
- **Two Eurasian Eagle-Owl territories have been registered** in the buffer zone, at 20 and 500-600 m from the route. At the site Suhi Do (5+300+000 m), one individual of the Eurasian Eagle-Owl was noticed during the night surveys for several times before going for night hunting. During the period of the research, the nest of this species has not been found. However, the habitat conditions for nesting of the Eurasian Eagle-Owl are optimal at the locality Suhi Do. In addition, it is known that this species protects the territory throughout the year, so it can be assumed that the species will nest at this site in the future period as well. Based on the ecology of the species, it has a teritory of 2km^2. The potential location of nesting is 500 m away from the motorway route in the project are of influence. The second individual was found 20 m away northwest from the motorway route near chainage 9+000+000, based on the traces of faeces. This nesting pair will need to be protected during construction works. In general, it is estimated that 200-400 Eurasian Eagle-Owl pairs nest in Bosnia and Herzegovina, two thirds (66%) of which are located in the rocky parts of Herzegovina. Specific mitigation measures will need to be applied for the Eurasian Eagle-Owl during the (pre-)construction phase to **preserve the two nesting sites.** In order to achieve it it is necessary to plan the installment of protective panels alongside M2 viaduct (Figure 3) and between T4 and T5 tunnels. No access roads or construction waste disposal is allowed between the T4 tunnel and T5 tunnel and also 100 m in direction northeast in order protect

the second breeding pair of Eurasian Eagle-Owl (*Bubo bubo*), as well as to protect the features of high geological value –vertical sandstone pillars, found near the chainage 9+000+000 as shown in Figure 4. Construction must be planned in a way that will not affect the young Eurasian Eagle-Owls leaving the nest; therefore, works must not be done in the period from February to the end of May.

Figure 3: Position of Bubo bubo nesting site in Suhi Do locality

Figure 4: Spatial distribution of suitable nesting area of Eurasian Eagle-Owl (Bubo bubo) to be avoided during construction activities

- Avoid unnecessary cutting of older trees and removal of dead wood, particularly oak, from habitats as they are important for **saproxylic species**, including Natura 2000 beetles: *Lucanus cervus* or *Cerambyx cerdo* that occur in the area.

In general, **other main mitigation measures** are:

- develop and implement Invasive Species Management Plan
- revise BMP accordingly to include additional measures after the preconstruction surveys are completed and agree the revised version of BMP with EBRD
- timely implement the set of mitigation measures listed in the BMP
- conduct monitoring as defined in BMP
- promote the aim of no net loss of biodiversity, and tend to achieve a net gain of biodiversity.

3.3.3 Residual impact

For the purpose of the CHA report, **residual impacts** refer to those biodiversity impacts predicted to remain after the application of mitigation measures, either in construction or operation phase. If mitigation measures are implemented as elaborated in BMP, no residual impact on CH and PBF(s) shall remain (Table 6). Impact that cannot be mitigated is project's permanent impact represented with loss of habitat and vegetation due to preparation and performance of construction.

Table 6: Assessment of biodiversity impacts after mitigation

Phase	*Identified impact*	*Impacts evaluation/ significance before mitigation*	*Proposed mitigation measures*	*Assessment of impacts after mitigation*	*Residual Impact after mitigation (yes/no)*
Habitats					
Pre-construction	Adverse impacts due to the lack of information on baseline for diagnostic species for specific habitats which may lead to inadequate planning of works and both Preliminary and Main Design requirements	Moderate/ Significant	BMP as well as mitigation measures no. 8.1.1 of ESIA report	This impact will be fully mitigated, if the: ▪ Preliminary and Main Designs is developed to include revitalisation of habitats after the construction is finalised with planting autochthonous plant species characteristic for the area (e.g. oak) and prevent growing and spread of invasive species. ▪ Mitigation measures given in BMP are implemented.	No
Construction	Habitat loss due to preparation of construction site and during the performance of construction works, fragmentation of habitats	Moderate/ Significant	BMP as well as mitigation measures no. 8.1.2 of ESIA report	With implementation of the proposed measures it is not possible to fully mitigate this measure. This impact is considered to be the project permanent impact.	Yes
	Potential additional disturbance of habitats	Moderate/ Significant	BMP as well as mitigation measures no.	This impact will be fully mitigated, if the mitigation measures given in BMP are implemented.	No

Phase	*Identified impact*	*Impacts evaluation/ significance before mitigation*	*Proposed mitigation measures*	*Assessment of impacts after mitigation*	*Residual Impact after mitigation (yes/no)*
			8.1.3 of ESIA report		
Vegetation and flora					
Pre-construction	Adverse impacts due to inadequate planning of works and Main Design requirements	Moderate/ Significant	BMP as well as mitigation measures no. 8.1.5 of ESIA report	This impact will be fully mitigated, if the: ▪ Planned Tunnel T4 through the hill sštri Rat and Stolac Hill is included in Preliminary and Main Design. It will minimize the impact on habitat of *Scutellaria orientalis* subsp. *pinnatifida*. It is important that in the area of Stolac Hill motorway remains underground. ▪ Main Design is developed to include Invasive Species Management Plan to prevent growing and spreading of invasive species. ▪ Mitigation measures given in BMP are implemented.	No
	Lack of up-to-date information on baseline for endemic flora	Moderate/ Significant	BMP as well as mitigation measures no. 8.1.5 of ESIA report	This impact will be fully mitigated, if the: ▪ Additional field surveys with the aim of finding *Scutellaria orientalis* subsp. *pinnatifida* and other endemic species are undertaken in late spring or early summer. ▪ Monitoring requirements and mitigation measures given in BMP are implemented.	No
Construction	Vegetation removal and clearance of flora species in the phase of preparation of construction site and during the performance of construction works	Moderate/ Significant	BMP as well as mitigation measures no. 8.1.6 of ESIA report	With implementation of the proposed measures it is not possible to fully mitigate this measure. This impact is considered to be the project permanent impact. Important special measure is no access roads or disposal of construction waste is allowed in the area of Stolac Hill due to potential presence of *Scutellaria orientalis* subsp. *pinnatifida*. The compensation tree planting and revegatation with	Yes

Phase	*Identified impact*	*Impacts evaluation/ significance before mitigation*	*Proposed mitigation measures*	*Assessment of impacts after mitigation*	*Residual Impact after mitigation (yes/no)*
				plant species is proposed as part of the BMP.	
	Destruction of vegetation and deforestation will lead to water runoff and soil erosion	Moderate/ Significant	BMP as well as mitigation measures no. 8.1.6 of ESIA report	This impact will be fully mitigated, if the mitigation measures given in BMP are implemented.	No
Fauna					
Pre-construction	Adverse impacts due to inadequate planning of works and Main Design requirements	Major/ Significant	BMP as well as mitigation measures no. 8.1.9 of ESIA report	This impact will be fully mitigated, if the: ▪ Pre-construction fauna surveys are conducted. ▪ Main Design is developed to include protective bird panels. ▪ Main Design is developed to avoid any possible roosts and hibernations sites ▪ Mitigation measures given in BMP are implemented.	No
	Lack of up-to-date information on baseline for migratory birds, bats, invertebrates	Major/ Significant	BMP as well as mitigation measures no. 8.1.9 of ESIA report	This impact will be fully mitigated, if the monitoring requirements and mitigation measures given in BMP are implemented.	No
Construction	Disturbance of fauna species due to increased levels of noise, vibration and light in the zone of construction activities	Major/ Significant	BMP as well as mitigation measures no. 8.1.10 of ESIA report	This impact will be fully mitigated, if the mitigation measures given in BMP are implemented.	No
	Potential disturbance of nests/roosts of species that have a seasonally variable vulnerability due to breeding, feeding times or seasonal migrations, such as Eurasian Eagle-Owl (*Bubo bubo*) or sensitive bat species in the project area	Major/ Significant	BMP as well as mitigation measures no. 8.1.11 of ESIA report	This impact will be fully mitigated, if the mitigation measures given in BMP are implemented.	No
	Potential fatalities or injuries of fauna	Moderate/ Significant	BMP as well as	This impact will be fully mitigated, if the mitigation	No

Phase	*Identified impact*	*Impacts evaluation/ significance before mitigation*	*Proposed mitigation measures*	*Assessment of impacts after mitigation*	*Residual Impact after mitigation (yes/no)*
	species due to vegetation removal and movement of heavy machinery		mitigation measures no. 8.1.12 of ESIA report	measures given in BMP are implemented.	
Operation	Potential collision of fauna species due to high speed of vehicles (bird species e.g. crows, seagulls, Eurasian Eagle-Owl, bat species, other small mammals, amphibians and reptiles)	Moderate/ Significant	BMP as well as mitigation measures no. 8.1.13 of ESIA report	If the Main Design is changed to include protective bird panels as given in this ESIA and BMP, the impact will be fully mitigated. Regarding the fencing of the motorway, the fence is considered a technical standard at all Corridor Vc sections. Recommendation regarding the type and maintenance of the fence given in BMP.	No

3.3.4 Monitoring requirements and CHA/BMP update

It is important to emphasize the CHA and BMP are living documents that will need to be updated and revised to reflect new findings from the additional surveys from the preconstruction phase, required to be undertaken due to precautionary approach. As additional surveys are completed these two documents will require updating to reflect the additional data and adjusting the mitigation measures, which need to be agreed by the EBRD, as well as addressing no net loss accounting for PBF post additional surveys and post construction to verify the effectiveness of mitigation measures. Further, any changes to the need for offsets or mitigation measures will be publicly disclosed.

In line with BMP, monitoring requirements during preconstruction phase refer to the following:

- additional field surveys with the aim of establishing presence of endemic species as given in ESIA and BMP - the survey needs to be performed from early spring to mid-summer, in order to record presence of early-flowering geophytes and fauna species, as follows:
    - additional field research should be undertaken during spring and early summer in order to investigate presence of other species of conservation concern, particularly in the northern part of project area (monitoring of the presence of *Platyceps najadum*, *Malpolon insignitus*, *Lacerta viridis*, *Podarcis muralis*, *Natrix tessellata* and *Algyroides nigropunctatu*s - species expected along the motorway route due to the suitable habitat,
    - additional field research shall be undertaken in the area of Kutilivac, Kuti and Brasinski potok during early spring season in order to confirm the presence of amphibians,
    - 1-year monitoring of bats using echolocation recording and identification, mist-net research, and potential roost sites examination in the project area.

Should any threatened species or habitats, or species and habitats of conservation concern be identified during preconstruction surveys, CHA and BMP update must include additional mitigation measures to ensure no net loss and net gain of biodiversity, as well as CH and PBF accounting update. BMP needs to be updated prior to finalisation of the Main Design to enable potential additional mitigation measures to be included in the Main Design.

The scope and the timing of the required surveys are defined in BMP, Chapter 5 and 7, whilst implementation schedule is not yet given due to lack of Preliminary Design and other technical documentation.

Due to the complexity on biodiversity features and ecosystem services, the aim will be to adopt a practice of adaptive management in which the implementation of mitigation and management measures are responsive to the changing conditions and the results of monitoring throughout the Project's lifecycle. This BMP should therefore be reviewed on an annual basis during the construction phase in order to review the mitigation contained herein.

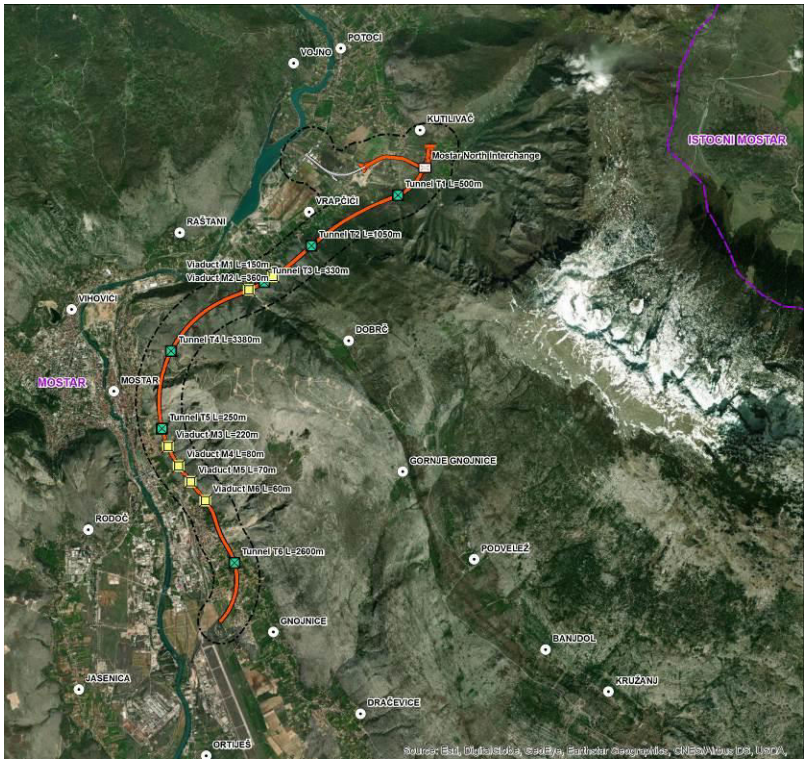
The plan will be reviewed in conjunction with the following stakeholders:

- JPAC (including Head of Project)
- Contractor's Representative – qualified biologist/ecologist and
- Supervising Authority
- The EBRD.

CATEGORY A PROJECT

BOSNIA AND HERZEGOVINA CORRIDOR VC IN FBIH

MOSTAR MOTORWAY



Waste Management Plan

Mostar North-Mostar South

May 2021

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1 INTRODUCTION

The Public Company Motorways of the Federation of Bosnia and Herzegovina (hereinafter: "JPAC") is a public company of the Federation of Bosnia and Herzegovina (FBiH), in charge of management of motorway construction and management, maintenance and protection of motorway operation in FBiH. One of the Company's key projects is the development of the motorway which is part of the Trans-European Corridor Vc connecting Budapest (Hungary) and Port of Ploce (Croatia). The total length of Corridor Vc in FBiH is approximately 335 km.

The European Bank for Reconstruction and Development ("EBRD") is considering providing financial support to JPAC for the construction of the new **14.2**[1] **km motorway section from Mostar North Interchange to the Mostar South Interchange**[2] on the Corridor Vc (LOT 4).

As part of the procedure for issuing an Environmental permit for the construction of the Mostar North-Mostar South subsection of the motorway on Corridor Vc (L=14.2 km), the Investor undertakes to develop a Waste Management Plan as an integral part of the Environmental Impact Study (Annex to the Study).

In accordance with Article 19 of the *Law on Waste Management* (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17), which specifies that "The investor of plants and facilities for which an environmental permit is required shall prepare a Waste Management Plan", the content of the Waste Management Plan has been defined.

