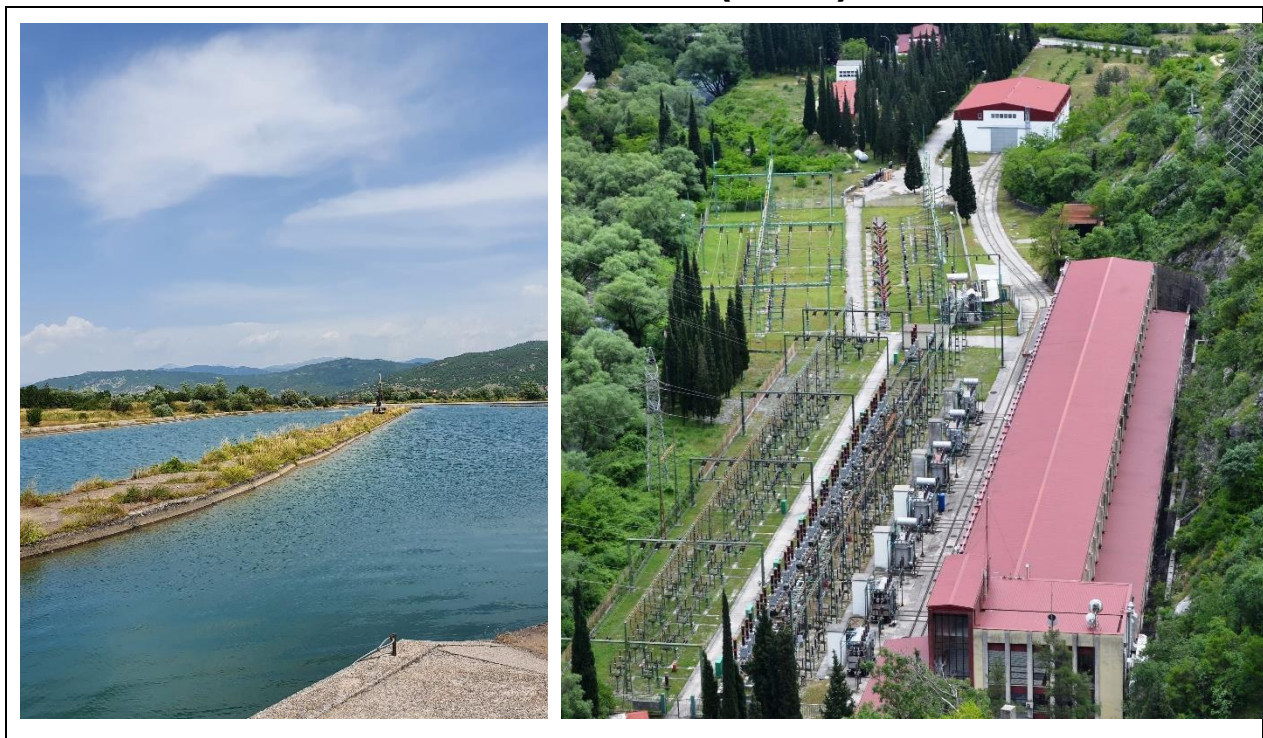




**GREENING PUBLIC INFRASTRUCTURE - PROMOTION  
OF ENERGY-EFFICIENCY AND UPGRADE OF HYDRO  
POWER PLANT PERUĆICA - INSTALLATION OF UNIT U8  
Consultancy Services for Upgrade of Hydro Power Plant  
Perućica  
Installation of Unit U8**

**SECTION D  
ACCOMPANYING REPORTS  
BOOK 3: ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT (ESIA)**



**22024-D-03**

**ENERGOPROJEKT**  
HIDROINŽENJERING a.d.

## **SYSTEMATIZATION OF DOCUMENTATION**

This Study is an integral part of the Design documentation:

### **GREENING PUBLIC INFRASTRUCTURE - PROMOTION OF ENERGY-EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT U8**

#### **Consultancy Services for Upgrade of Hydro Power Plant Perućica**

#### **Installation of Unit U8**

which comprises the following parts that are being prepared within this Contract:

#### **SECTION A - FINAL DESIGN FOR RECONSTRUCTION OF THE HUB BETWEEN ZETA I CANAL - COMPENSATION BASIN - INLET STRUCTURE**

##### **Volume 1: General Volume**

##### **Volume 2: Inputs**

Book 1: Geodetic Report

Book 2: Geological Documentation Required for Preparation of the Final Design for Reconstruction of the Hub between ZETA I CANAL - COMPENSATION BASIN - INLET STRUCTURE

Book 2-1: Detailed Geological Investigations Design

Book 2-2: Report on Performed Geological Investigations of the Soil

##### **Volume 3: Hydraulic Analyses**

##### **Volume 4: Civil Engineering Design**

##### **Volume 5: Final Design of Construction Management and Construction Execution Technologies**

##### **Volume 6: Other Reports**

#### **SECTION B - REPORT ON EXAMINATION AND ASSESSMENT OF THE EXISTING CONDITION AND GEOLOGICAL PROPERTIES OF THE TERRAIN FOR THE TAILRACE SYSTEM OF UNIT U8**

##### **Volume 1: Geodetic Report for the Outlet System of Unit U8**

##### **Volume 2: Geological Documentation**

Book 1: Design of Detailed Geological Investigations Required for the Final Design for Reconstruction of the Tailrace System of Unit U8

Book 2: Report on Performed Geological Investigations of the Soil Required for Reconstruction of the Tailrace System of Unit U8

##### **Volume 3: Report on Examination and Assessment of Condition of Civil Structures and Proposal of Repairing Measures**

**SECTION C - REPORT ON ASSESSMENT OF POSSIBILITY OF DRAINAGE OF  
OVERFLOWING WATER FROM THE SURGE TANK**

**SECTION D - ACCOMPANYING REPORTS**

**Book 1: Scoping Report**

**Book 2: Stakeholder Engagement Plan**

**Book 3: Environmental and Social Impact Assessment**

**Book 4: Non-Technical Summary**

**Book 5: Environmental and Social Management Plan**

**Book 6: Environment, Social, Health and Safety Study**

**COVER PAGE**

GREENING PUBLIC INFRASTRUCTURE - PROMOTION  
OF ENERGY-EFFICIENCY AND UPGRADE OF HYDRO  
POWER PLANT PERUĆICA - INSTALLATION OF UNIT U8

Consultancy Services for Upgrade of Hydro Power Plant  
Perućica

Installation of Unit U8

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## 0.1 PARTICIPANTS IN DOCUMENTATION PREPARATION

The Design documentation:

### **GREENING PUBLIC INFRASTRUCTURE - PROMOTION OF ENERGY-EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT U8**

**Consultancy Services for Upgrade of Hydro Power Plant Perućica**

**Installation of Unit U8**

**SECTION D**

**ACCOMPANYING REPORTS**

**BOOK 3: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)**

has been prepared in ENERGOPROJEKT HIDROINŽENJERING Joint Stock Company, the company specialized in designing, consulting and engineering of hydropower, water management and infrastructural facilities, from Belgrade, under the Contract No. 22024-204 (EPCG No. 10-005357) concluded with the Electric Power Industry of Montenegro, Joint Stock Company Nikšić.

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At its xx session, held on xx, 2022, the Board of Experts of ENERGOPROJEKT - HIDROINŽENJERING Joint Stock Company, analysed and adopted the following Design Documentation:

### **GREENING PUBLIC INFRASTRUCTURE - PROMOTION OF ENERGY-EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT U8**

**Consultancy Services for Upgrade of Hydro Power Plant Perućica**

**Installation of Unit U8**

**SECTION D - ACCOMPANYING REPORTS**

**BOOK 3: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)**

Based on this approval, the subject Design documentation can be delivered to the Employer.

**CHAIRMAN OF  
TECHNICAL BOARD**

---

Vladimir Beličević, PhD - Graduate  
Geological Engineer

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## 1. Introduction and project background

Hydro-Power Plant Perucica (HPP Perucica) represents one of the most important power generation facilities in Montenegro, representing about 50% of the total hydropower capacities of Montenegro. HPP Perucica is located on territory of municipality of Nikšić, in northern part of Bjelopavlički plain, next to the border of Danilovgrad Municipality. According to the Spatial - Urban Plan of Nikšić Municipality, the area of HPP Perucica belongs to Cadastral Municipality Bogetići. It is the oldest large HPP in Montenegro. It is named after the well Perucica, which originates in the vicinity of HPP.

HPP Perucica system was built in three phases in the period from 1960 to 1977 with seven installed units and possibility to extend for one more unit. Current total installed capacity of HPP Perucica is reaching 307MW and has potential annual production is about 1,300GWh.

Installation of Unit U8 in HPP Perucica shall encompass measures of reconstruction and modernization, i.e. upgrade of HPP Perucica to the end of increasing the installed power of the plant to 365.5MW. Upgrade of HPP Perucica covers installation of the mechanical, hydro-mechanical, and electrical equipment with corresponding civil works.

Construction permit for modernisation and upgrade of HPP Perucica was issued by the competent Montenegrin ministry in 1991, thus these works are going to be carried out in accordance with the relevant permits and legislative requirements. Additionally, reconstruction and modernisation of HPP Perucica is included in the most important national and local strategic and planning documentation, such as Energy Development Strategy of Montenegro until 2030 and Spatial and Urbanistic Plan for Municipality Nikšić.

## 2. Objectives of the assignment

The purpose of the Project is installation of Unit 8 in HPP Perucica, which will include reconstruction and modernization of the existing facilities.

In the previously implemented Phase I of the Programme of Modernisation, Rehabilitation and Upgrade of HPP Perucica, four out of the total of seven installed generating units were reconstructed and modernised, as well as two auxiliary units and the auxiliary power supply system of the power plant. A modern SCADA control system was developed at the power plant level for the previously rehabilitated units and facilities. Reconstruction of a part of facilities of the power plant system was also completed including: Zeta I Canal, Zeta II Canal and retention basin for the discharge of 81.75 m<sup>3</sup>/s.

The current Phase II of the Programme shall involve reconstruction and modernization of the hydro- mechanical and electrical equipment of units U5, U6 and U7, hydro-mechanical equipment of the valve chambers, equipment for hydraulic and hydrological measurements, installation of the integral information system at the plant level, reconstruction and modernization of the civil structures of the system – remediation and heightening of the Opacica Canal for the discharge of 81.75 m<sup>3</sup>/s, reconstruction of the Mostanica Canal and construction of a measuring profile on the Zeta River.

The specific project activities which are covered by the ESIA, and which are also pertaining to the Phase II of the Programme, include installation of the eight power generation unit U8 and rehabilitation of the retention basin which represents an integral part of the HPP's power

generation system. The eight unit is going to be installed in the existing machine building, in which the previous 7 units have been installed and which already has a designated space for the eight unit. Rehabilitation of the retention basin is going to include local works on the retention facility, which are going to be aimed at ensuring its efficiency and sustainability over time, taking into account that installation of the eight unit is going to improve the capacity of the HPP.

### 3. ESIA requirements

The purpose of this ESIA is to identify, assess and propose management and mitigation measures for all the relevant environmental and social impacts, throughout all project phases. This ESIA has been prepared for the purpose of compliance with KfW standards and requirements and the corresponding project categorisation, as this project has been categorised as a B+ category project.

This ESIA was prepared in accordance with KfW Sustainability Guideline and IFC's Sustainability Framework, i.e. the performance standards. Additionally, this ESIA takes into account the relevant EU provisions and conventions from the area of environmental and social protection and sustainability; ILO regulation and conventions from the area of labour rights and management; the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines); national legislative and regulatory framework related to environmental and social protection and rights, labour rights and management, occupational health and safety and all other relevant national regulations.

### 4. ESIA scoping

Scoping phase for this ESIA was carried out in the period from March until May 2022, and the scoping phase included desk review of the officially available data, studies, literature and documentation provided by EPCG. The desk research and literature review were aimed at initial overview of the baseline environmental and socioeconomic aspects of the project and the overall project area, identification of environmental and socioeconomic aspects that should be analysed in more details in ESIA, aspects that should be supplemented with additional information and data (surveys and primary data collection), stakeholder identification and analysis, as well as presentation of all the previous project-related activities.

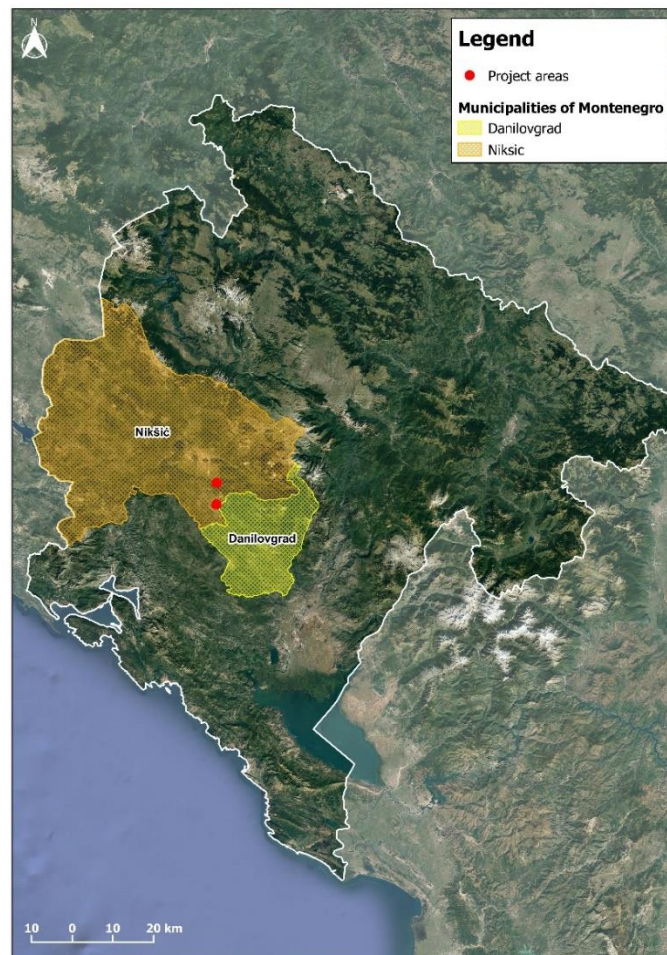
During the scoping phase it was determined that the additional data shall be collected in regards to biodiversity and noise. Thus, additional biodiversity and noise surveys were carried out in June 2022 by the competent team of biologists and a certified laboratory. Results of the additional surveys are analysed in the corresponding chapters, whereby the full survey results are provided in annexes.

## 5. Description of the Project and its associated facilities

HPP “Perucica” is the oldest large hydropower plant in Montenegro, and was put into operation in 1960. It is named after the well Perucica, which originates in the vicinity of hydroelectric power plant.