During the preparation of the Waste Management Plan for the Mostar North-Mostar South subsection, the data from the following documentation were used:

- Main construction design (Book A 1010) LOT 5 for the Mostar North-Mostar South section, Inženjerski projektni zavod (*Engineering Design Institute*) d.d. Zagreb, September 2010
- Geotechnical mission G1, Mostar North - Mostar South subsection, IGH d.o.o. Mostar, November 2019.
- Environmental impact study (LOTs 5 and 6) for the section Mostar North-Mostar South-Pocitelj, CETEOR d.o.o. Sarajevo, April 2017
- Environmental impact study (LOT 4) for the Mostar North-Mostar South section, Institut građevinarstva Hrvatske (*Institute of Civil Engineering of Croatia*) d.d. Zagreb, September 2006
- Preliminary expropriation study for the Mostar North-Mostar South section, GEO-DATA d.o.o. Mostar, January 2020.

Note: During the preparation of the referenced document, some parts were used (when estimating the amount of waste for the subsection route) from the Main construction design (Book A 1010) LOT 5 for the Mostar North-Mostar South section (2010), but the design has undergone some changes in terms of relocation of the motorway route. Currently, there is no Main design and technical documentation for the new route, and the Consultant, based on his experience in the development of the same and/or similar designs, made preliminary assessments of the course of waste generation and waste quantities. The new route defined by the *Decision on the implementation of the spatial plan for the areas of the special features of importance for the Federation of Bosnia and Herzegovina "Motorway on Corridor Vc"* defines the final route of Corridor Vc (2017), including the considered Mostar North-Mostar South subsection.

The main purpose of the Waste Management Plan is to provide an overview of the waste streams of construction and operational phase of the planned subsection of the motorway, the amount of waste generated during the

[1] Even though the ToR states that the section is 15.4 km long, during a meeting held with the representatives of JPAC, it was confirmed that the official length of this section is 14.2 km.
[2] Mostar South interchange is part of Mostar South-Tunnel Kvanj Corridor Vc subsection

operation/exploitation of the motorway or an estimate of these quantities and recommendations for waste management in a manner that environmental impacts are minimized.

Waste management should respect the basic principles of waste management, which have the following hierarchy:

- waste prevention,
- reducing quantities by reusing waste,
- recycling,
- processing,
- final disposal.

The plan defines activities for long-term waste management in case of changes in the technological process, considering economic constraints. Waste prevention has the highest priority in waste management, while final disposal of has the lowest priority.

The Waste Management Plan contains:

- data on waste generation sites during the construction and operation of the motorway,
- measures to be taken to prevent/reduce waste generation, in particular hazardous waste,
- guidelines for the separation of waste, in particular hazardous waste, from other types of waste and waste that will be reused,
- waste treatment methods,
- final disposal of waste at the landfill.

The basic principles of waste management are defined in Article 5 of the *Law on Waste Management* (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17):

- Prevention - avoiding the generation of waste or minimising the amount and harmfulness of waste generated in order to minimise the risk to human health and the environment and to avoid environmental degradation;
- Precautionary measures - prevention of hazards or damage to the environment caused by waste, taking measures, even if a complete scientific basis is not available;
- Responsibility of the waste producer - the producer is responsible for selecting the most acceptable environmental solution according to the product characteristics and production technology, including the product life cycle and the use of the most adequate available technology;
- Polluter pays principle - the producer or owner of the waste bears all costs of waste prevention, treatment and disposal, including post-use care and monitoring. They are also financially responsible for preventive and recovery measures for environmental damage that they have caused or will most likely cause;
- Proximity - waste treatment or disposal should be carried out in the nearest adequate facility or location, considering environmental and economic profitability;
- Regionality - development of waste treatment and construction of facilities for its disposal should be done so to meet the needs of the region and enable self-sustainability of constructed facilities.

Relevant principles of waste management in the EU, common to all directives related to the waste management process are:

- ensure the preservation of nature and natural resources, by reducing the amount of waste produced (prevention principle),
- ensure the reduction of the impact of waste on human health and the environment, and the reduction of the amount of hazardous substances in waste (precautionary principle),
- ensure that waste producers and polluters bear the costs and responsibilities for their parts (polluter pays principle),
- ensure adequate infrastructure through the establishment of an integrated and adequate system and network of waste treatment and disposal facilities based on the proximity principle and disposal of own waste.

The main goal of this document is to ensure the most important conditions for waste prevention, separation of waste that can be used as raw material, reuse and recycling, and safe disposal of waste.

2 LEGAL AND INSTITUTIONAL FRAMEWORK FOR WASTE MANAGEMENT

This chapter presents the legal and institutional framework relevant for the development of the Waste Management Plan for the construction and operation of the motorway subsection Mostar North-Mostar South.

Given the approximation of Bosnia and Herzegovina (BiH) to EU membership, the Waste Management Plan draws particular attention to the basic EU directives defining this area.

2.1 The legal framework for waste management in the EU

Directive 2008/98/EC on waste and repealing certain Directives, as amended by Directive (EU) 2018/851 establishes a legal framework for waste management in the EU. The Directive contains definitions of key terms and sets out the main principles in waste management. In addition, this Directive introduces basic requirements for waste management, in particular the obligation for an institution or undertaking carrying out waste management operations to have a permit or be registered, and the obligation to draw up waste management plans to reduce waste that is finally disposed of. The Directive focuses on waste prevention and sets new goals that will help the EU on its way to its ultimate goal, a recycling society.

This Directive required Member States to launch national waste prevention programmes by 2013.

According to the requirements of the Directive, any uncontrolled waste disposal or waste disposal in a way that can threaten the environment and human health is prohibited. In addition to waste management, the Directive treats hazardous waste and waste oils and, as a general rule, prohibits the mixing of different categories of hazardous waste, or in other words, the mixing of hazardous and non-hazardous waste as well as the separate collection of waste oils. If hazardous waste has already been mixed with other waste, substances or materials, it must be separated if technically feasible or economically viable.

Other European directives relating to specific waste streams and to waste treatment and disposal facilities must be considered when drawing up waste management plans.

The most important European directives in the waste management sector are:

- Regulation (EC) 1013/2006 on shipments of waste,
- Decision 2000/532/EC on the list of waste,
- Regulation (EC) no. 2150/2002 on waste statistics,
- Directive 1999/31/EC on the landfill of waste, as amended by Directive (EU) 2018/850,
- Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control)[3],
- Directive 2000/53/EC on end-of-life vehicles, as amended by Directive (EU) 2018/849,
- Directive 96/59/EC on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT),
- Directive 2002/96/EC on waste electrical and electronic equipment, as amended by Directive (EU) 2018/849,
- Directive 94/62/EC on packaging and packaging waste, as amended by Directive (EU) 2018/852,
- Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators, as amended by Directive (EU) 2018/849,
- Directive 78/176/EEC on waste from the titanium dioxide industry,

[3] This Directive refers to the air emission limit values from waste incineration or co-incineration plants and is transposed in BiH through the air protection sector and for this reason will not be the subject of the analysis in this Chapter.

- Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture,
- Directive 2006/21/EC on the management of waste from extractive industries and amending Directive 2004/35/EC,
- Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment.

2.2 Legal framework for waste management

In accordance with the requirements of the EU legislation, six framework laws regulating environmental protection were adopted at the level of the Federation of Bosnia and Herzegovina (FBiH) in 2003. Terminology in the field of waste management is defined in laws and by-laws and laws that address waste management are as follows:

Law on Waste Management (Official Gazette of FBiH, 33/03, 72/09 and 92/17) establishes a general framework for all aspects of waste management, primarily:

- Waste management planning (mandate, roles and responsibilities of authorities, types of planning documents, waste management permits, financial guarantees, etc.);
- Waste management responsibilities (responsibility of waste producers, responsibility of waste retailers, responsibilities of waste producers and holders);
- Main functional elements of waste management system (temporary storage, collection, transport, recovery, recycling and/or processing and disposal);
- Main requirements for hazardous waste management;
- Transboundary movement of waste;
- Controlling waste management operations.

This framework law is supported by particular and specific by-laws and strategic and planning documents prescribed by the Law itself. By-laws adopted pursuant to the requirements defined in the *Law on Waste Management* that are relevant for the preparation of this Plan are as follows:

- *Rulebook regulating the conditions for the delegation of waste management responsibilities from producers and retailers to waste collection system operators* (Official Gazette of FBiH, No. 9/05),
- *Rulebook on categories of waste with lists* (Official Gazette of FBiH, No. 9/05),
- *Rulebook on construction waste* (Official Gazette of FBiH, No. 93/19),
- *Rulebook on treatment of waste present in the list of hazardous waste or waste with unknown content* (Official Gazette of FBiH, No. 9/05),
- *Rulebook on management of waste from electrical and electronic equipment* (Official Gazette of FBiH, No. 87/12, 107/14, 08/16, 79/16, 12/18),
- *Rulebook on packaging and packaging waste* (Official Gazette of FBiH, No. 88/11, 28/13, 08/16, 54/16, 103/16, 84/17),
- *Decree on financial and other guarantees to cover the costs of minimizing any possible damage, clean-up and after-care operations* (Official Gazette of FBiH, No. 39/06),
- *Decree on selective collection, packaging and labelling of waste* (Official Gazette of FBiH, No. 38/06),
- *Decree on the obligation to submit annual reports on the waste management permit conditions* (Official Gazette of FBiH, No. 31/06).

The ***Law on Environmental Protection*** (Official Gazette of FBiH, No. 33/03 and 38/09) is an umbrella law regulating: preservation, protection, restoration and improvement of the ecological quality and capacity of

environment and of the quality of life; measures and conditions for managing, preserving and for rational use of natural resources; the framework for legal measures and institutions for preservation, protection and improvement of environmental protection; financing environmental activities and voluntary measures and responsibilities and tasks and duties of administration authorities at different levels of government. Article 19 of this Law defines waste as "all substances, products - including also the packaging and wrapping materials thereof - that their holders discard or intend or are required to discard". Also, the Law prescribes that "The holder shall ensure the proper management of wastes, and the basic measures to prevent the waste generation and to encourage recycling, processing and waste treatment for re-use; the extraction of secondary raw materials and possible of energy there from; and safe disposal".

The by-laws in the field of environmental protection relevant to this document include:

- *Rulebook on plants and facilities that require an environmental impact assessment and on plants and facilities that can be constructed and commissioned only if an environmental permit has been issued* (Official Gazette of FBiH, No. 19/04),
- *Rulebook on the contents of the report on the state of safety, content of information about safety measures and contents of internal and external intervention plans* (Official Gazette of FBiH, No. 68/05),
- *Rulebook on registries of plants and pollution* (Official Gazette of FBiH, No. 82/07),
- *Rulebook on passing the best available techniques for achieving environmental quality standards* (Official Gazette of FBiH, No. 92/07),
- *Rulebook on the requirements and criteria that project leaders in charge of developing the Environmental Impact Study must meet and on rates of fees and other costs incurred during the environmental impact assessment* (Official Gazette of FBiH, No. 33/12).

Law on Water (Official Gazette of the FBiH, No. 70/06) **-** regulates the manner of water management within the territory of the FBiH. Water management includes water protection, water use, protection against harmful effects of water and regulation of watercourses and other waters. The Law regulates water resources and public water resources, water facilities, legal entities and all institutions responsible for certain issues of water management and all other issues related to water in the FBiH. The purpose of the Law is to ensure water management with the aim of reducing water pollution, achieving good water status and preventing water degradation, sustainable water use, ensuring fair access to water, and reducing all water-related risks.

By-laws in the area relevant to the document are as follows:

- *Rulebook on conditions and criteria that must be met by a legal entity for the preparation of documentation on the basis of which water acts are issued* (Official Gazette of FBiH, No. 38/12) and
- *Decree on discharge of wastewater into the environment and public sewer systems* (Official Gazette of FBiH, No 24/20).

2.3 Institutional framework for waste management

In BiH, waste management is in the mandate of entity, cantonal and municipal level institutions.

Pursuant to the Constitution, BiH consists of two Entities: Federation of BiH (FBiH) and Republika Srpska (RS), and Brčko District (BD) of BiH, a single administrative unit existing under exclusive sovereignty of BiH, while it territorially belongs to both Entities at the same time.

Pursuant to Article III. 3 (c) of the BiH Constitution, "functions and powers not expressly assigned in this Constitution to the institutions of Bosnia and Herzegovina shall be those of the entities", therefore, environmental issues are within the authority of the entities, i.e. entities regulate the environmental protection policy and adopt relevant legislation.

In accordance with the foregoing, environmental protection issues fall within the competence of constitutional entity governments, specifically entity ministries responsible for environmental protection. In FBiH, that is the Federal Ministry of Environment and Tourism (FMET). FBiH is administratively divided in ten cantons. Each canton has its own constitution, laws, parliament and government. Through their relevant ministries, cantonal governments coordinate all waste management activities in their respective cantons. This project is located in the Herzegovina-Neretva Canton.

This Waste Management Plan is a part of environmental documentation prepared for the purpose of obtaining an Environmental permit for construction and commissioning of the planned motorway subsection Mostar North-Mostar South. Pursuant to Article 5 of the *Rulebook on plants and facilities that require an environmental impact assessment and on plants and facilities that can be constructed and commissioned only if an environmental permit has been issued* (Official Gazette of FBiH, No. 45/09), FMET is responsible for the issuance of environmental permits.

Pursuant to Article 20 of the *Law on Waste Management*, the Investor has the obligation to appoint a person responsible for waste management.

The responsible person is obliged to:

- draw up and update the draft Waste Management Plan,
- implement the Waste Management Plan,
- propose measures to improve the prevention, reuse and recycling of waste,
- supervise the compliance with defined requirements for waste management and report to the Investor.

By the Contract (which will be the subject of the tender documentation), the Investor will oblige the Contractor and the company to be hired to the motorway maintenance activities to appoint a person responsible for waste management during the execution of works, as well as a person responsible during the operation of the motorway subsection Mostar North-Mostar South.

3 PROJECT DESCRIPTION

3.1 Project location description

The 14.2 km long section Mostar North-Mostar South begins 500 m before the Mostar North Interchange in the Kutilivac settlement, east of Vrapcici, and ends just before the Mostar South Interchange near the Mostar Airport. After the interchange, the alignment extends towards the settlement of Suhi Do, where the route is moved to the east ("up the hill"), in order to avoid houses.

After Suhi Do, the section enters the longest tunnel on this subsection, Tunnel Ostri Rat (L=3,380 m), turning towards the south and bypassing the City of Mostar. In the area east of Luke settlement, the alignment exits the tunnel and passes the slopes above the settlements and extends south. The section crosses the relatively uneven terrain between Ostri Rat and Gnojnice via viaducts and tunnels. In Kocine settlement the alignment passes through a tunnel (L=2,600 m). After exiting this tunnel, the alignment descends towards the Mostar South Interchange.

The section ends at the Mostar South Interchange, which enables the connection between the motorway and main road M6.1 and it is located east of Mostar Airport. This location provides direct connection between the City of Mostar, the Airport and western Herzegovina via the planned southern bypass of the City to the motorway on Corridor Vc.

On this section the total length of the tunnels is 8,110 m, and the total length of the viaducts is 940,00 m. The route on this section runs manly through a mountainous and hilly terrain with significant spatial limitations, so cuts and embankments alternate with a larger number of buildings along the section.