HPP Perucica hydropower system is located on the Zeta River in central Montenegro, around 35 km to the northwest of Montenegrin capital Podgorica, between the neighbouring cities of Danilovgrad (approx. 21 km) and Niksic (approx. 15 km). According to the Spatial - Urban Plan of Niksic Municipality, the area of HPP Perucica belongs to Cadastral Municipality Bogetici.

HPP Perucica is one of the most important power generation facilities in Montenegro, accounting for around one half of hydropower capacities. Figures below provide a more detailed overview of the subject project locations.



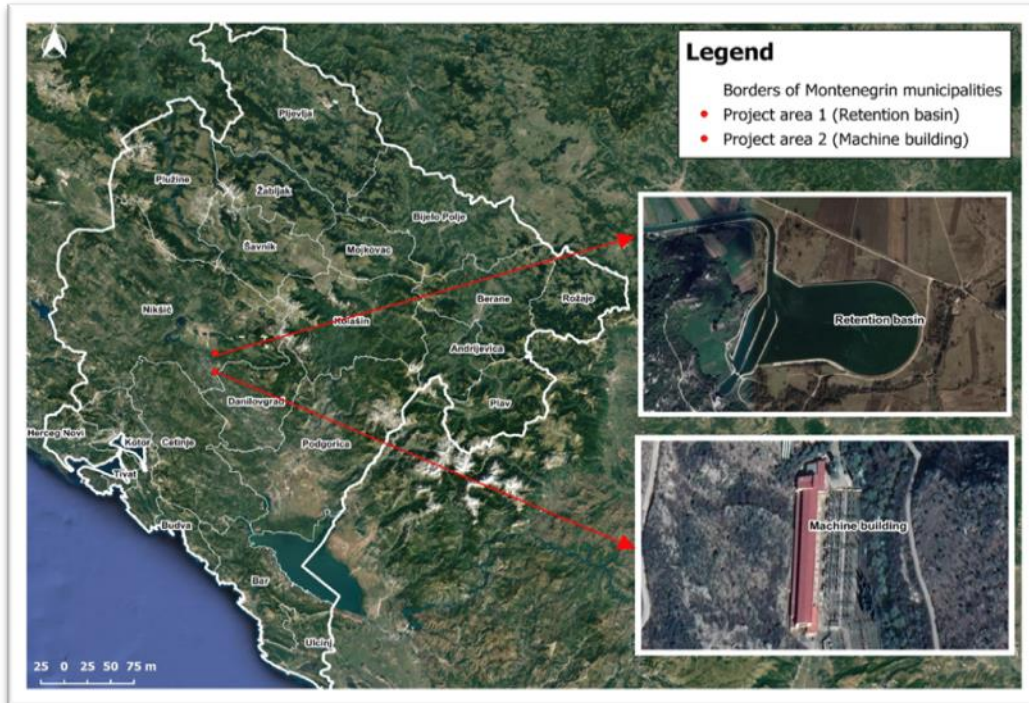
**Figure 1: Overview of the Project areas in Montenegro**

For electricity production, HPP “Perucica” uses water catchment of river Gornja Zeta, which is water that flows into Niksic field with favourable decline in the short distance between the



Nikšić field and Bjelopavlići plains. Its installed capacity is 307MW, and a potential annual production is about 1,300GWh. Catchment area of HPP “Perucica” is 850km<sup>2</sup>.

When it comes to the Project Area, works are going to be carried out at two locations: (1) the main machine building in Bogetici and (2) retention basin in Slivlje/Ozrinici (Figure 2).



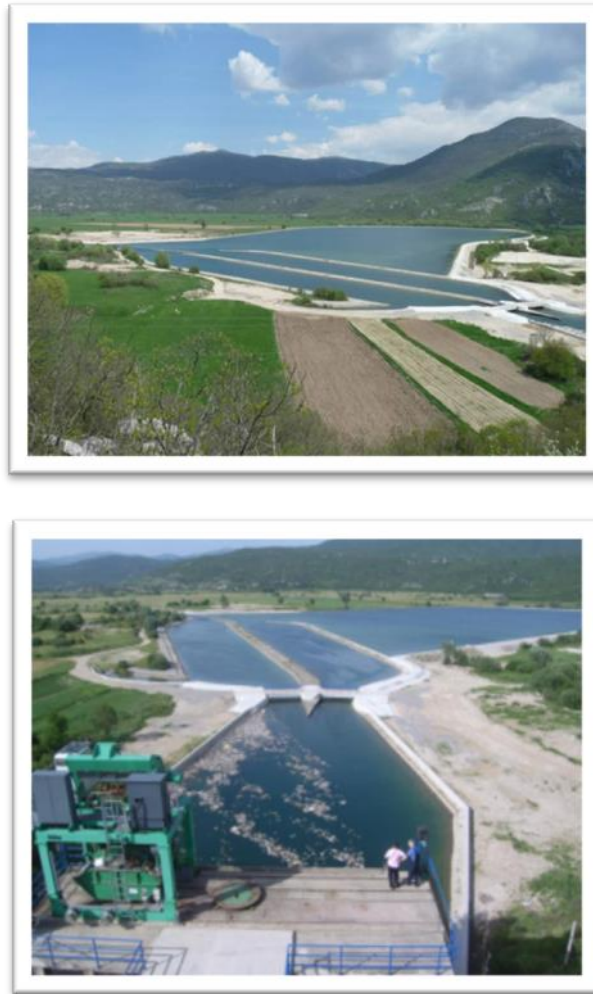
**Figure 2: Location of the two Project Areas (1) retention basin and (2) machine building**

## 5.1 Description of the Location 1

The retention basin is located in Norin and belongs to the Cadastral Municipality Ozrinici. In front of the retention basin there is an intake structure "Marin Krst". Also, in the vicinity of the retention basin there is a valve chamber "Povija" and a surge tank.

The retention basin was partially reconstructed in the summer of 2008 and finalized in the summer of 2009. The active storage capacity of the retention basin is 224.000 m<sup>3</sup> with the spillway crest level at 604.00 m and embankment top at 604.55 m.

Access to the retention basin is possible via the existing access road Podgorica - Nikšić. The road is in good condition and can be used. Access is possible right next to the settling tank, channel and retention basin.



**Figure 3: Retention basin**

The biggest problem in the retention basin is waste. Tons of waste, which passes through the drainage and supply channels of the hydroelectric power plant every day, clogs the grid on the valve chamber, which reduces the water supply, which is a biggest problem. For this reason, HPP "Perucica" workers clean the retention basin every year.

## 5.2 Description of the Location 2

The machine building belongs to the Cadastral Municipality Bogetici. Within the machine building of HPP "Perucica" there is a control room where the data necessary for understanding the operational condition of the equipment and the entire power plant are collected and processed. It is an area where operators monitor the production process and establish the desired state of the power plant, in accordance with the agreement with the Directorate for Energy Management.

In the machine building of HPP "Perucica", seven twin turbine-type "Pelton" generators with the horizontal properties of the total installed capacity of 307MW were built. Five units have installed capacity of 40MVA and two of 65MVA. It is planned that the eighth power generator of 65MVA to be installed.





**Figure 4: Machine building**

### 5.3 System of HPP "Perucica"

HPP Perucica is consisting of following facilities: accumulations "Krupac" and "Slano" and retention "Vrtac", system of channels, sedimentation tank, retention basin, intake tunnel with the intake structure, pipeline with three pipes under pressure, machine building for eight units, electrical substations of 110kV and 220kV. Seven units were installed in the machine building, five of 40MVA and two of 65MVA. A 110-kV switchyard is located next to the machine building.

Three dams with spillway structures and bottom outlets were constructed for the hydropower plant purposes. The reservoir Krupac is located at the end of the Krupac Field. The Krupac Dam was built on the Mostanica River in 1962 and it is the first accumulation of the Perucica hydropower system in the Niksic field. The reservoir Slano occupies the area of the former Slano field and it is the second hydroaccumulation in the Perucica hydropower system in the Niksic field. Slano Dam was built in 1962, in Niksic field on the Opacica River. The third accumulation in the Perucica hydropower system is the retention Vrtac. It occupies the space of Vrtac field. The dam was built on the end of Vrtac field, on the Zeta River in 1964. Characteristic data on dams and reservoirs are shown in Table 1.

**Table 1: Characteristic data on dams and reservoirs**

| CHARACTERISTICS                 | Unit of measure       | RESERVOIR   |         |        |
|---------------------------------|-----------------------|-------------|---------|--------|
|                                 |                       | Krupac      | Slano   | Vrtac  |
| Dam height                      | [m]                   | 19.6        | 22.5    | 16.5   |
| Dam length                      | [m]                   | 1500.0      | 1663.0  | 2350.0 |
| Dam crest level                 | [m asl]               | 622.0       | 623.0   | 616.5  |
| Normal water level in reservoir | [m asl]               | 620.0       | 621.0   | 614.0  |
| Min. operating water level      | [m asl]               | 612.0       | 606.5   | 606.0  |
| Spillway capacity               | [m <sup>3</sup> /s]   | 180.0       | 150.0   | 600.0  |
| Bottom outlet capacity          | [m <sup>3</sup> /s]   | 12.0 / 22.3 | 81.15   | 81.15  |
| Total storage capacity          | [106 m <sup>3</sup> ] | 42.100      | 111.200 | 71.900 |
| Active storage capacity         | [106 m <sup>3</sup> ] | 38.143      | 105.151 | 69.971 |

Water from Slano and Krupac reservoirs and from the Zeta River is brought through Opacica, Mostanica and Zeta II canals to Vrtac dam and further through the main collecting canal Zeta I to the inlet valve chamber i.e. Marin Krst intake structure. The system of headrace channels Zeta I, Zeta II, Opacica and Mostanica has the following characteristics which are shown in Table 2.

**Table 2: Characteristic data on canals**

| CANALS             | Unit of measure     | Zeta I    | Zeta II   | Opacica   | Mostanica         |
|--------------------|---------------------|-----------|-----------|-----------|-------------------|
| Length             | [m]                 | 6113      | 5380      | 4257      | 3518.5            |
| Discharge capacity | [m <sup>3</sup> /s] | 81.20     | 81.20     | 81.20*    | 12.0              |
| Cross section      | [ - ]               | trapezoid | trapezoid | trapezoid | trapezoid/U-shape |

\*Upon implementation of the civil part of the Project on Reconstruction and Modernization of HPP Perucica - Phase II (2022)

Water is transported from the inlet valve chamber through a pressure tunnel to the surge tank valve chamber. The length of the pressure tunnel is 3323 m. The tunnel has circular cross section with the diameter of 4.8 m and concrete lining. From the surge tank valve chamber the system branches into three penstocks. The characteristics of the three penstocks are shown in Table 3.

**Table 3: Characteristic data on penstocks**

| PENSTOCK           | Unit measure of     | I         | II        | III        |
|--------------------|---------------------|-----------|-----------|------------|
| Diameter           | [m]                 | 2.2 - 1.8 | 2.2 - 2.1 | 2.65 - 2.5 |
| Length             | [m]                 | 1851      | 1883      | 1930       |
| Discharge capacity | [m <sup>3</sup> /s] | 17.00     | 25.5      | 38.25      |
| Unit conveyance    | [No.]               | 1, 2      | 3, 4, 5   | 6, 7, 8    |

The system tailrace comprises tailrace tunnel of each turbine, tailrace collecting tunnel of all units, tailrace collecting canal and outlet into the Zeta River. The powerhouse of HPP Perućica houses seven units with Pelton turbines. Table 4 shows the characteristics on the units.

**Table 4: Characteristic data on units with Pelton turbines**

| PHASE                               | I    |     | II   |     |     | III   |       | IV           |
|-------------------------------------|------|-----|------|-----|-----|-------|-------|--------------|
| Unit No.                            | 1    | 2   | 3    | 4   | 5   | 6     | 7     | 8            |
| Rated head [m]                      | 526  |     |      |     |     |       |       |              |
| Rated discharge [m <sup>3</sup> /s] | 8.5  | 8.5 | 8.5  | 8.5 | 8.5 | 12.75 | 12.75 | <b>12.75</b> |
| Rated capacity [MW]                 | 38   | 38  | 38   | 38  | 38  | 58.5  | 58.5  | <b>58.5</b>  |
| Number of Pelton runners per unit   | 2    | 2   | 2    | 2   | 2   | 2     | 2     | <b>2</b>     |
| Number of nozzles per turbine       | 1    | 1   | 1    | 1   | 1   | 2     | 2     | <b>2</b>     |
| Rotation speed [rpm]                | 375  |     |      |     |     | 428   |       |              |
| Year of commissioning               | 1960 |     | 1962 |     |     | 1976  | 1979  | <b>2024</b>  |

HPP was built in three phases. The first phase involved two units with respective capacities of 38MW and respective discharges of 8.5m<sup>3</sup>/s and it was completed in 1960; the second phase, which involved three units with the same power and discharge was completed in 1962 and the third phase, involving two units with respective capacities of 58.5MW and respective discharges of 12.75m<sup>3</sup>/s was completed in 1977.

Installation of Unit U8 in HPP Perucica shall encompass measures of reconstruction and modernization, i.e., upgrade of HPP Perucica. Upgrade of HPP Perucica covers installation of the mechanical, hydro-mechanical, and electrical equipment with corresponding civil works.

The Project will be realized through the implementation of two tasks, as follows:

- **Task 1:** *Preparation of Main Designs and tender documents, assistance, and support to EPCG during tendering procedures for selection of the contractor, assistance with bid assessment and evaluation as well as with contracting of works for the execution of civil works:*
  - 1) Reconstruction of the present tailrace canal of the unit U8;
  - 2) Reconstruction of the hub Zeta I canal – retention basin – intake structure;
  - 3) Surge tank small rehabilitation.
- **Task 2:** *Preparation of tender documents, assistance and support to EPCG during tendering procedures for selection of the supplier, assistance with bid assessment and evaluation as well as with contracting of works for electrical and mechanical equipment and the corresponding civil works tied to the installation of Unit U8, 65 MVA, i.e. for the following works:*
  - 1) Installation of the mechanical and hydro-mechanical equipment (turbine guard valve, turbine, turbine governor, cooling and lubrication devices, draining system, auxiliary downstream valves);
  - 2) Installation of the electrical equipment (synchronous generator, excitation and electrical braking system, impedance equipment, step-up transformer, HV equipment, MCC; auxiliary consumption, control system at the level of the unit and from the plant's control room, monitoring systems and electrical and technological unit protection systems);
  - 3) Corresponding civil works on installation of the mechanical and electrical equipment.