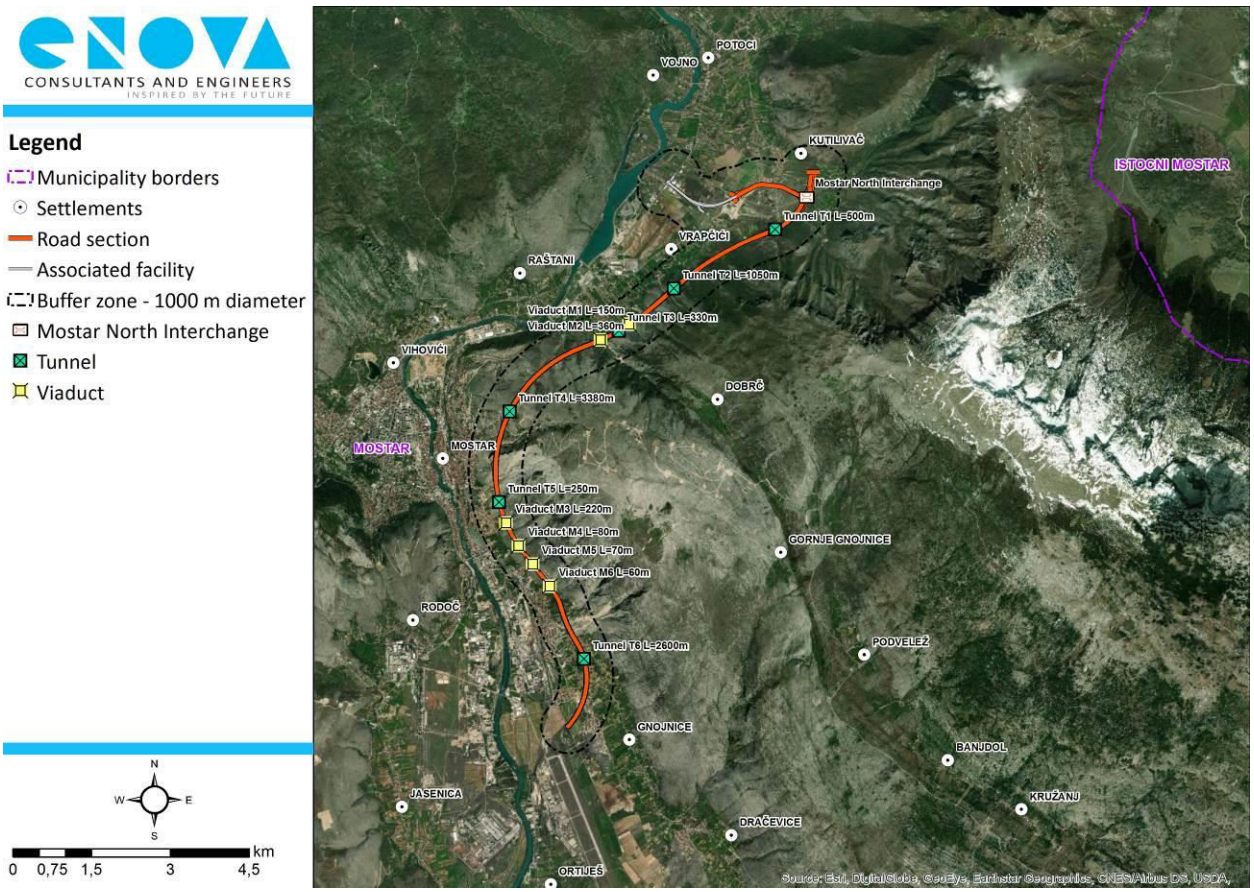


Figure 1: Subsection of the motorway from Mostar North to Mostar South on the Corridor Vc

3.2 Description of the design components

3.2.1 Interchange and toll collection facility "Mostar North"

The section starts with the Mostar North Interchange at the chainage km 0+000, including also additional access road and roundabout planned for connection up to to the M17 road in Potoci settlement. Interchange is laid in the embankment, and it is in a shape of a trumpet. Mostar North Interchange is projected with lateral toll station (Figure 2, Figure 3).

Toll station Mostar North consist of 8 toll booths and 9 traffic lanes and it has a ground floor structure - pay toll control building and passage for extra-large vehicles, roofed parking for employees and a power supply structure.

All technical elements of the motorway and other parts of roads are defined according to the *Rulebook on basic conditions which roads, its elements and facilities must meet due to traffic safety* (Official Gazette of BiH, No. 13/07).

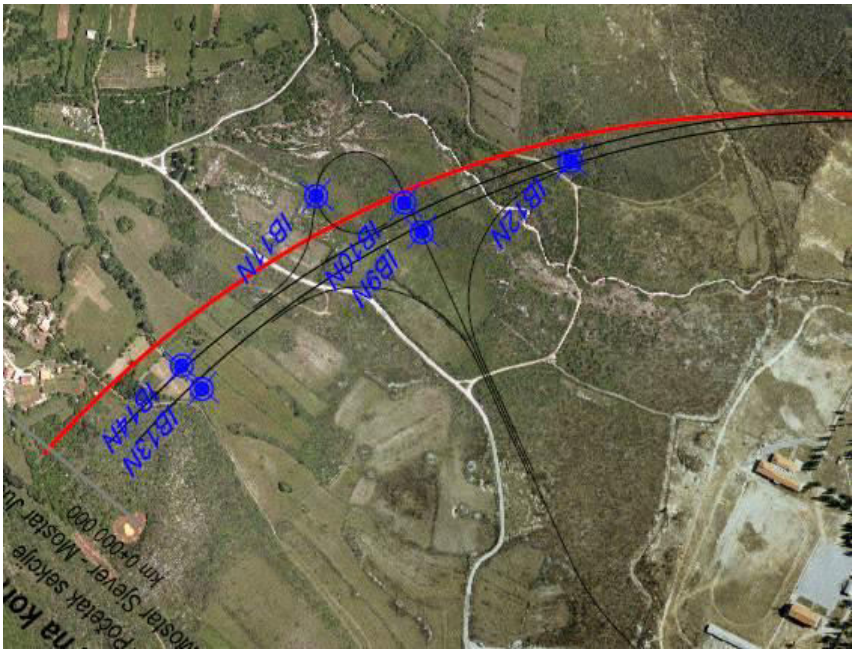


Figure 2: Mostar North Interchange 1[4]

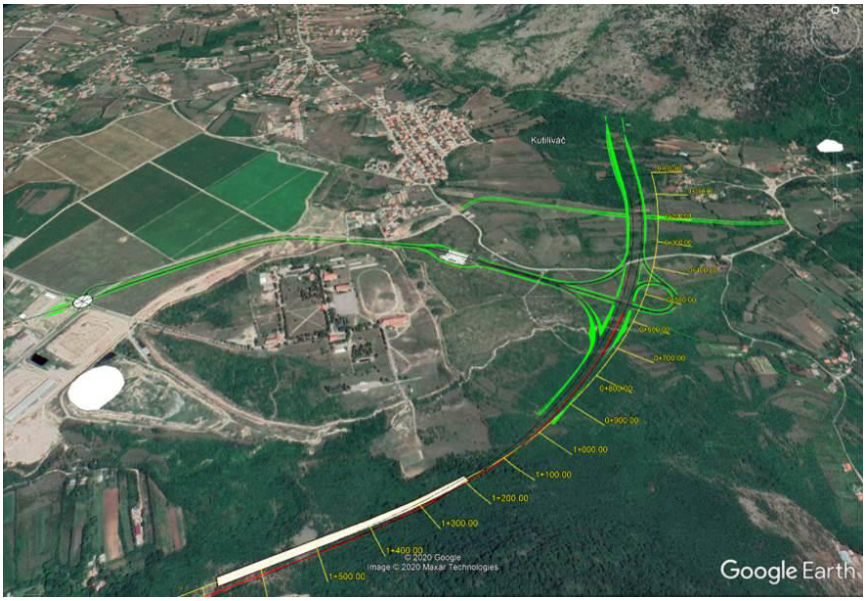


Figure 3: Mostar North Interchange 2 (Source: Google Earth)

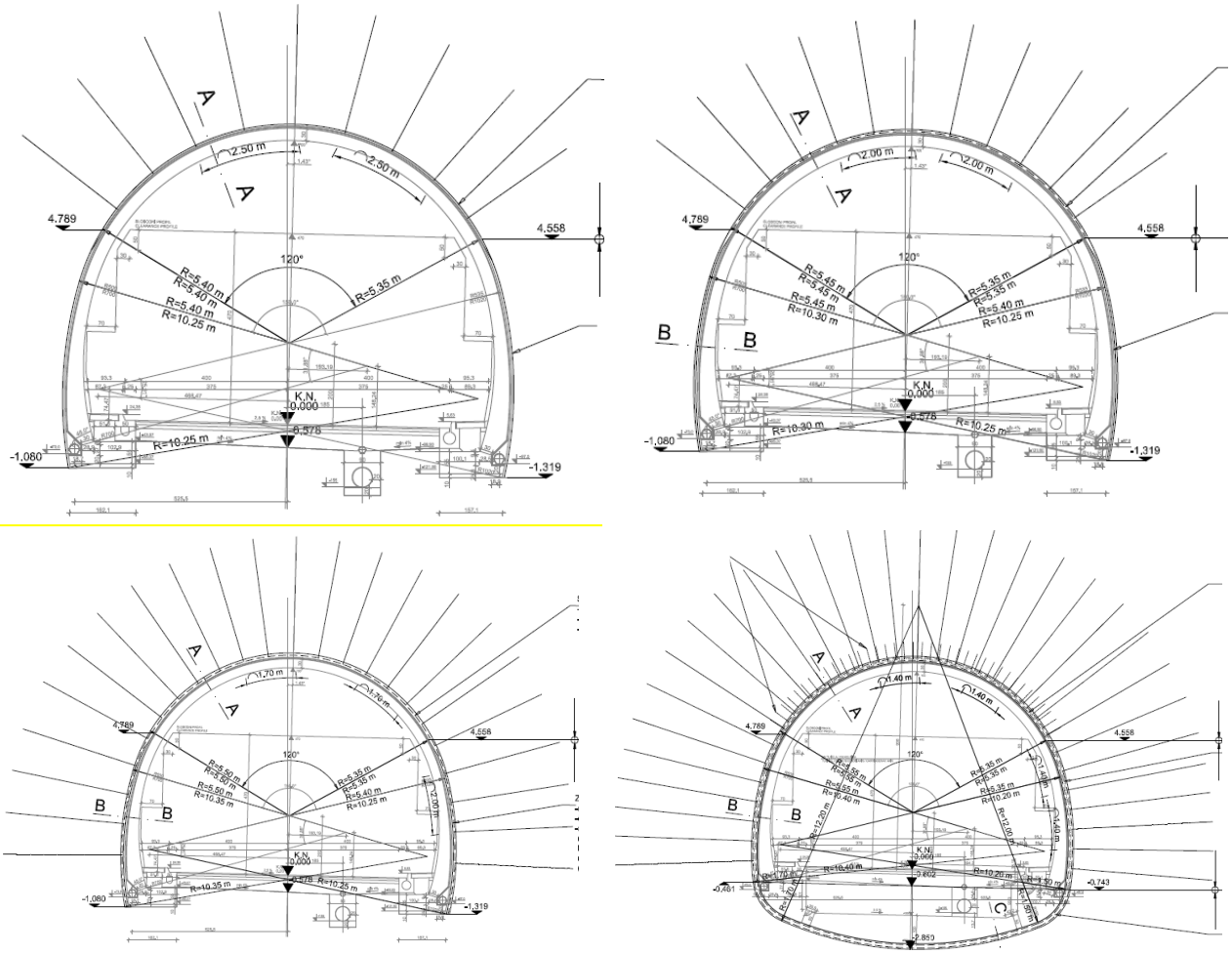
3.2.2 Tunnels

Construction of 6 tunnels is planned on the section Mostar North-Mostar South from chainage km 1+190.00 to chainage km 14+210.00 along the route of Corridor Vc. The length and position of the tunnels with regard to the motorway route is presented in the Table 1 below.

[4] IGH d.o.o. Mostar, Performance of Geotechnical Investigation Works and Preparation of Geotechnical Mission G1, Subsection Mostar North-Mostar South, November 2019.

Table 1: Overview of tunnels on the route Mostar North-Mostar South[5]

Chainage of beginning and the end of tunnel	*Length of the tunnel*
Tunnel 1 (km 1+190.00 to 1+690.00)	500 m
Tunnel 2 (km 3+165.00 to 4+215.00)	1,050 m
Tunnel 3 (km 4+850.00 to 5+180.00)	330 m
Tunnel 4 (km 5+560.00 to 8+940.00)	3,380 m
Tunnel 5 (km 9+300.00 to 9+550.00)	250 m
Tunnel 6 (km 11+610.00 to 14+210.00)	2,600 m



[5] IGH d.o.o. Mostar, Performance of Geotechnical Investigation Works and Preparation of Geotechnical Mission G1, Subsection Mostar North-Mostar South, November 2019.

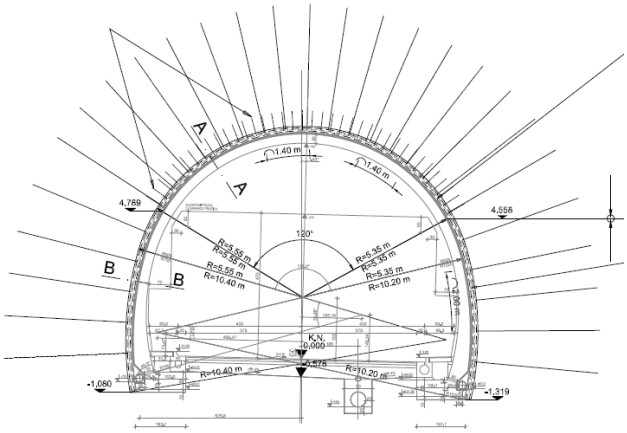


Figure 4: Tunnel design on the Mostar North-Mostar South route[6]

3.2.3 Viaducts

On the route of the section Mostar North-Mostar South, 6 viaducts of different lengths, different span between columns and different height of columns are foreseen. Their length and position on the route are presented in the table below.

Table 2: Overview of viaducts on the route Mostar North-Mostar South[7]

Chainage of beginning and the end of viaduct	*Length of the viaduct*
Viaduct M1 (km 4+675.00 to 4+825.00)	150 m
Viaduct M2 (km 5+180.00 to 5+540.00)	360 m
Viaduct M3 (km 9+710.00 to 9+930.00)	220 m
Viaduct M4 (km 10+280.00 to 10+360.00)	80 m
Viaduct M5 (km 10+730.00 to 10+800.00)	70 m
Viaduct M6 (km 11+270.00 to 11+330.00)	60 m

3.3 Description of technical elements of the route

All technical elements of the motorway are defined according to the *Rulebook on the basic requirements that public roads, their elements and facilities on them must meet from the aspect of traffic safety* (Official Gazette of BiH, 2007).

The most important technical elements of the route are:

- Design speed, Vp = 120 km/h
- Calculated speed, Rp = Vp = 120 km/h
- Relevant axle load, 15 kN
- Floor plan curves radius, Rmin = 1,180.75 m
- Transition curve, Lmin = 121.62 m
- Longitudinal slope, Smax = 5%

[6] IGH d.o.o. Mostar, Performance of Geotechnical Investigation Works and Preparation of Geotechnical Mission G1, Subsection Mostar North-Mostar South, November 2019.
[7] IGH d.o.o. Mostar, Performance of Geotechnical Investigation Works and Preparation of Geotechnical Mission G1, Subsection Mostar North-Mostar South, November 2019.

- Convex radius, Rmin = 23,500 m
- Concave radius, Rmin = 15,000 m
- Transverse slope, q = 2.5 %
- Traffic lanes = 3.75 m
- Emergency lane = 2.30 m
- Edge strip, along the traffic lanes, 0.5 + 0.2 = 0.70 m
- Central reservation, 4.00 - 26.50 m
- Deceleration (acceleration) lanes, 3.50 m
- Width of embankment (berm), 2.0 (2.5) m

Inclinations of cutting slopes and embankments were determined based on the results of geotechnical investigation works. Based on the relevant parameters, traffic load, climatic, topographic and geotechnical characteristics of the soil and materials in the bed, available resources (natural and artificial materials), as well as the appropriate performance technology, a design of the pavement structure dimensioning was made.

The pavement structure has been harmonised with the neighbouring sections and subsections, and the following has been adopted for the main route:

- SMA 11s, PmB 45/80-65 3,5cm
- VS 22, bitumen 50/70 7cm
- BNS 32s A, B 50/70 7cm
- unbound crushed stone material 0/63 mm (Ms>100MN/m^2) roadbed bearing capacity, CBR>20%, Ms>40MN/m^2 30 cm
- Total d=49,50 cm

Emergency lane:

- AB16, PmB 45/80-65 6,0 cm
- unbound crushed stone material 0/63 mm (Ms>100MN/m^2) roadbed bearing capacity, CBR>20%, Ms>40MN/m^2 43,50 cm
- Total d=49,50 cm

Bridges and viaducts:

- SMA 11s, Pm AB16, PmB 45/80-65 6,0 cm
- AB 45/80-65 3,5cm
- single-layer waterproofing with bitumen strips

Figure 5 shows the normal profile of the route of the future Mostar North-Mostar South subsection in the cut.

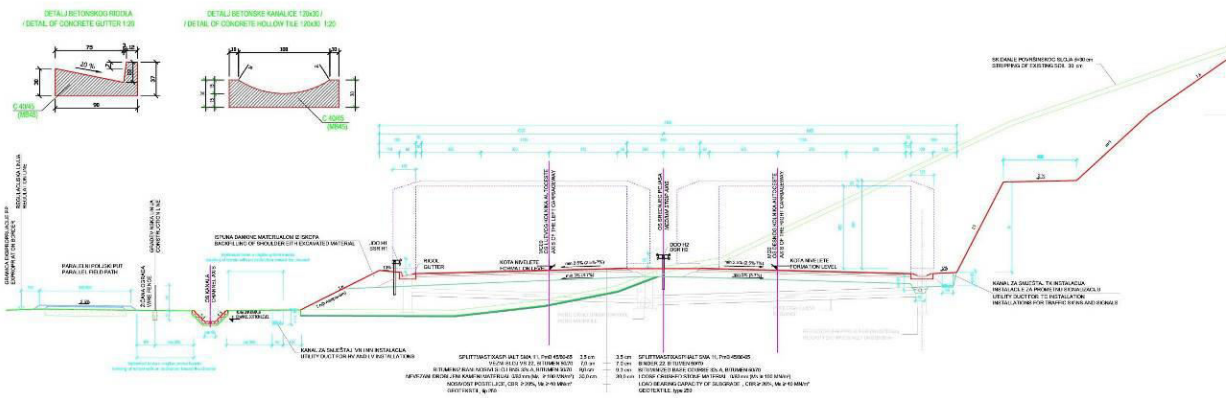


Figure 5: Normal profile of the motorway route in the cut[8]

3.3.1 Motorway drainage

External drainage

The referenced section route is located in terrain of stronger morphological expression and is mostly constructed in a viaduct or tunnel.

The beginning and end of the route along the Mostar North and Mostar South interchanges are laid in the embankment.

The motorway route is laid in a north-south direction between the Neretva River valley from the west and the mountains from the east, from which occasional streams flow towards the valley of the River Neretva.

Most of these torrents pass the route under the viaducts or above the tunnels. Occasional flows that collide with the motorway route will be regulated as part of the Preliminary and Main designs.

The terrain through which the route passes for the most part (middle) is classified as a well-permeable rock, while the beginning and end of the route around the interchanges is classified as rocks of alternating properties.

Parallel external drainage channels capture the external water that collides with the route, and drain it towards the waterbeds of temporary flows to be discharged there. Due to the terrain configuration, some canals are introduced directly into the underground through absorption wells.

Parallel external drainage channels that protect the route from water pouring from drainage areas are defined so that they can take the inflow from said water drainage of a 20-year return period.

In places where the route is laid in a cut and the terrain locally gravitates towards it, and the drainage area is not defined, the referenced cut is protected by parallel channels. This ensures the stability of the cut.

The geometry of the transverse profile of the parallel channel is a trapezoidal transverse profile with a bottom width of 60 cm. The slope inclination depends on the morphological characteristics of the terrain on which the channel is laid. The channels on the steep sections above the cut, due to the reduction of the layout position, are made in a slope inclination of 2:1, while the others on flatter terrain, are made in a slope inclination of 1:1.5.

[8] Main construction design (Book A 1010) LOT 5 for the section Mostar North - Mostar South, Inženjerski projektni zavod d.d. Zagreb, September 2010

The lining of the bottom and the slope of the channel is made of crushed stone in concrete. The stone is 15-20 cm in size and is placed in a layer of concrete MB 20 (C16/20) so that the minimum thickness of concrete is 10 cm.

Due to the already mentioned morphological structure of the terrain and the fact that most of the watercourses that intersect the discharge route are either below or above the route facility, two culverts pass through the route. One culvert leaks the Susica watercourse. The culvert measures 4.0 m x 2.0 m. The second culvert is located in the km axis 4+460.00 and its dimensions are 2.0 m x 2.0 m. It allows the occasional watercourse to pass through.

Internal drainage

A closed drainage system is planned on the entire section in question, where the water from the pavement structure is drained through the channels and gutters to the water drain and further through the sewer system to the oil and grease separator (moderate and stricter regime), and the water thus purified is discharged into absorption wells and/or occasional watercourses.

Corrugated PEHD pipes and drains made of polyethylene pipes DN 630/535 mm are planned for water drainage along the route. Manholes on the route are made of polyethylene, i.e. HDPE material or concrete, and are made monolithically on site.

Considering the laid level of the motorway and the size of the drainage area, oil and grease separators should be installed in the hypsometrically lowest points of the longitudinal profile. The total number of locations where oil and grease separators will be installed is 6.

A detail (cross-section) of the oil and grease separator to be installed on the Mostar North-Mostar South subsection is shown in Figure 6.

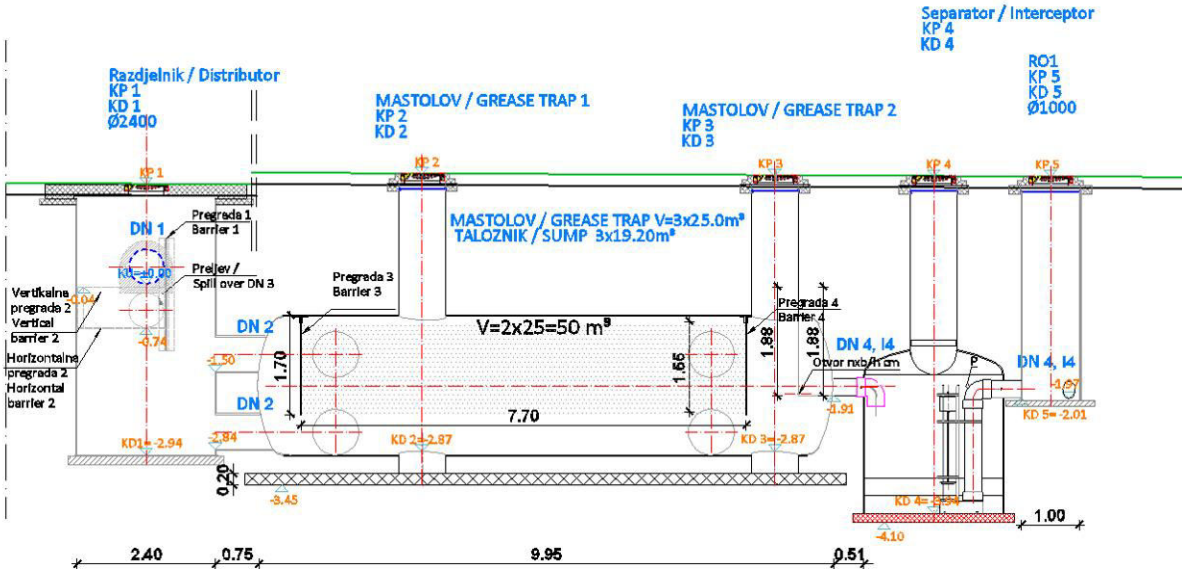


Figure 6: Cross section of oil and grease separators

Drainage of sanitary-faecal wastewater

The generation of sanitary-faecal wastewater for the Mostar North - Mostar South subsection is related to the planned toll collection facility, which is located on the Mostar North interchange. The Mostar North toll collection

facility consists of 8 toll booths and 9 traffic lanes, and also contains a ground floor structure - a toll control building and a passage for large vehicles, a covered parking lot for employees and a power supply structure. Within the toll control building, there is a sanitary block where sanitary - faecal wastewater is generated. They are collected through faecal vertical and horizontal PEH pipes. Collected waste sanitary-faecal water is drained through PEHD pipes to the wastewater treatment device located in the background of the toll facility.

For the needs of sanitary-faecal wastewater treatment at the location of toll booths, an SBR biological faecal water purifier with a capacity of 8 ES is planned to be installed (Figure 7). After the wastewater treatment in SBR, the treated water shall be discharged into the recipient (Susica stream) while the sludge generated as a by-product of treatment is disposed of by a company authorised to deal with this type of waste (sludge). Disposal is performed on the basis of an Agreement signed between JPAC and the company hired to maintain the motorway subsection.

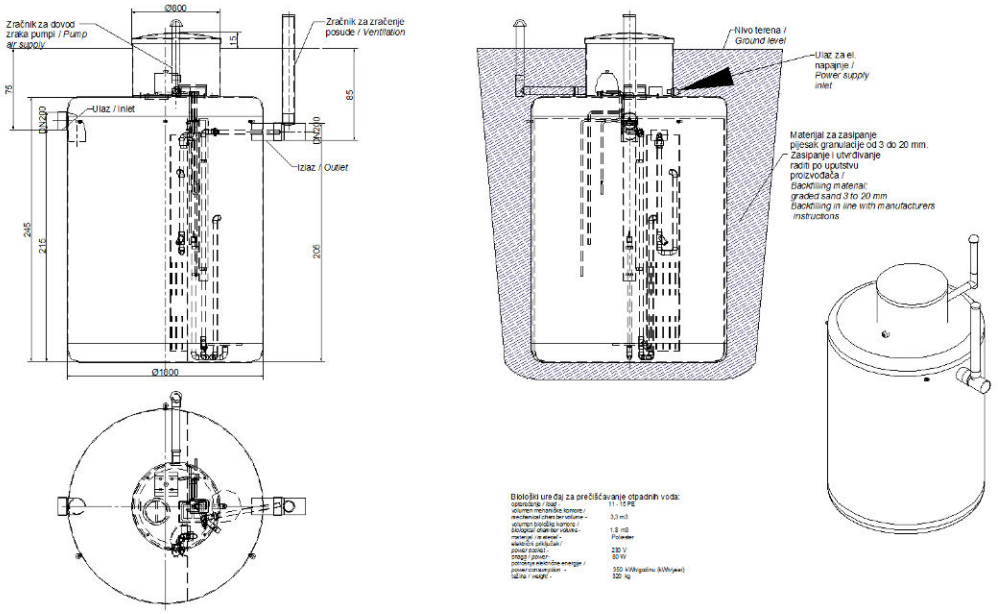


Figure 7: Biological treatment of sanitary-faecal wastewater[9]

[9] Technical standards used in the development of motorway construction designs on Corridor Vc (JPAC)

4 DESCRIPTION OF WASTE THAT WILL BE GENERATED DURING CONSTRUCTION AND OPERATION OF THE PROJECT

In order to describe the waste and estimate the expected amounts of waste and emissions during the implementation of the project of construction of the planned motorway subsection Mostar North-Mostar South at a length of 14.2 km, consideration was given to the generation of waste and emissions during:

- construction of the motorway and
- operation of the motorway.

During the construction and operation of the planned motorway, waste will be generated and, according to the *Rulebook on categories of waste with lists* (Official Gazette of FBiH, No. 9/05), it is classified by the characteristics and activities from which it generated.

Pursuant to the Rulebook, waste groups and individual waste names are marked with six-digit key numbers where the first two digits indicate the activity from which the waste originates, the other two indicate the process in which the waste was generated and the last two digits indicate the part of the waste process. Hazardous waste in the Rulebook on categories of waste with lists is marked with an asterisk (*).

The categorization of waste in relation to the origin according to the Rulebook on categories of waste with lists is given in Table 3.

Table 3: Categorization of waste in relation to origin according to the Rulebook on categories of waste with lists

Code	*Waste*
01 00 00	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals
02 00 00	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
03 00 00	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard
04 00 00	Wastes from the leather, fur and textile industries
06 00 00	Wastes from inorganic chemical processes
07 00 00	Wastes from organic chemical processes
08 00 00	Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), sealants and printing inks
09 00 00	Wastes from photographic industry
10 00 00	Wastes from thermal processes
11 00 00	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy
12 00 00	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13 00 00	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
14 00 00	Waste organic solvents, refrigerants and propellants (except 07 00 00 and 08 00 00)
15 00 00	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
16 00 00	Wastes not otherwise specified in the list
17 00 00	Construction and demolition wastes (including road construction waste)
18 00 00	Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)
19 00 00	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use
20 00 00	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

4.1 Waste that will be generated during construction

The type and scope of works on the construction of the motorway and ancillary facilities, which include excavation, concreting, installation works, transport of materials and equipment, will dictate the types and quantities of waste generated.

During the preparation of the document concerned, some parts (when estimating the amount of waste for the subsection route) from the Main Construction Design (Book A 1010) LOT 5 for the Mostar North-Mostar South section (2010) were used, however the design has undergone some changes related to relocation of the motorway route. Currently, there is no design and technical documentation for the new route, and the consultant, based on his experience in the development of the same and/or similar designs, made preliminary assessments of the course of waste generation and waste quantities. The new route defined by the *Decision on the implementation of the spatial plan for the areas of the special features of importance for the Federation of Bosnia and Herzegovina "Motorway on Corridor Vc"* defines the final route of Corridor Vc (2017), including the considered Mostar North-Mostar South subsection.