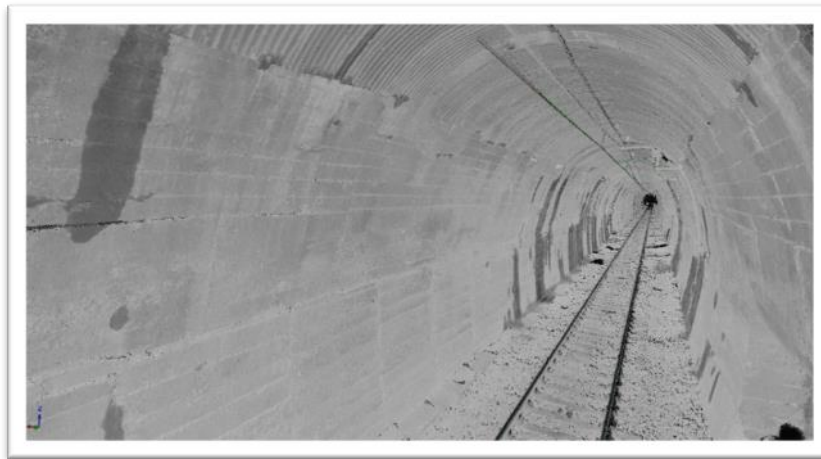
#### 5.4 Reconstruction of the present tailrace canal of Unit U8

The tailrace tunnel, intended for drainage of water that passes through the U8 unit, was executed in accordance with the proposed technical solution from the Preliminary Design of Modernisation, Revitalisation, and Extension of the HPP Perucica, in 1984. The canal part of the tailrace is only partially executed, so that access to the tunnel is enabled, but no connection to the river Zeta has been executed, so that the tunnel is not currently under the influence of the tailrace of the hydroelectric power plant.

The relevant Design documentation from previous Design phases is not available, so for the purposes of preparing of the Main Design for tunnel rehabilitation, it is necessary to collect all technical information and prepare adequate inputs, based on which this Design shall be prepared in the future. The Main Design for rehabilitation of tunnel and tailrace canal shall be prepared by the future Contractor for electrical and mechanical works, as well as corresponding civil works, related to the installation of Unit U8.

As a precondition for proper preparation of the future Main Design for rehabilitation of canal and tailrace tunnel, within the scope of this task, tests, measurements, and preparation of input data shall be done.

All the above input data, as well as all valid data from the previous technical documentation, will be combined into one integral report on the current state of the tail passage. As part of the report's conclusions, a proposal for a technical solution for the rehabilitation and/or reconstruction of this facility will be presented, so that it can meet the working conditions after the installation of the new U8.



**Figure 5: An example of tunnel scanning**

The tailrace tunnel is in good condition, except for the last 20 m before the tunnel exit, and its transition to the canal part of the tailrace. The imagery of the damage on the concrete structure shall be the most important input data for a part of the Main Design for rehabilitation of canal and tailrace tunnel, which shall deal with reparation of damages within the tunnel.

Before the start of surveying the condition of the tunnel and mapping, a system for marking the damage at the site will be adopted, according to the types and dimensions of damage. Spray paint shall be used, which can be applied on a wet surface, in shades that are well visible in dimly lit areas. Simultaneously with the marking of the damage, the tunnel chainage shall be measured and marked.

After the damage has been marked, scanning will be performed by means of high precision geodetic laser scanning. Based on the obtained image, a plan of recorded tunnel damages will be prepared, which will be further used for the purpose of designing rehabilitation works.

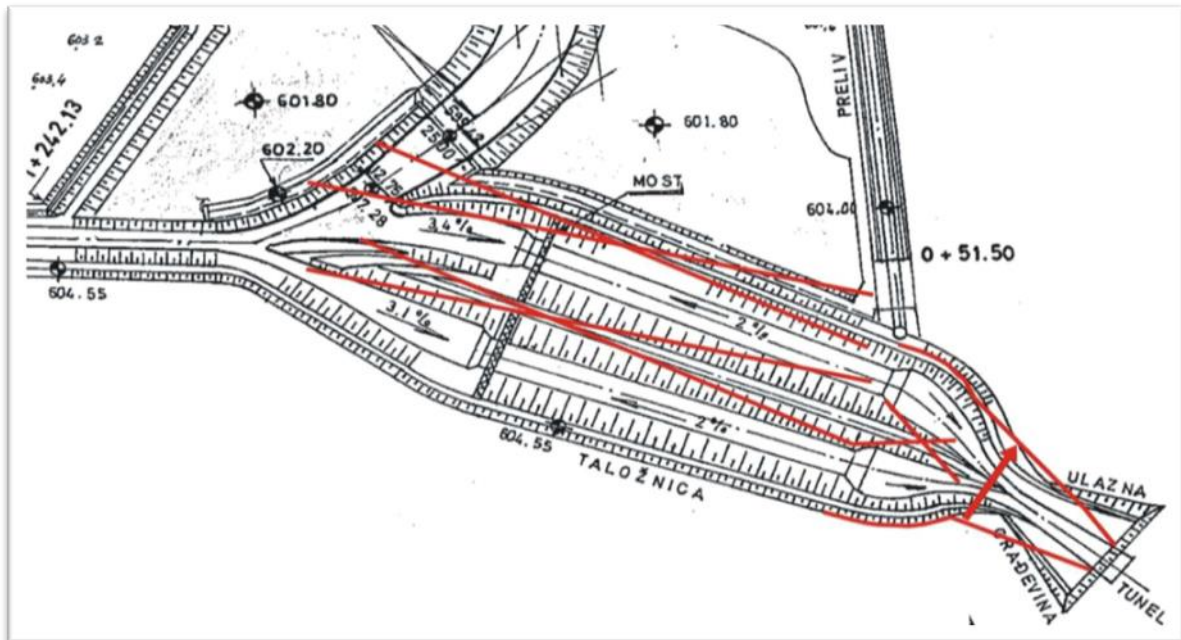
## **5.5 Reconstruction of the hub Zeta I canal – retention basin – intake structure**

During the conducted testing of the flow conditions in the headrace system, the uneven distribution of discharge in this hub has been observed, resulting in higher energy losses, presence of vortices that may cause aeration of the system under pressure as well as prevent elimination of the floating debris from the forebay.

To the end of improving hydraulic conditions of the flow and eliminating the mentioned phenomena that directly affect electricity generation, it is necessary to reconstruct the



retention basin – stilling basin- forebay-intake structure hub by means of connecting the walls from the end of the existing stilling basin to the cleaning rack, removing walls diverging the flow from the stilling basin inlet, as well as walls between the stilling basin and the retention basin.



**Figure 6: Reconstruction of the hub**

The reconstruction of the hub implies interventions on the construction of the sedimentation tank. Depending on the technical solution which will result from the 3-D Mathematical Modelling Study of the Hub Geometry Effects on the Flow Field, the Design will specify removal of the existing walls, and construction of new ones, in accordance to the conditions of providing the appropriate flow regime. A new bridge for crossing of vehicles shall be designed on the site of the existing one. This bridge shall have the same capacity and carrying capacity as the existing bridge over the sedimentation tank. Technical solution for new external walls, piers on the river bank, and piers in the middle shall be harmonized with geological, geotechnical, and topographic conditions at the site.

For all concrete structures, depending on the conditions of their load, a stability analysis shall be conducted for all characteristic load cases, primarily for situations that can occur during construction, regular operation, earthquake occurrences, and floods.

Within the Main Design, technological and organizational solutions for the execution of works will be developed. Organization of works on demolition and rehabilitation of existing structures, as well as on the construction of newly-designed structures shall be presented. For all mentioned works, the necessary machinery and work crews will be provided for their execution, with a presentation of performance, in order for the works to be performed more efficiently, while adhering to all natural and time limitations.