The main construction design (Book A 1010) LOT 5 for the Mostar North-Mostar South section (2010) was used only as a reference for the most adequate assessment of the types and quantities of waste that will be generated during the construction of the Mostar North-Mostar South subsection.

Projections of types and quantities of waste can be seen through the dimensions of the planned facilities given in the Main Design (Bill of Quantities) and comparison, or projection with similar motorway construction projects throughout BiH, while one of the basic types of waste that will occur during the construction of the motorway is construction waste.

Construction waste may contain hazardous substances, in which case this type of waste must be treated as hazardous waste.

Construction waste includes:

- earth, sand, gravel, clay, loam, stone as a result of earthworks and excavation;
- bitumen (asphalt) or cement-bound material, sand, gravel, crushed stone as a result of construction of civil engineering structures;
- concrete, bricks, mortar, gypsum, aerated concrete, natural stone as a result of the construction of buildings;
- wood, plastic, paper, cardboard, metal, cables, paint, varnish and other mixed waste on the construction site as a result of other construction operations.

Indicative composition of construction waste:

- excavation material 90%,
- demolition and construction waste 5%,
- asphalt and concrete 5%.

For the most part (95%) construction waste is inert waste (earth and stones from excavation, plaster, broken concrete, iron, steel, metals, wood, plastic, paper, etc.), and may be hazardous, for example, asphalt binder or waste containing asbestos, which requires special control and treatment. Other waste (5%) is mixed municipal waste produced by hired employees of the Contractor, oil waste and packaging waste.

The types of waste that can be generated during the construction of the motorway are shown in Table 4.

Table 4: Categorization of waste that will be generated during the construction of the motorway

Code	*Waste*
02 00 00	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
08 00 00	Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), sealants and printing inks
13 00 00	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
15 00 00	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
16 00 00	Wastes not otherwise specified in the list
17 00 00	Construction and demolition wastes (including rod construction waste)
20 00 00	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

The estimation of the amount of waste generated during construction was performed on the basis of the bill of quantities from the Main Design. Within the Bill of Quantities, the planned works on the construction of the tunnel were not considered, and for a given segment, the consultant assessed the planned works and the amount of excavation materials. The assessment was performed based on the length and cross-section of the tunnel.

During the preparatory works on the construction of the motorway route due to the removal of humus, shrubs and trees with trunks, waste from forest exploitation will appear (plant waste, shrubs, stumps, etc.). Clean-up and preparation of the terrain includes cutting shrubs and trees of all sizes, cutting branches, cutting trees and thick branches to lengths suitable for transport, removing roots, shrubs and old stumps and stumps of newly cut trees, transporting shrubs, branches, logs and stumps to the landfill designated by the supervising engineer. Clean-up also includes removing any unnecessary material left behind after these works. The total quantity of waste from the removal of bushes and shrubs is calculated per square meter of cleared overgrown area. The total area that will be covered by the removal of waste from forest exploitation is 144,000 m^2.

Cut trees and stumps should be disposed of along the route in places accessible for the trees to be removed by the competent authorities and where it will not disturb the works. The Contractor will temporarily place this waste at a sufficient distance from the watercourse. In the preparatory phase of the project implementation, the competent (local) forestry authority will cut and remove this waste.

Construction of structures requires ground excavation and removal of extra quantities of excavated soil and removal of bad quality soil from the construction site (marl soil, soil containing high percent of biodegradable material). Granular materials – broken stone, crushed stone and sand are used for filling works and lining for road laying. Cement, concrete, steel and wood are materials that will be most frequently used in structure construction. Estimates of types and quantities of waste can be made based on dimensions of structures given in the Main Design.

According to the conducted geotechnical research works (mission G1) and according to section 2.2.2.1 of the Guidelines for design, construction, maintenance and supervision of roads, Book II: Construction, Part 2: Special technical conditions, categorisation of excavated materials at the location of the future Mostar North - Mostar South subsection of the motorway was made. According to the given categorisation, in the design phase, the forecast of representation of individual categories is given. The largest amounts of excavated materials are generated during excavations and tunnelling.

The Bill of Quantities from the Main Project provides the quantities of excavated materials on the open part of the route, i.e. during the excavation, while the quantities of excavated materials generated by tunnel penetration were estimated by the consultant based on the physical dimensions of the planned tunnels.

The input data for the assessment of the excavation category are the forecast of thicknesses and the presence of: cover (3 excavation categories), completely broken rock masses and cohesive rock creeps (category 4 excavations) and the forecast depth of occurrence of less karst and fresh rock base (category 5 excavations).

It should be noted that the possible assessment of the 4th category of excavation is very rough, especially because the requirement that the material is used in construction of embankments, in this category of rock, involves more work due to material fragmentation than in case of excavation of cuts.

An estimate of each category of excavation is given for cuts in the entire subsection:

- category 5 - 80%,
- category 4 - 15%,
- category 3 - 5% (category 3 is not recommended for construction of embankments).

Table 7 shows the total quantities of excavated materials by categories that will be generated during the construction of the motorway on the open part of the route.

Table 5: The amount of excavated materials that will be generated during the construction of the motorway on the open part of the route[10]

Category	*Quantity m³*
Category 3	231.465
Category 4	212.604
Category 5	1.133.886
Total	**1.577.955**

Of the total amount of excavated materials on the open part of the route, category 5 (hard rock) of excavated materials is planned for the embankment, which amounts to 784,316 m^3.

The total amount of excavated materials that was not used for the embankment, which was excavated on the open route of the motorway and which needs to be adequately disposed of, is approximately **793,639 m^3**.

Estimation of excavation materials that will occur during the drilling of all tunnels in the subsection was performed based on the length and cross-sectional area of the tunnel pipe. The material obtained by excavating the tunnel is mostly the category 5 (limestone, dolomite and breccia) material.

The cross-sectional area of the planned tunnels averages 115 m^2 (Figure 7).

Table 6 shows the estimated quantities of excavated materials that will be generated during the tunnel penetration on the Mostar North-Mostar South subsection.

Table 6: Estimated quantities of excavated materials during tunnelling on the route Mostar North-Mostar South[11]

Tunnel	*Tunnel length*	*Surface of one pipe (m^2)*	*Excavation amount (m^3)*
Tunnel 1	500 m	115	115.000
Tunnel 2	1.050 m		241.500
Tunnel 3	330 m		75.900

[10] Bill of Quantities (Main construction design, 2010)
[11] IGH d.o.o. Mostar, Performance of geotechnical investigation works and preparation of geotechnical mission G1, Subsection: Mostar North-Mostar South, November 2019.

Tunnel	*Tunnel length*	*Surface of one pipe (m^2)*	*Excavation amount (m^3)*
Tunnel 4	3.380 m		777.400
Tunnel 5	250 m		57.500
Tunnel 6	2.600 m		598.000
		Total	**1.865.300**

Considering that filling will be required only in the first part of the route (from the (Mostar North interchange to the first tunnel) of the considered subsection, and that the amount of 784,316 m^3 has already been used for the embankment, and that no embankment will be required in other parts of the route, because most of the work is done on the construction of viaducts and tunnels, where there is no embankment, the amount obtained from the tunnel will be considered as construction waste.

Therefore, the total amount of excavated materials resulting from the construction of the Mostar North-Mostar South subsection route of the motorway, which should be adequately disposed of and disposed of at the construction waste landfill, is **2,658,939 m^3**.

During the construction works and operation of machinery, accidental situations of spillage of waste oils, mineral or synthetic oils, oil and gasoline that contaminate the soil, surface and groundwater may occur. The estimation of the quantities of waste oils and fuels that are the result of the work of construction machines is based on the determination of the number of working hours of construction machines (excavators, bulldozers, trucks ...). This was done by applying a formula to determine the performance of the excavator:

$$U_p = \frac{q \cdot T}{t_c} \cdot k_A \cdot k_B \cdot k_C$$

where:

- q - excavator bucket volume,
- T - time (h),
- t_c - duration of a cycle,
- k_A - product material coefficient (medium excavation, earth and stone, wet earth and stone, adopted value is $k_A = 0,52$),
- k_B - product coefficient of working conditions (trench, loading into the vehicle, turning the arm of the excavator 90o, adopted value is $k_B = 0,66$),
- k_C - product coefficient of organisation (good conditions of excavation and loading, good use of working time, preserved working machines, adopted value is $k_C = 0,63$).

The list of waste codes with the composition, quantity, place of origin and collection, types of shipment to the temporary and/or final disposal site as well as the place of final disposal of all categories of waste generated during the construction of the motorway, is shown in Table 7.

Table 7: Estimated types and quantities of waste in the motorway construction phase with guidelines for the management of individual types of waste

1[1]	2[1]	3[1]	Name of waste	Composition of waste	Quantity during construction	Place of origin	Place of collection	Type of shipment to place of temporary and final disposal	Place of final disposal, authorised company, producer
02			**WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING**						
02	01		Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing						
02	01	07	Waste from forestry	Wood and plant waste from surface, humus, etc.	144,000 m^2 (on the area to be cleared)	Shrubs, bushes on the planned route, due to cleaning and preparation of the route	Temporary disposal next to the route	Transport vehicle	Firewood, composting, incineration and/or the competent (local) forestry authorities
08			**WASTES FROM THE MANUFACTURE, FORMULATION, SUPPLY AND USE (MFSU) OF COATINGS (PAINTS, VARNISHES AND VITREOUS ENAMELS,) ADHESIVES, SEALANTS AND PRINTING INKS**						
08	01		Wastes from MFSU and removal of paint and varnish						
08	01	11*	Waste paint and varnish containing organic solvents or other dangerous substances	Paints and varnishes	approx. 150 l	When painting along the route and protecting metal structures	Temporary storage of hazardous waste	Transport vehicle	Authorised company
08	01	21*	Waste paint or varnish remover	Thinners for paints and varnishes	approx. 120 l	When painting along the route and protecting metal structures	Temporary storage of hazardous waste	Transport vehicle	Authorised company
13			**OIL WASTES AND WASTES OF LIQUID FUELS (except edible oils, and those in chapters 05, 12 and 19)**						
13	01		Waste hydraulic oils						
13	01	10*	Mineral-based non-chlorinated hydraulic oils	Hydraulic oils	(Calculated on the basis of the table of rate of yield for construction machinery number of working	Complete planned route	Storage of hazardous waste	Transport vehicle	Authorised company

					hours) approx. 420 l				
13	01	11*	Synthetic hydraulic oils	Hydraulic oils	(Calculated on the basis of the table of rate of yield for construction machinery number of working hours) approx. 300 l	Complete planned route	Storage of hazardous waste	Transport vehicle	Authorised company
13	02		Waste engine, gear and lubricating oils						
13	02	06*	Synthetic engine, gear and lubricating oils	Engine oils, lubricants, lubricating materials	(Calculated on the basis of the table of rate of yield for construction machinery number of working hours) approx. 730 l	Construction machinery, equipment installation, entire route	Temporary storage of hazardous waste	Transport vehicle	Authorised company
13	02	07*	Readily biodegradable engine, gear and lubricating oils	Engine oils, lubricants, lubricating materials	(Calculated on the basis of the table of rate of yield for construction machinery number of	Construction machinery, equipment installation, entire route	Temporary storage of hazardous waste	Transport vehicle	Authorised company

					working hours) approx. 450 l				
13	07		Wastes of liquid fuels						
13	07	01*	Fuel oil and diesel	Motor fuels	Calculated on the basis of the table of rate of yield for consumption and working hours, waste of 1%) approx. 420 l	Construction machinery, equipment installation, entire route	Temporary storage of hazardous waste	Transport vehicle	Authorised company
13	07	02*	Petrol	Motor fuels	Calculated on the basis of the table of rate of yield for consumption and working hours, waste of 1%) approx. 210 l	Construction machinery, equipment installation, entire route	Temporary storage of hazardous waste	Transport vehicle	Authorised company
13	08		Oil wastes not otherwise specified						
13	08	99*	Wastes not otherwise specified	Oily cloths, clothes, oily materials	approx. 180 kg	Construction machinery, equipment installation, entire route	Temporary storage of hazardous waste	Transport vehicle	Authorised company
15			**WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**						
15	01		Packaging (including separately collected municipal packaging waste)						
15	01	10*	Packaging containing residues of or contaminated by dangerous substances	Packaging of paints and varnishes,	approx. 220 kg	The entire route of the section, and the accompanying facilities, protection of metal	Temporary storage of hazardous waste	Transport vehicle	Authorised company

						structures			
15	02		Absorbents, filter materials, wiping cloths and protective clothing						
15	02	02*	Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	Filters, absorbent fillers	approx. 310 kg	Construction machinery and means of transport, installation of equipment, ancillary facilities,	Temporary storage of hazardous waste	Transport vehicle	Authorised company
16			**WASTES NOT OTHERWISE SPECIFIED IN THE LIST**						
16	01		End-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)						
16	01	03	End-of-life tyres	Residues of worn tires	approx. 15 pcs	Due to the operation of construction machinery	Temporary waste storage	Transport vehicle	Authorised company
16	01	11*	Brake pads containing asbestos	Asbestos-containing pads	approx. 525 kg	Construction machinery and means of transport that are distributed along the entire route	Temporary storage of hazardous waste	Transport vehicle	Authorised company
16	01	12	Brake pads other than those mentioned in 16 01 11	Pads	approx. 450 kg	Construction machinery and means of transport that are distributed along the entire route	Temporary storage	Transport vehicles	Authorised company
16	06		Batteries and accumulators						
16	06	05	Other batteries and accumulators	Batteries and accumulators	approx. 520 kg	Occurring on the construction site due to the failure of construction machinery	Temporary storage	Transport vehicles	Authorised company
17			**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**						
17	01		Concrete, bricks, tiles and ceramics						
17	01	01	Concrete	Waste	Resulting from the	Route, demolition of existing concrete	Temporary storage	Transport vehicles	Construction waste landfill

				concrete	demolition of buildings, concrete debris, and debris in construction (400 m^3 demolition and approx. 50 m^3 from construction	barriers, houses, construction of all structures, road barriers			
17	01	02	Bricks	Brick	Resulting from the demolition of buildings built of brick approx.425 m^3	Demolition of residential buildings	Temporary storage	Transport vehicles	Construction waste landfill
17	01	03	Tiles and ceramics	Tiles and ceramics	Resulting from the demolition approx. 50 m^3	Demolition of residential buildings	Temporary storage	Transport vehicles	Construction waste landfill
17	01	06*	Mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances	Concrete, roof tiles, bricks and ceramics	approx. 50 m^3	Demolition of residential buildings	Temporary storage of hazardous waste	Transport vehicles	Authorised company
17	02		Wood, glass and plastic						
17	02	01	Wood	Wooden boards, poles, wooden scaffolding, wooden pads	Demolition: approx. 100 m^3 and during construction	Demolition of buildings, installation of equipment, concrete works, works on the route, construction of all structures	Temporary landfill	Transport vehicles	Authorised company and/or handover to third parties

					approx. 25 m^3				
17	02	02	Glass	Window and door glazing - demolition of buildings	approx. 100 kg	Demolition of existing structures	Selective waste containers	Transport vehicles	Authorised company
17	02	03	Plastic	Thermal contraction branch, insulation from pre-insulated pipes, PVC bags, warning tapes, foils, PVC pipes, cables	Demolition: approx. 150 and during construction approx. 300 kg	Demolition of buildings, construction of structures and routes	Selective waste containers	Transport vehicles	Authorised company
17	02	04*	Glass, plastic and wood containing or contaminated with dangerous substances	Mixtures of mentioned materials	approx. 300 kg	Demolition of buildings, installation of equipment, concrete works, works on the route, construction of all structures	Temporary storage of hazardous waste	Transport vehicles	Authorised company
17	03		Bituminous mixtures, coal tar and tarred products						
17	03	01*	Bituminous mixtures containing coal tar	Plastic anti-corrosion tapes, waste asphalt	approx. 700 m^2	Route construction, existing road barriers, structures	Temporary storage of hazardous waste	Transport vehicles	Authorised company
17	03	02	Bituminous mixtures containing other than those mentioned in 17 03 01*	Mixtures based on bitumen, cardboard	approx. 250 m^2	Route construction, existing road barriers, structures	Selective waste containers	Transport vehicles	Authorised company
17	04		Metals (including their alloys)						
17	04	05	Iron and steel	Mounting accessories, damaged steel and iron parts, wire, marking poles, barriers, sheet metal,	Demolition: approx. 100 kg and during construction approx. 50 kg	Construction of buildings, installation of equipment on the route, disassembly of old wire on barriers, preparation of poles, road crossings,	Selective waste containers	Transport vehicle	Authorised company

				grounding strip					
17	04	07	Mixed metals	Electronic equipment, residue of welding electrodes, cables	Demolition: approx. 50 kg and during construction approx. 25 kg	Installation of equipment in ancillary structures including electronic equipment	Selective waste containers	Transport vehicle	Authorised company
17	05		Soil (including excavated soil from contaminated sites), stones and dredging spoil						
17	05	04	Soil and stones other than those mentioned in 17 05 03*	Dredge spoil, stones, sand, lime sand, gravel	2.658.939 m^3	Excavation works along the route, mining works, preparation works along the route, sand filling on the route, macadam roads, road crossings, tunnels and structures	Temporary disposal sites	Transport vehicle	Construction waste landfill (surplus that will not be used as construction material)
17	05	06	Dredging spoil other than those mentioned 17 05 05*	Dredge spoil, humus resulting from preparation works in a layer of thickness d= 20 cm	approx. 28.800 m^3	Excavation works along the route, drilling works, preparation works along the route, road crossings, structures	Temporary disposal sites	Transport vehicle	Construction waste landfill (surplus that will not be used as construction material)
17	06		Insulation materials and asbestos-containing construction materials						
17	06	01*	Insulation materials containing asbestos	Insulation materials	Demolition: approx. 100 kg	Construction of all structures and demolition of residential buildings	Temporary storage of hazardous waste	Transport vehicles	Authorised company
17	09		Other construction and demolition waste						
17	09	03*	Other construction and demolition wastes (including mixed wastes) containing dangerous	Mixed construction hazardous waste	approx. 500 kg	Demolition of existing structures on the entire planned route	Temporary storage of hazardous waste	Transport vehicles	Authorised company

			substances						
17	09	04	Mixed construction and demolition waste other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	Mixed construction waste	approx. 925 m^3	Demolition of existing structures on the entire planned route	Temporary disposal sites	Transport vehicle	Construction waste landfill
20			**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**						
20	01		Separately collected fractions (except 15 01)						
20	01	01	Paper and cardboard	Cardboard boxes, paper packaging…	approx. 1,1 t	Warehouse for construction materials, installation of equipment, workers, entire route	Selective waste containers	Transport vehicle	Authorised company
20	03		Other municipal wastes						
20	03	01	Mixed municipal waste	Food products, packaging…	approx. 2,0 t	Entire construction site	Municipal waste containers	Transport vehicle	PUC transport to the municipal waste landfill

*1^1 - activity from which the waste originates, 2^1 - the process in which the waste was generated, 3^1 - the process from which the waste originates; * - hazardous waste*

4.2 Waste that will be generated during operational phase

During the operational phase of the motorway, the Investor is obliged, pursuant to Article 19 of the *Law on Environmental Protection* and Article 19 of the *Law on Waste Management*, to take adequate waste management measures and take basic measures to prevent waste generation, to recycle and treat waste for re-use, extraction of raw materials and possible energy, and safe disposal.

During the operational phase of the motorway, there will appear waste specific to road traffic, as well as waste resulting from inappropriate behaviour of road users, such as throwing garbage from cars while driving or especially in parking lots. This waste is of a sedimentary character. Waste from the ground, along the road, as well as waste from the parking lot should be taken away by the institutions responsible for motorway maintenance.

During the operational phase of the motorway, the primary task is to take adequate measures to prevent pollution of both surface and groundwater. The Preliminary Design envisages the installation of oil and grease separators for the treatment of oil wastewater. The technical solution in the Main Design must also provide for the treatment of storm water (which is contaminated with heavy oils and lead, and washed off the lanes), so that they do not contaminate natural watercourses.

Motorway maintenance works require the use of some types of materials that belong to the group of toxic and dangerous substances.

The most commonly used products are:

- diesel - fuel used for equipment in most transport vehicles,
- petrol,
- lubricants (oils, petroleum jelly),
- paints and varnishes, thinners - used for maintenance, protection and marking.

During the operational phase, waste will be generated during the maintenance of facilities, road maintenance by workers and machinery of authorised companies, and due to accident situations, or breakdowns.

Solid waste will be generated during maintenance (tires, metal waste, packaging contaminated with hazardous substances, greasy cloths, municipal waste and packaging waste), and in the separator (precipitated suspended solids).

Liquid waste (oil wastewater, motor oils and greases, light liquids and petroleum products, etc.) will be generated during the maintenance of the route due to traffic, and in the oil and grease separator (sludge).

The types of waste that are expected during the operational phase are given in the following table.

Table 8: Categorization of waste that will be generated during the operational phase of the motorway

Code	*Waste*
08 00 00	Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), sealants and printing inks
13 00 00	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
15 00 00	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
19 00 00	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use
20 00 00	Municipal wastes (household waste and similar commercial, industrial and institutional wastes)

Code	*Waste*
	including separately collected fractions

The list with waste codes, types, quantity, place of origin and collection, types of shipment to the temporary and/or final disposal site as well as the place of final disposal of all categories of waste generated during motorway operation in a period of one year is shown in Table 9, and the quantities of waste are estimated for a period of five years throughout the legal duration of the Waste Management Plan.

Table 9: A list of waste with codes that will be generated during the operational phase of the motorway

1[1]	2[1]	3[1]	Name of waste	Composition of waste	Quantity per year	Place of origin	Place of collection	Type of shipment to place of temporary and final disposal	Place of final disposal, authorised company, producer
08			**WASTES FROM THE MANUFACTURE, FORMULATION, SUPPLY AND USE (MFSU) OF COATINGS (PAINTS, VARNISHES AND VITREOUS ENAMELS,) ADHESIVES, SEALANTS AND PRINTING INKS**						
08	01		Wastes from MFSU and removal of paint and varnish						
08	01	11*	Waste paint and varnish containing organic solvents or other dangerous substances	Paint and varnish	approx. 100 l	The whole route due to painting and marking	Storage of hazardous waste	Transport vehicle and special containers for hazardous waste	Authorised company
13			**OIL WASTES AND WASTES OF LIQUID FUELS (except edible oils, and those in chapters 05, 12 and 19)**						
13	02		Waste engine, gear and lubricating oils						
13	02	05*	Mineral-based non-chlorinated engine, gear and lubricating oils	Motor oils	approx. 80 l	Ancillary facilities, transport vehicles, maintenance route	Storage of hazardous waste	Transport vehicle	Authorised company
13	02	06*	Synthetic engine, gear and lubricating oils	Motor oils	approx. 80 l	Ancillary facilities, transport vehicles, maintenance route	Storage of hazardous waste	Transport vehicle	Authorised company
13	08		Oil wastes not otherwise specified						
13	08	99*	Wastes not otherwise specified	Cloths, containers, clothes...	approx. 200 kg	Ancillary facilities, transport vehicles, maintenance route	Storage of hazardous waste	Transport vehicle	Authorised company
15			**WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**						
15	01		Packaging (including separately collected municipal packaging waste)						
15	01	01	Paper and cardboard packaging	Cardboard and paper boxes,	approx. 450 kg	Ancillary facilities, transport vehicles, maintenance route	Selective waste containers	Transport vehicle	Authorised company
15	01	02	Plastic packaging	Plastic packaging,	approx. 150 kg	Ancillary facilities, transport vehicles,	Selective waste containers	Transport vehicle	Authorised company

1[1]	2[1]	3[1]	Name of waste	Composition of waste	Quantity per year	Place of origin	Place of collection	Type of shipment to place of temporary and final disposal	Place of final disposal, authorised company, producer
				boxes, bottles, ...		maintenance route			
15	01	04	Metallic packaging	Metal	approx. 200 kg	Ancillary facilities, transport vehicles, maintenance route	Selective waste containers	Transport vehicle	Authorised company
19			**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**						
19	08		Wastes from waste water treatment plants not otherwise specified						
19	08	05	Sludges from treatment of urban waste water	Sludges from treatment	approx. 1 m^3/year	Location of SBR device at the site of toll station	SBR sludge chamber	Transport vehicles	Authorised company with which a third party engaged in maintenance will sign a contract for waste disposal (sludge)
19	08	10*	Grease and oil mixture from oil/water separation other than those mentioned in 19 08 09	Grease and oil, mixtures of oil waste	approx. 800 l	Grease and oil separators on the planned route	Storage of hazardous waste	Transport vehicle and special containers for hazardous waste	Authorised company
20			**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**						
20	01		Separately collected fractions (except 15 01)						
20	01	01	Paper and cardboard	Paper	approx. 80 kg	Ancillary facilities, transport vehicles, maintenance route	Selective waste containers	Transport vehicle	Authorised company
20	01	39	Plastics	Plastic equipmen	approx. 150 kg	Ancillary facilities, transport vehicles,	Selective waste	Transport vehicle	Authorised company

1[1]	2[1]	3[1]	Name of waste	Composition of waste	Quantity per year	Place of origin	Place of collection	Type of shipment to place of temporary and final disposal	Place of final disposal, authorised company, producer
				t and parts		maintenance route	containers		
20	03		Other municipal wastes						
20	03	01	Mixed municipal waste	Waste resulting from food for workers, cleaning...	approx. 4.5 t	Entire site	Containers per locations	Transport vehicle	PUC transport to the municipal waste landfill

1[1] - activity from which the waste originates, 2[1] - the process in which the waste was generated, 3[1] - the process from which the waste originates * - hazardous waste

5 TREATMENT OF WASTE THAT WILL BE PRODUCED DURING THE CONSTRUCTION AND OPERATION OF THE MOTORWAY

5.1 Introduction

In order to minimise waste generation during construction and operation of the motorway, it is necessary to take measures to prevent waste generation. One of the goals of waste management is controlled waste disposal, prevention of irresponsible waste management, controlled procurement and education on waste management and safe disposal of waste and taking all necessary measures to protect human health and the environment.

The treatment of waste that will be generated during the construction will be the obligation of the Contractor defined through the Contract, and through the tender documentation prepared by the Investor (JPAC).

The treatment of waste that will be generated during the operational phase will be the obligation of a third party who will be engaged in the maintenance of the motorway defined by the Contract, and through the tender documentation prepared by the Investor (JPAC).

Waste from construction activities will be minimised by an appropriate project terms of reference and adherence to proper waste management measures during motorway construction. All resources and consumables will be adequately protected, stored and maintained to minimise waste generation (e.g. use of part of construction waste as bulk material). **According to the Main Design (Bill of Quantities), the total amount of excavated materials that will be recycled, or reused for embankments, is 784.316m^3, or 30% of the total excavated materials.**

The space where the unloading, disposal and warehousing of construction materials will be performed must be accessible in order to be able to work smoothly during the manipulation of construction materials.

In order to prevent the generation of waste during construction works it is necessary to:

- Mark the direction of movement with a sign and traffic signs;
- Use the following for transport of materials on the construction site: freight motor vehicles, loading and unloading machinery and handcarts.

Only functional vehicles whose shape corresponds to the type and weight of the material may be used for the transport of construction materials on the construction site. Before loading or unloading, the breaks must be put on and the sides of the box should be opened by two workers at the same time. If loading or unloading takes place along a platform or ramp, the vehicle must be placed next to the platform.

Internal transport by motor vehicles must be supervised. This is especially true of reversing vehicles. The internal transport of materials, prefabricated elements and heavy objects performed by the crane must be organised in such a way that:

- The load is transferred from the place of loading to the place of unloading as carefully as possible and that the load is never transferred above the workers. Attaching the load at the place of loading as well as its reception and removal at the place of unloading must be entrusted to persons who are familiar with the manner of proper operation, sources and protection measures in such operations (signalmen);
- Plant fibre ropes (hemp, manila, cotton) and synthetic fibre ropes can be used to tie and hang loads that do not have sharp edges;
- Each rope used for carrying, tying and hanging loads must be marked with the permissible load capacity. If the temperature is lower than - 10°C the permissible load is reduced by 50%.

During the operational phase of the project, waste is mostly generated during the maintenance and servicing of roads and ancillary facilities, which will be minimised by efficient operation and maintenance in accordance with the manufacturer's instructions. The maintenance of the motorway will be entrusted to a third party through an adequate contract.

Waste generated during maintenance will be minimised through reuse or recycling wherever possible.

The Waste Management Plan identifies all places where waste is generated, places where it is temporarily disposed of, as well as the manner of its further disposal.

Table 10 gives an overview of all waste streams with a description of waste management practices, which the Contractor, or a third party engaged in maintenance, is obliged to carry out during the construction and operation of the motorway, and a comparison with applicable regulations in FBiH.

The following chapter describes the management of waste that will be generated during the construction and operation of the motorway.