Furthermore, the investment value of the main and preparatory works will be considered, and each activity in BoQ that is defined through quantities of works will be accompanied by an adequate unit price. Unit prices of major construction works will be formed on the basis of experience on similar reconstruction projects, as well as on the basis of market prices for similar reconstruction works in the State of Montenegro, and in the region for the past few years. The cost of preparatory works will be presented as a percentage of the main

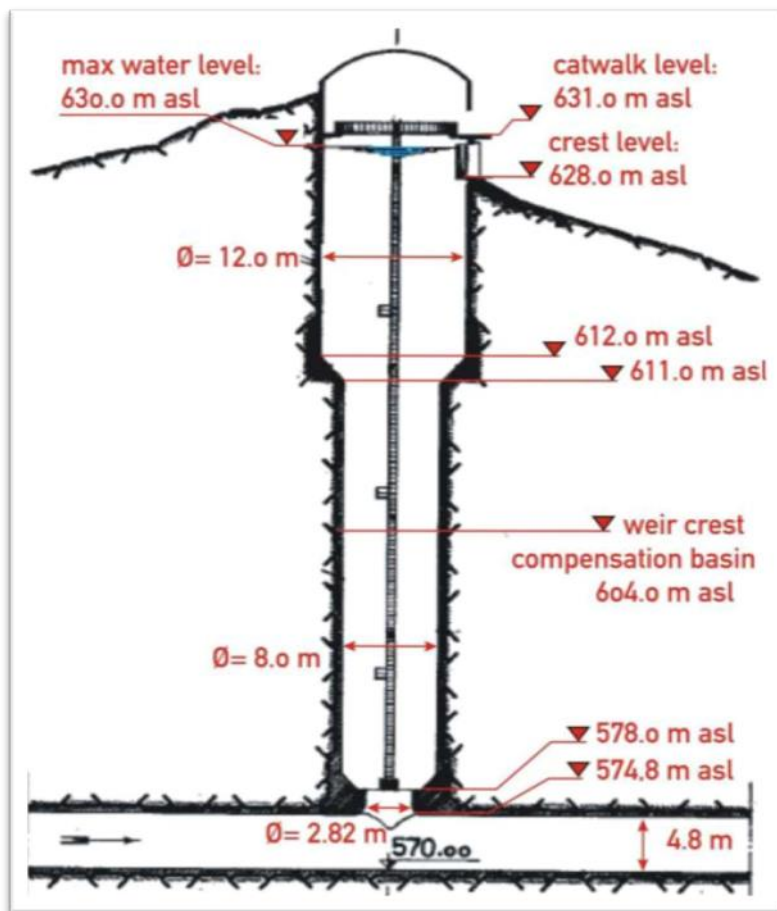
construction works, by taking into consideration the scope, specificity, and uniqueness of these main construction works on reconstruction.

The objective of this hub modification is to resolve the following issues:

- Significant reduction of the water level between the retention basin and the intake structure (head loss tied to the ground water measuring devices at the narrow section) which is reflected through lower electricity losses, thus increased availability for electricity generation;
- Elimination of vortices in front of the intake structure thus reducing the possibilities of aeration of the system under pressure as well as flowing of debris to the cleaning rack and the cleaning machine in order to increase efficiency of the removal of debris;
- Reconstruction of the stilling basin and increase of its efficiency;
- Higher flexibility of the power plant given that the entire volume of the retention basin may be used.

## 5.6 Surge tank small rehabilitation

The reservoir is located in Slivlje and the entire reservoir is concreted. The surge tank exhibits a total depth of 60 metres from the highest water level that its design allows for (630 m asl) to the invert of the headrace tunnel. The diameter of the shaft increases over the height from 8 to 12 metres (Figure 7).



**Figure 7: Surge tank with dimensions**

The tests performed until nowadays showed that, during the plant's outage at the planned maximum discharge of 81.20m<sup>3</sup>/s as well as when the discharge increases from 50% to 100%, the present volume of the surge tank is not sufficient which is followed by spilling of certain amount of water outside the surge tank.

Elimination of the remaining quantities of water from the level above 628 m asl in the surge tank through removal of the surge tank top does not cause hydraulic issues, while spilling of water will result in unexpected instantaneous flooding. Therefore, it is necessary to analyse the structure of the upper chamber where the remaining water is collected and returned to the surge tank, by monitoring the decrease of the water level in the surge tank.

Furthermore, it is necessary to analyse the fact that this upper chamber with the minimum volume of around 2,600m<sup>3</sup> (81.20m<sup>3</sup>/s) may be built as an open-air basin (pond) located in the subsidence between the entrance door to the surge tank and the access road. The water may be collected there and could be slowly drawn back to the surge tank via small canal.

## 5.7 Installation of electrical, mechanical and hydro-mechanical equipment of Unit U8

Installation of Unit 8 in HPP Perucica shall encompass measures of reconstruction and modernization. Upgrade of HPP Perucica to the end of increasing the installed power of the plant to 365.5MW. The extension of the power capacity of HPP Perucica from 307 to

365.5MW enables modified operation modes with further impacts. When it comes to power plants similar to HPP Perucica, those operating for more than half a century and comprising a higher number of units, the installation of an additional unit has become a widespread practice also for the sake of operating reserve given that any major breakdown of the primary equipment (generator or step-up transformer) may bring about a long-term stoppage i.e. reduction of the available power of the plant and generation losses.

As it is foreseen, HPP Perucica is to operate in the secondary and tertiary regulation with all the units, U8 included, and total installed capacity for provision of ancillary and system services to the Electric Power System of Montenegro, thus the quality and capacities of the plant in terms of the electricity market shall be improved.

The required mechanical, hydro-mechanical and electrical equipment for the extension of HPP Perucica with an 8th generating unit will consist of the following:

#### Mechanical Equipment

- Impulse (Pelton) turbine with two runners, Q Rated = 12.75 m<sup>3</sup>/s, H Rated = 526 m, P Rated= 58.5 MW, 2 nozzles per turbine incl. model test and housing of discharge pit;
- One digital turbine governor complete and hydraulic oil pressure unit;
- Cooling water system for transformer, generator and turbine bearings incl. instrumentation and all other necessary equipment;
- Drainage system for generator pit and below turbine needles incl. instrumentation and all other necessary equipment;
- General spare parts and tools for mechanical turbine equipment.

#### Electrical Equipment

- One horizontal synchronous generator 65 MVA and rated voltage of 10.5 kV, three phase thyristor type excitation system;
- One three-phase step-up transformers 10.5/121 kV, 65 MVA forced oil with forced water coolers for outdoor installation complete with aux. equipment;
- Control system, measurements, monitoring systems and protection equipment;
- Systems for turbine and generator monitoring (such as vibration monitoring, monitoring of the step-up transformer, monitoring of the partial discharge of the generator);
- HV/MV-switchgear equipment;
- MCC, auxiliary system / electrical installations;
- General spare parts and tools for electrical equipment.

#### Hydro-mechanical Equipment

- Two auxiliary gates for turbine tailwater pit, complete with frames and guides;
- Two turbine shut-off spherical valve, complete with aux. systems, DN1200, PN66;
- General spare parts and tools for hydromechanical equipment.