Table 10: Waste management at the location of the motorway and comparison with the applicable regulations in FBiH

No.	*Emission*	*Description of waste stream management practices*	*Final disposal*	*Comparison with the applicable regulations in FBiH*
1.	**Solid waste**			
1.1.	Municipal waste	▪ Proper temporary storage in special-purpose containers ▪ Keep regular records on the quantities and types of disposed municipal waste	▪ Competent Public Utility Company ▪ Depositing at the location of the municipal waste landfill with which the Contractor and a third party will be engaged in the maintenance of the motorway	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17)
1.2.	Construction waste (excavated materials that cannot be used in any other way, waste generated during construction and demolition of buildings - concrete, brick, tile, stone, etc.)	▪ Develop a detailed construction waste management plan ▪ Adherence to the prescribed measures listed by the Contractor in the detailed construction waste management plan ▪ Temporarily store separately at the location of works until the moment of final disposal ▪ Adequate transport (without raising dust during loading, transport and unloading) with the use of tarpaulin during transport to the nearest construction waste landfill ▪ Keep records of the types and quantities of transported construction	▪ Contractor Final disposal of construction (non-hazardous) waste at the location of the newly designed landfill for construction waste	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17) ▪ Pursuant to the Rulebook on construction waste (Official Gazette of FBiH, No. 93/19)

No.	*Emission*	*Description of waste stream management practices*	*Final disposal*	*Comparison with the applicable regulations in FBiH*
		waste with adequate transport documentation		
1.3.	End-of-life tyres	▪ Proper temporary storage in a specially designated place (which includes a waterproof base), ▪ Handover to an authorised company for further management ▪ Keep regular records of quantities and types of disposed waste ▪ Have transport documentation	▪ Authorised company for this type of waste with which the Contractor will enter into a contract	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17) ▪ Pursuant to the Decree on selective collection, packaging and labelling of waste (Official Gazette of FBiH, No. 38/06), ▪ Pursuant to the Rulebook regulating the conditions for the delegation of waste management responsibilities from producers and retailers to waste collection system operators (Official Gazette of FBiH, No. 9/05)
1.4.	Metal waste	▪ Proper temporary storage in a specially designated place (metal waste storage), ▪ Handover to an authorised company for further management ▪ Keep regular records of quantities and types of disposed waste ▪ Have transport documentation	▪ Authorised company for this type of waste with which the Contractor, or a third party engaged in maintenance will enter into a contract	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17) ▪ Pursuant to the Decree on selective collection, packaging and labelling of waste (Official Gazette of FBiH, No. 38/06), ▪ Pursuant to the Rulebook regulating the conditions for the delegation of waste management responsibilities from producers and retailers to waste collection system operators (Official Gazette of FBiH, No. 9/05)
1.5.	Filter and filter material waste	▪ Waste generation control, ▪ Proper temporary storage of hazardous waste in a specially designated place (metal waste storage), ▪ Use of dedicated closed containers, ▪ Handover to an authorised company for further management ▪ Keep regular records of quantities and types of disposed waste ▪ Have transport documentation	▪ Authorised company for this type of waste with which the Contractor, or a third party engaged in maintenance will enter into a contract	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17) ▪ Pursuant to the Decree on selective collection, packaging and labelling of waste (Official Gazette of FBiH, No. 38/06), ▪ Pursuant to the Rulebook regulating the conditions for the delegation of waste management responsibilities from producers and retailers to waste collection system operators (Official Gazette of FBiH, No. 9/05)
1.6.	Oil sand and cloths	▪ Waste generation control, ▪ Proper temporary storage of hazardous waste in a	▪ Authorised company for this type of waste with which the	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03,

No.	*Emission*	*Description of waste stream management practices*	*Final disposal*	*Comparison with the applicable regulations in FBiH*
		specially designated place (metal waste storage), ▪ Use of dedicated closed containers, ▪ Handover to an authorised company for further management ▪ Keep regular records of quantities and types of disposed waste ▪ Have transport documentation	Contractor, or a third party engaged in maintenance will enter into a contract	72/09 and 92/17) ▪ Pursuant to the Decree on selective collection, packaging and labelling of waste (Official Gazette of FBiH, No. 38/06), ▪ Pursuant to the Rulebook regulating the conditions for the delegation of waste management responsibilities from producers and retailers to waste collection system operators (Official Gazette of FBiH, No. 9/05)
1.7.	Packaging waste	▪ Encourage the reduction of packaging waste, ▪ Encourage reuse, or recycling, ▪ Separate collection of packaging waste, ▪ Handover to an authorised company for further management ▪ Keep regular records of quantities and types of disposed waste ▪ Have transport documentation	▪ Authorised company for this type of waste with which the Contractor, or a third party engaged in maintenance will enter into a contract	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17) ▪ Pursuant to the Rulebook on packaging and packaging waste (Official Gazette of FBiH, No. 88/11, 28/13, 08/16, 54/16, 103/16, 84/17) ▪ Pursuant to the Decree on selective collection, packaging and labelling of waste (Official Gazette of FBiH, No. 38/06), ▪ Pursuant to the Rulebook regulating the conditions for the delegation of waste management responsibilities from producers and retailers to waste collection system operators (Official Gazette of FBiH, No. 9/05)
2.	**Liquid waste**			
2.1.	Waste oil for engines and devices	▪ Strict visual control of the road and separators and SBR by the staff, ▪ Regular maintenance and overhaul of equipment by the authorised professional service of the company with which the contract was signed, ▪ Take the prescribed safety measures when repairing equipment, ▪ Proper temporary storage in a specially designated place (metal waste storage), ▪ Removal by special vehicles by an authorised company of oil and grease	▪ Authorised company for this type of waste with which the Contractor, or a third party engaged in maintenance will enter into a contract	▪ Pursuant to the Law on Waste Management (Official Gazette of FBiH, No. 33/03, 72/09 and 92/17) ▪ Pursuant to the Decree on selective collection, packaging and labelling of waste (Official Gazette of FBiH, No. 38/06), ▪ Pursuant to the Rulebook regulating the conditions for the delegation of waste management responsibilities from producers and retailers to waste collection system operators (Official Gazette of FBiH, No. 9/05)

No.	*Emission*	*Description of waste stream management practices*	*Final disposal*	*Comparison with the applicable regulations in FBiH*
		waste from separators and sludge from SBR ▪ Handover to an authorised company for further management ▪ Keep regular records of quantities and types of disposed waste ▪ Have transport documentation		

5.2 Reduction of waste generation

The reduction of waste generation at the location of the motorway should be carried out as follows:

- rational use of resources,
- careful handling and use of devices and equipment,
- separate collection of recycled materials of municipal waste (separation of useful components of municipal waste),
- separate collection and adequate temporary storage of hazardous and non-hazardous waste (reduction of hazardous waste).

5.3 Separation of waste, especially hazardous waste

All different types of waste that will be generated at the location of the motorway must be collected separately and stored properly until the moment of taking over the waste by a legal entity authorised to manage certain types of waste.

Below are basic instructions for waste separation and temporary storage of waste, especially hazardous waste.

Waste material must be stored safely and securely in appropriate containers. Waste intended for delivery to different legal entities for waste management must be separated. Separately collected waste should not be mixed as such a procedure would interfere with or prevent recovery activities of most or all of the waste.

Waste that is collected according to the system of selective waste collection must be previously separated from the rest of the generated waste.

Waste that causes chemical reactions in contact with each other must be stored separately.

Waste transported to another authorised person, if necessary, requires packaging in a container or packaging previously agreed with the transporter, considering the type of vehicle and means of transport so that the waste material is safe and does not spill or scatter during transport.

Hazardous waste transported to another authorised person is packed in an adequately closed container that can withstand the load of daily use and moderate storage conditions and which prevents the waste from coming into contact with the environment.

Packaging and labels used for waste collection must be made of material that is not reactive with hazardous waste. Warnings on mandatory selective waste disposal will be posted at selective waste collection sites.

If waste for which the content is unknown is stored, measures should be taken that include testing and analysis to determine the characteristics of the waste. Until the characteristics are determined, the waste is treated as hazardous waste and, in accordance with the Rulebook on categories of waste with lists, it has an asterisk (*).

Waste that is stored in closed containers or that cannot be visually identified should be marked with an inscription (label) of the contents.

The manner of separation, selection and final handover for disposal will be elaborated in detail for all organisational units through the procedures and instructions of the Investor. The stated procedures and instructions should be adopted by the Investor within two years after obtaining the environmental permit.

The final disposal of certain types of waste needs to be resolved through contracts with companies authorised for this type of business.

Before transferring, transporting, recovering components or disposing of waste, it is necessary to ensure that the waste is stored and, if necessary, packed in the following way:

- waste must not be spilled or scattered as a result of inadequate treatment of waste or natural phenomena,
- liquid waste and leachate must not be discharged into drains, watercourses or surrounding land,
- waste must be insured against vandalism, theft, handling by unauthorised people and animals or any other type of trouble,
- waste must not leave negative consequences on the environment, nor must it be a cause of disturbance due to the development of unpleasant odours or disturbance of aesthetic characteristics and values of the landscape.

5.3.1 Temporary storage of hazardous waste

In order to implement the Waste Management Plan, or protect the environment and human health and safety, it is necessary to carry out activities related to the establishment of a temporary storage of hazardous waste. The hazardous waste storage facility must be a closed or enclosed covered storage facility, and it must have compartments/special containers so that hazardous waste can be stored according to groups and subgroups.

All surfaces and containers must be impermeable and resistant to hazardous waste. The hazardous waste storage facility must be equipped with fire extinguishers and, if necessary, other safety equipment. Hazardous waste should be stored in containers, tanks or other packaging for storage and transport of hazardous waste, which must have the inscription "Hazardous waste" and the name of the type of hazardous waste. Containers, tanks or other packaging and markings on them must be resistant to hazardous waste and safe to handle. Records must be kept on the groups and quantity of stored hazardous waste. The contingency plan must be displayed in a visible place in the hazardous waste storage facility.

Persons responsible for the storage of hazardous waste and for the collection of hazardous waste must be familiar with the method of work, hazards and measures of protection at work and environmental protection, through regular training and testing of knowledge in the field of waste management.

5.4 Waste reuse and/or recycling

Reuse is carried out using the same material several times, if possible, while recycling involves a set of activities in which new products are created from the collected secondary raw materials.

Recycling is based on the separate collection of usable waste at the place of generation because it forms separate streams of different types of usable waste materials (e.g. paper, plastic, glass, packaging and packaging waste and electrical and electronic (EE) waste) and most importantly, ensures separate collection of hazardous and non-hazardous waste. Reuse and/or recycling of separately collected fractions of mixed municipal waste currently depends on the practices of the competent utility companies: JP Komunalno d.o.o. Mostar, JP Parkovi d.o.o. Mostar and Alba BH d.o.o. Mostar. If these companies do not recover materials and/or energy from separately collected waste fractions, the Contractor and/or a third party engaged in motorway maintenance should consider the option of handing over the separated waste fractions to an authorised legal entity that uses materials and/or energy (e.g. packaging waste can be handed over to the packaging and packaging waste operator).

With the aim of reusing and/or recycling packaging waste, the Investor may, through a contract, transfer its obligations to the packaging management system operator, authorised by FMET, which will further ensure that the packaging waste collector regularly takes over and collects packaging waste, selectively separates it and reuses packaging waste for recycling in authorised facilities and disposes of unusable part of packaging waste in landfills.

According to the Main Design (Bill of Quantities), the total amount of excavated materials to be recycled, i.e. reused for embankments, is 784,316 m^3 or 30% of the total excavated materials.

5.5 Waste treatment

Waste treatment involves physical, thermal, chemical or biological processes, including sorting, that change the characteristics of the waste in order to reduce the amount or hazardous properties, facilitate handling or increase the recovery of components.

Apart from separate waste collection, no other waste treatment methods will be implemented at the motorway location. More precisely, the separation and temporary storage of waste will be performed until the moment of delivery to companies authorised for waste management.

5.6 Final disposal of waste

Waste must not be disposed of or allowed to be disposed of at any location that does not have a disposal permit and if the disposal does not comply with the provisions of the waste management permit. Waste may be transferred to third parties, if that person is authorised to transport, store, restore or dispose of waste of the specified type or composition. Hazardous waste should be separated and temporarily stored within the hazardous waste warehouse at the construction site and handed over to authorised companies for further disposal.

5.6.1 Final disposal of construction waste

Considering that during the motorway construction, in addition to other wastes listed in Table 7, the largest percentages of construction waste generated will refer to inert construction materials generated from excavations on the route and excavations from tunnels (a total of 6 tunnels).

The total amount of excavated materials generated during the construction of the Mostar North-Mostar South motorway is as follows:

- **excavations on the route: 793.639 m^3 and**
- **excavations from tunnels: 1.865.300 m^3.**

According to the Main Design (Bill of Quantities), the total amount of excavated materials to be recycled, i.e. which will be reused for embankments, is 784,316 m^3 or 30% of the total excavated materials.

Therefore, the total amounts of excavated materials that cannot be used for backfilling or for any other purposes must be adequately disposed of. Such materials are envisaged to be disposed of at construction waste landfill, the location of which has been predetermined and assessed by the consultant engaged for drafting the Preliminary Construction Waste Management Plan.

While selecting the suitable location for potential disposal site, it is important to plan the construction waste landfills outside any river or stream and preferably in areas with already degraded condition. During site visits conducted in September 2020, the Consultant has visited three potential locations as disposal sites, as shown in figure below.

Figure 8: Three recommendations for potential construction landfill sites (orange polygons) (Source: Google Earth)

First potential landfill site is located on the river terrace of the Neretva River, represented by the area of former above-ground extractive industrial site upon which existing illegal construction waste landfill is being disposed, between the left river bank on the west and main road M17 on east (Figure 9). The given location is as an already degraded area, represented with large excavation pits. Disposal at the proposed location in this case will have two purposes: the first purpose for the disposal of excess construction waste, and the second is adequate compaction of excavated materials brought in and proper landscaping for future facilities.

Figure 9: First considered construction landfill site (orange polygon) (Source: Google Earth)

The second alternative construction landfill site is found near the Mostar North Interchange and south from the toll station (Figure 10), represented by Illyrian [*Paliurus spina-christi*] garrigues. After the site visit, the idea of the second potential location is abandoned since subsequent biodiversity field research has proven the presence of reptile species listed in Annex II and IV of Habitat Directive (e.g. reptiles and invertebrates), thus requiring protection of the species and its habitats.

Figure 10: Second considered construction waste landfill site (orange polygon) (Source: Google Earth)

The third alternative location of the construction waste landfill was located in dry canyon of occasional stream Suhi Do (Figure 11). After completion of the ornithology surveys, the idea of the third potential location was abandoned as well, considering the finding of the Annex I species from the Birds Directive, Eurasian Eagle-Owl (*Bubo bubo*), and its nesting territory in this locality. In addition to this, the area of Suhi Do is prone to a strong seasonal stream; therefore, the location has been dismissed from any further planning with regard to disposal of construction waste.