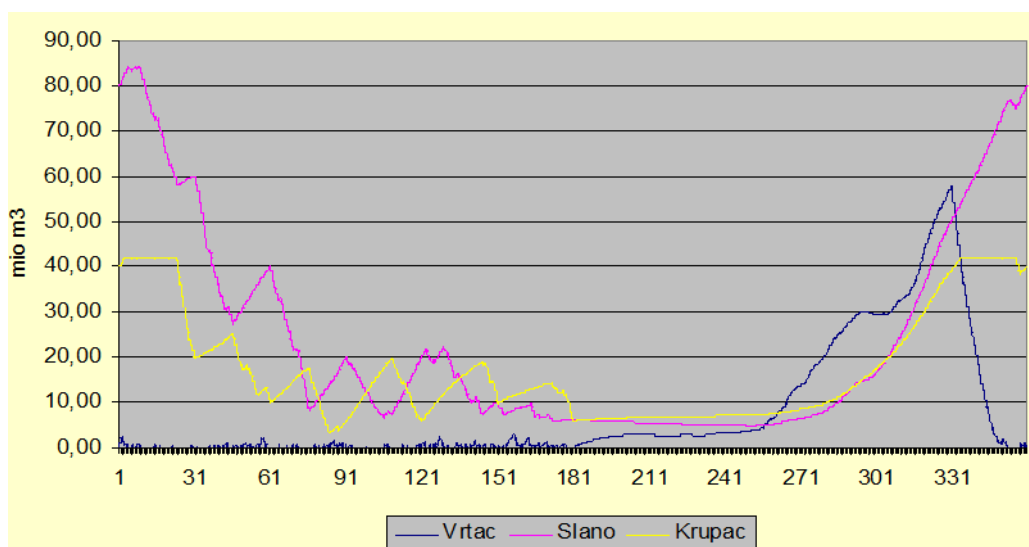
## 6. Assessment of alternatives

During preparation of the Feasibility study for the installation of the 8th unit in HPP Perucica, the following alternative solutions have been considered:

### 6.1 “No project alternative”

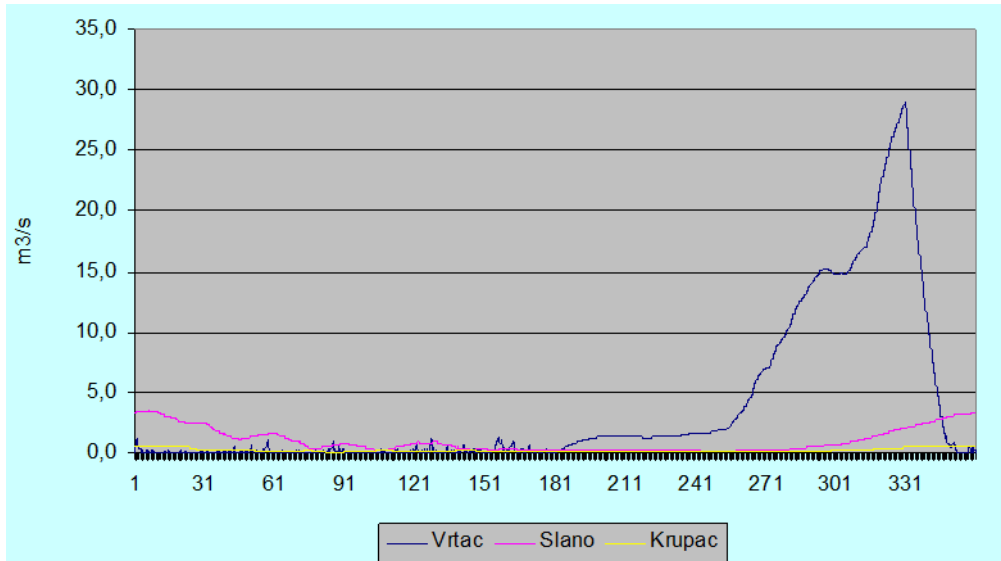
In the scenario without investment, HPP Perucica produces 1,045GW per year on average. Of the total annual production, 636GWh accounted for 1-5 units, which is 61%, and 409GWh for 6-7 units, which is 39% of the total production. If all the produced electricity were sold at simulated prices on the stock exchange, then the power plant would generate revenue of EUR78.8 million.

The condition of the pool as well as losses without the realization of the project, i.e. the installation of the 8th unit is shown in the following figures.



**Figure 8: Accumulations condition in case “no project” alternative**

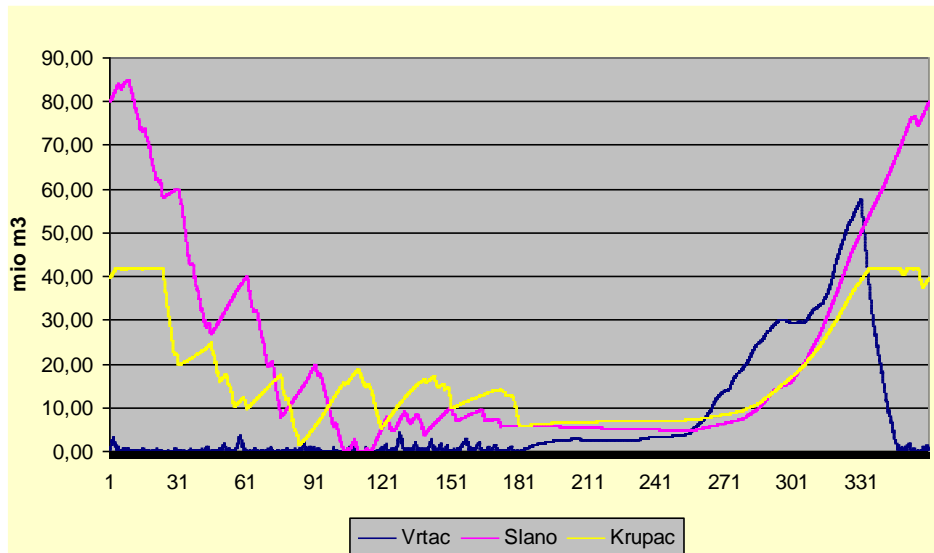




**Figure 9: Losses at the accumulations in the case “no project” alternative**

### 6.2 Alternative solutions with investment

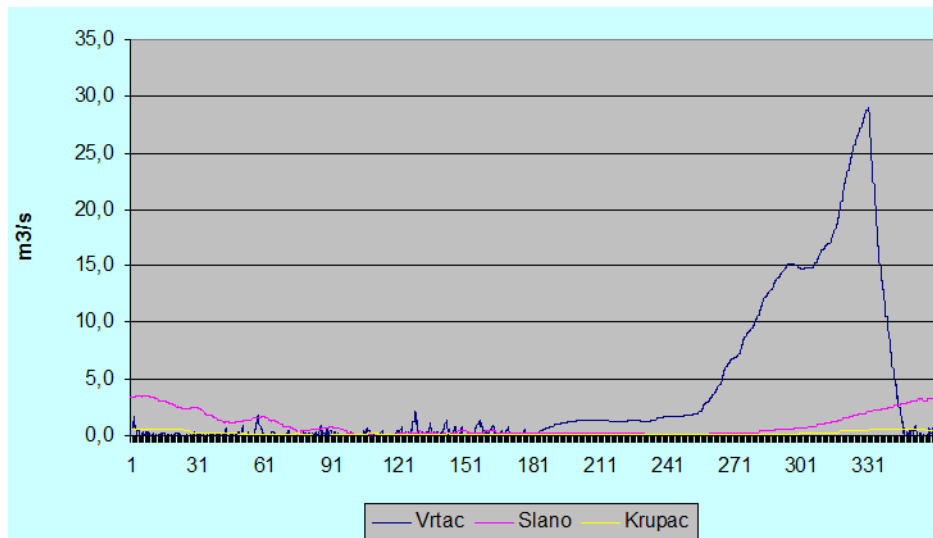
In the scenario with included investment, which will include reconstruction and modernization measures, HPP Perucica produces an average of 1,053GWh per year. Of the total annual production, 1-5 units account for 533GWh, which is 51%, 6-7 units for 345GWh, which is 33%, and the eighth unit, 173GWh, which is 16% of the total production. In the variant with the investment, the power plant generates revenue in the amount of EUR 84.5 million. The condition of the accumulations and the forecasted losses after the installation of the 8<sup>th</sup> unit are shown in the following figures



**Figure 10: Condition of the accumulations in case of installation of the 8th Unit**

According to the obtained results in Feasibility study for the installation of the 8<sup>th</sup> unit in HPP Perucica, reconstruction of the existing drainage channel for Unit 8 and reconstruction of the Zeta I canal - retention basin is recommended and due to reduce losses which, due to water

infiltration occur at the location of the existing accumulations and thus increase the efficiency of the new unit.