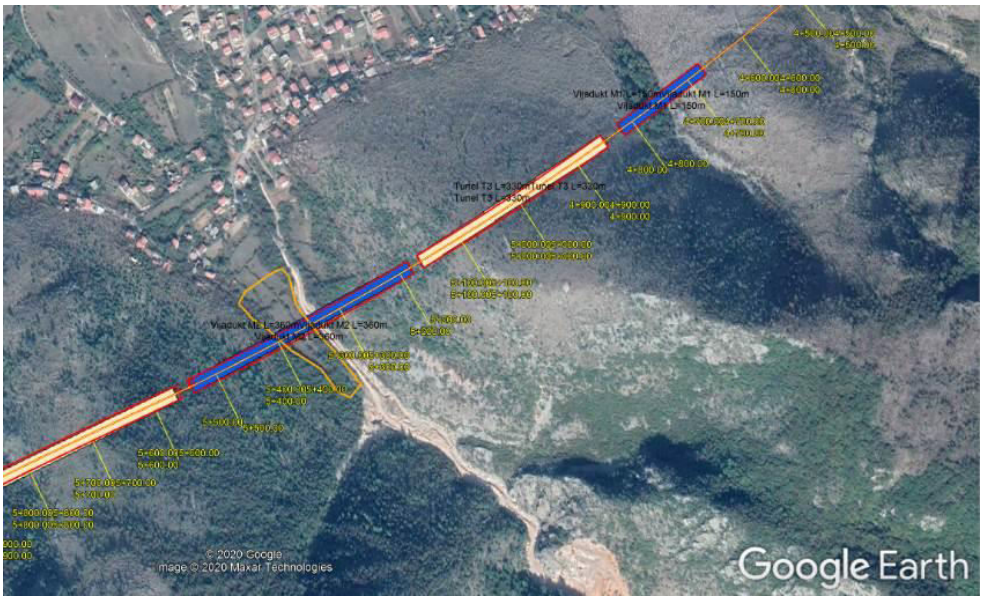


Figure 11: Third considered construction waste landfill site (orange polygon) (Source: Google Earth)

Although three potential locations were considered for the purpose of construction waste landfill, after the site visit it is concluded that only the first location can be used as a potential landfill. The other two potential locations were rejected. The final location will be determined by JPAC and the Contractor during development of the Preliminary Design and Main Design.

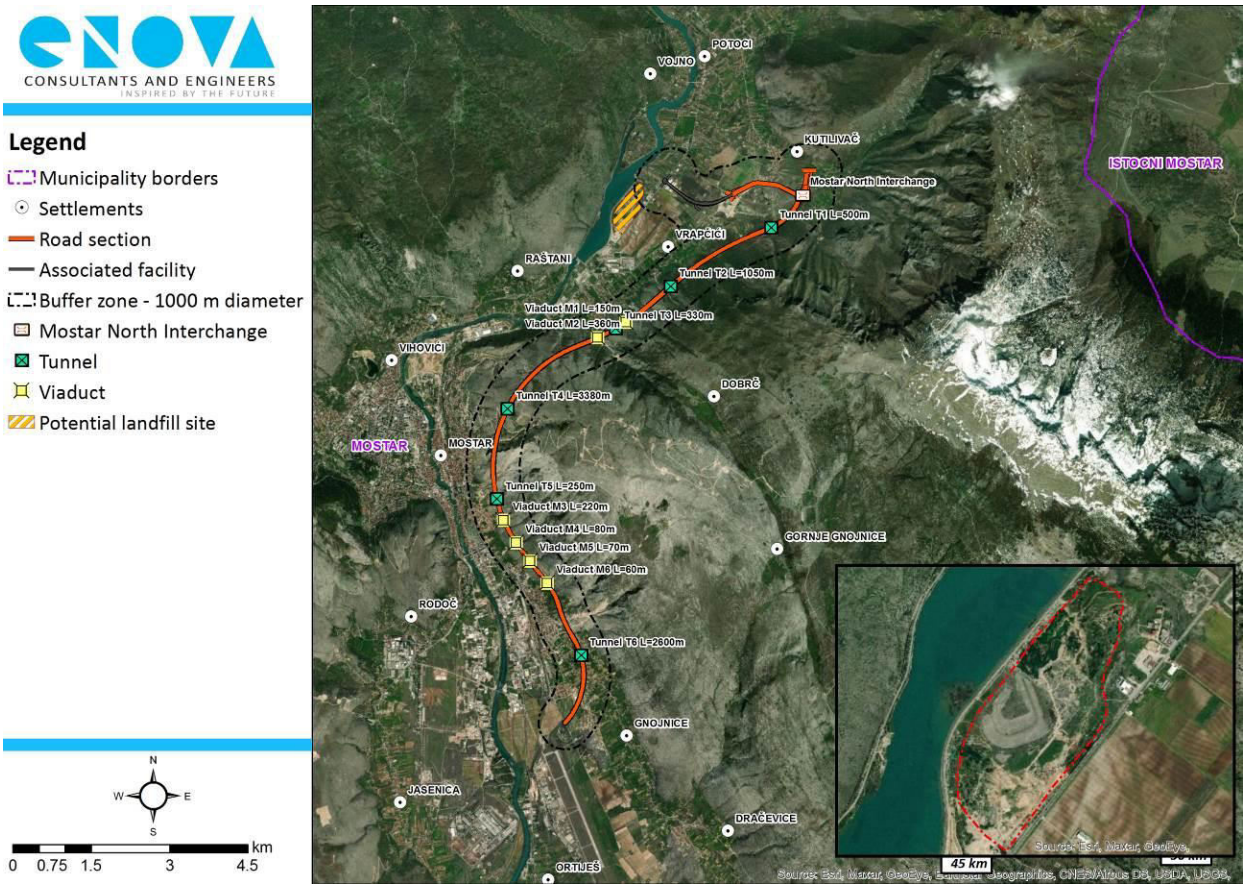


Figure 12: First construction waste landfill in relation to the motorway route

According to Table 7, the total amount of construction waste that will be generated and that is planned to be disposed of at construction waste landfill from the location of the Mostar North-Mostar South subsection route is shown in Table 11.

Table 11: Types and quantities of construction waste that are planned to be disposed of at the location of the construction waste landfill from the subsection Mostar North-Mostar South

No.	1^1	2^1	3^1	Name of waste	Composition	Quantity in m^3
1.	17	01	02	Bricks	Bricks resulting from the demolition of existing brick buildings	925
2.	17	05	04	Soil and stones other than those mentioned in 17 05 03*	Excavation materials such as: earth, stones, sand, limestone sand, gravel (surplus that will not be used as construction material during construction) - preliminary design	1.988.100,55
3.	17	05	06	Dredging spoil other than those mentioned in 17 05 05*	Dredge spoil, humus resulting from preparation works in a layer of thickness d= 20 cm (surplus that will not be used as construction material during construction)	28.800
4.	**Total construction waste to be disposed of at the location of the construction waste landfill**					**2.688.664**

1^1 - activity from which the waste originates, 2^1 - the process in which the waste was generated, 3^1 - the process from which the waste originates

The construction of the Mostar North-Mostar South motorway subsection will generate approx. 2.7 million[12] m^3 of waste. The location of the construction waste landfill has been preliminarily determined within this task as a recommendation of the consultant. The final location of the landfill will be determined by JPAC and the Contractor during the preparation of the new project documentation of the Preliminary and Main Designs for the newly adopted route of the motorway.

Figure 13: Potential construction waste landfill (orange polygon)[13]

The area of the potential construction waste landfill is approximately 350,000 m^2. It is possible to dispose of construction waste in a layer with an average thickness of 7.7m, which gives it a capacity of 2,700,000 m^3.

Based on the foregoing, it can be concluded that the designed construction waste landfill can accept the complete construction waste that will be generated during the construction of the Mostar North-Mostar South subsection.

The total capacity for the landfill is 2,700,000 m^3.

Considering the different types of materials to be brought to the landfill, it is necessary to plan for transport and unloading of different materials. Materials will be brought to landfill by dump trucks or tipper trucks. Machines for spreading, planning and compacting the excavated material should be provided at the landfill. Compaction of the

[12] Assessment based on the data on the condition of the road bed and the technical description given in the geotechnical investigation works and geotechnical mission G1, Subsection: Mostar North-Mostar South (IGH d.o.o. Mostar, November 2019)
[13] Google Earth computer programme

material shall be done in layers with vibratory rollers. The filling of the material should be done up to the designed elevations, while respecting the designed slopes which will ensure the drainage of the landfill surfaces.

The height of the embankment is variable (5-6 m) so that the subsidence of the material will be approximately 50 cm and will be completed within a year. Upon completion of the excavation works, the landfill will be levelled and closed.

After the completion of the landfill formation works, it is necessary to humus it. Removed humus which is deposited on the side shall be used for humus-coverage, bringing a new amount of humus, if necessary. It is planned to humus the slopes in a layer 20 cm thick.

Along the perimeter of the landfill, perimeter ditches are provided to receive external rainwater and rainwater from the closed body of the landfill, so as to be taken to the nearest recipient. On the other side, the designed ditch follows the edge of the landfill and fits into the drainage ditch along the path of the existing road to the recipient. In places where the slope of the ditch is higher than 4%, it is necessary to line the ditch with concrete elements. During transport, the trucks should be covered with a tarpaulin, and the wheels should be washed because the main road will be used.

The areas of the landfill closure plateau are designed to be horizontal. The slope inclination between the two layers is given in the inclination ratio 1: 2 so that the slope of each subsequent surface is pulled by 2.00 m towards the middle of the landfill due to material shedding and slope stability.

5.6.2 Final disposal of mixed municipal waste

Removal and disposal of municipal waste at the municipal waste landfill in the area of the City of Mostar is currently done by three companies: JP Komunalno d.o.o. Mostar, JP Parkovi d.o.o. Mostar (mostly collecting waste from green public areas and garden waste) and Alba BH d.o.o. Mostar.

These utility companies dispose of the collected municipal waste only at the locations of the municipal waste landfills.

The relationship between the Contractor, or a third party engaged in the maintenance of the motorway and the competent utility company should be regulated by the Contract on services of collection of municipal waste from the location of the motorway during the execution of works and during operational phase.

5.7 Other measures for waste management

In waste management activities, the Contractor, or the persons engaged in the maintenance of the motorway are obliged to implement other measures presented below.

5.7.1 Records of waste

Hazardous and non-hazardous waste will be generated during the execution of works and operational phase of the motorway.

The waste recording system is explained below.

Records of (non-hazardous and hazardous) waste should contain the following information:

- record date,
- data on generated waste (type and quantity of waste, waste code),
- method of waste storage,

- the name of the authorised operator to whom the waste has been delivered,
- responsible person.

A record sheet should be prepared for each shipment of non-hazardous and hazardous waste. The record sheet is made in two copies, one of which is handed over to the authorised company to which the waste is handed over, and one is kept in own archive. Based on the stored documents, the quantity of delivered waste can be determined. Examples of recording and transport sheets are given in *Annex 1* and *Annex 2* herein. As already mentioned, in accordance with the Regulation on selective collection, packaging and labelling of waste, it is mandatory to fill in the transport documentation for the transported waste.

The operator to whom the waste has been handed over for further management is obliged to keep the mentioned records on waste, and to submit the certificate on the final disposal of the waste to the person responsible for waste management. Records on the taken over waste are kept every time the (non-hazardous and hazardous) waste is taken over for further disposal.

5.7.2 Person responsible for waste management

Pursuant to Article 20 of the *Law on Waste Management*, the Contractor, or the persons engaged in the maintenance of the motorway will appoint a person who will be responsible for waste management, updating and implementation of the Waste Management Plan. The responsible person will be appointed subsequently.

By the Contract (which will be the subject of the tender documentation), the Investor will oblige the Contractor/Company hired for the motorway maintenance activities to appoint a person responsible for waste management during the execution of works, as well as a person responsible during the operational phase of the motorway subsection Mostar North -Mostar South.

5.7.3 Auxiliary equipment and waste prevention

It is necessary to continuously implement measures for educating employees in the field of waste management on the proper separation of waste with the aim of isolating and recovering useful components. These types of training can be conducted once a year within the activities of the Environmental Protection Service and the Occupational Safety Service or through the implementation of ISO 14001:2004 environmental management standard, if the Investor decides to introduce this standard.

The Investor will implement waste management through three types of approaches, namely:

- reduced use of waste-generating materials,
- waste reuse and
- separate waste collection for recycling and/or reuse.

In addition to measures of selective collection and separation of waste for secondary recovery, the purpose of waste management is as follows:

- education on handling different types of waste,
- prevention of inadequate waste management,
- safe temporary storage of waste,
- controlled disposal.

The Waste Management Plan has been prepared in accordance with the applicable legislation in the field of waste management. The implementation of this Waste Management Plan will be carried out according to the internal procedures and instructions of the Investor and the Contractor.

6 REFERENCES

- Main Construction Design (Book A 1010) LOT 5 for the Mostar North - Mostar South section, Inženjerski projektni zavod d.d. Zagreb, September 2010
- Geotechnical mission G1, Mostar North - Mostar South subsection, IGH d.o.o. Mostar, November 2019
- Environmental impact study (LOTs 5 and 6) for the section Mostar North - Mostar South - Počitelj, CETEOR d.o.o. Sarajevo, April 2017
- Environmental impact study (LOT 4) for the Mostar North - Mostar South section, Institut građevinarstva Hrvatske (*Institute of Civil Engineering of Croatia*) d.d. Zagreb, September 2006
- Preliminary study of expropriations for the Mostar North - Mostar South sections, GEO-DATA d.o.o. Mostar, January 2020

7 ANNEXES

Annex 1. Template of waste recording sheet

Annex 2. Template of waste transport sheet

WASTE RECORDING SHEET

Date	Waste code	Waste quantity	Type of disposal	Name of the authorized operator for transport and treatment of waste
Total:				
Notes:				

Date: _____

Responsible person: _____

Signature: _____

WASTE SHIPPMENT DOCUMENTATION

Shipment documentation No. _____

A.Information about shipment

1.Waste specified below is removed from (name, address, municipality)

2.Waste is to be shipped to (address)

3.□ Individual shipment □ Multiple shipment Please specify ……..
4.Expected date /time of removal ……
5.Name …… On behalf of (company…….
signature……

6.Phone 7.Producer of waste (if different from the above)

B.Description of waste

1.Waste is ……. 2.Classification …….
3.Physical form□ Liquid□ Powder□ Sludge□ Solid□ Mixed
4.Total quantity to be removed: Quantity…….. (kg/m^3/ton) No. of units……
5.Type, size and number of containers
6.Chemical/biological components determining hazardous properties ……
……..
Description Six-digit code Quantity No. of units

7.Hazard is ……
8.Process generating waste: ……..

C.Transporter's confirmation

I hereby confirm that today I collected a shipment and that information under A1, A2 and B5 is accurate.

Name….. On behalf of company (name and address) …….

Signature …… Date…….a t …… hours.

1.Transporter's registration No…… [relevant identification]
2.Registration plates No. (or transport code for non-road transportation) ……..

D.Sender's confirmation

I hereby confirm that information under B and C is accurate, that the transporter is registered and familiar with relevant precautionary measures.

Name….. On behalf of company …….

Signature …… Date…….

E.Recipient's confirmation

1.I received waste ……at…….hours. 2.Vehicle registration plates No. ……..
3.Received quantity:Quantity……..(kg/m^3/ton) No. of units:……
4.Method of waste treatment……..
5.I hereby confirm that this company is licensed to receive and treat this waste based on waste management license No. ….
Name….. On behalf of company …….
Signature …… Date……