**Figure 11 Losses in accumulations in case of installation of the 8th Unit**

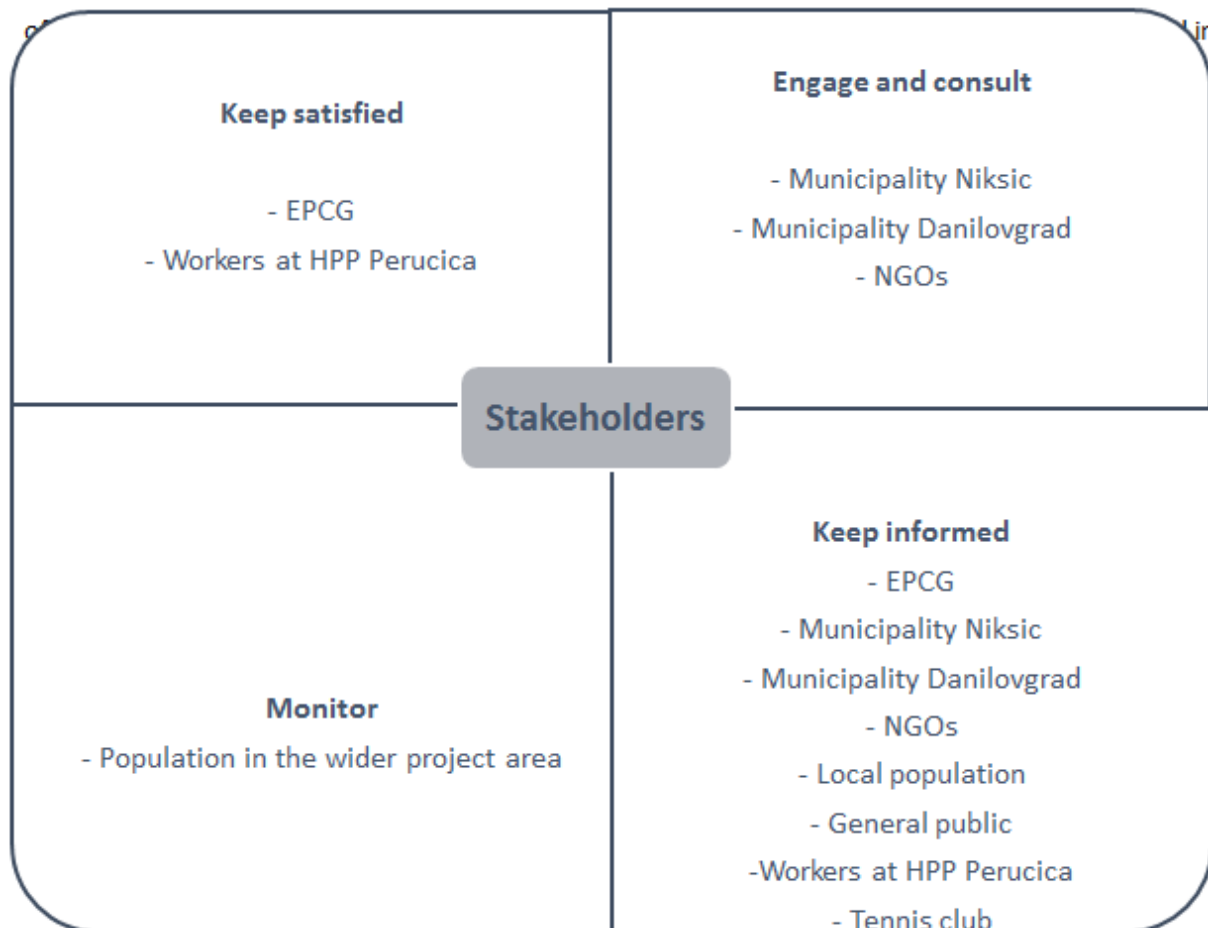
According to the above, it can be concluded that due to the installation of the 8th unit will achieve improvement of operating conditions of the power plant (increase in production) is achieved by installing the eighth unit. The production of HPP Perucica will increase by 7.41GWh per year in average.

## 7. Key project stakeholders

The process of identification and engagement with the project stakeholders has been ongoing since the project kick-off. During the project kick-off phase, meetings were held with representatives of EPCG and NEPA (Nature and Environment Protection Agency of Montenegro) in order to present the planned project and discuss the requirements related to national environmental impact assessment. Additionally, the consultant held meetings with EPCG during this phase in order to define the plan of activities, develop the list of available official documentation and agree on principles of cooperation.

The second project activity was related to the project scoping phase, which was realised for the purpose of determining the baseline environmental and social conditions, and further activities which are going to be implemented for the purpose of development of ESIA. Prior to commencement of development of the scoping report, the consultant conducted meetings with representatives of the local municipalities relevant to the project, i.e. Municipality Nikšić and Municipality Danilovgrad. These meetings were attended by representatives of EPCG who presented the project, and representatives of the consultant, who presented the process and inputs required for implementation of the project activities in accordance with KfW requirements. Moreover, these meetings were aimed at obtaining information about any previous interest in the project, the relevant stakeholders and the potential concerns raised during the preparatory phase.

After completion of the scoping phase, the Consultant carried out additional site visits in order to monitor the project area and identify any potential stakeholders who reside and/or use some of the objects in the project area. The site visit showed that the project area, nor the area outside of the project area, are not populated, but that these areas are characterised by obsolete and abandoned residential objects (buildings), which have completely been devastated over the years. Thus, no residents were identified in the project area. Additionally, a local tennis club was identified outside



Methodological approach to stakeholder engagement during the overall project lifecycle is going to rely on IFC principles, and thus it is going to be focused on building strong relationships with all the interested stakeholders. This is going to be achieved via an ongoing stakeholder engagement process, which is fully going to rely on continuous stakeholder identification and analysis, whereby the stakeholders are going to be continuously monitored and allocated their pertaining roles and significance in each project phase, in accordance with their involvement, interest and potential concerns regarding the project. Additionally, the stakeholder engagement process for this project is going to include disclosure and dissemination of information via the relevant local and national media, consultation and participation in the form of public consultation meetings, grievance mechanism and ongoing reporting to the relevant communities.

EPCG is going to be responsible for communication and dissemination of information, which shall be done in cooperation with the consultant and local municipalities, whereby KfW is going to be duly informed about all the stakeholder engagement activities and outcomes

through the corresponding project documentation. All the above-mentioned stakeholders are going to be duly informed about all the project developments, activities, public consultations and disclosure of documents via the official website of EPCG and the local and national media. All the official project documentation is going to be presented to the relevant stakeholders via the official website of EPCG, public consultation meetings (time, date and venue are to be announced at least 10 days prior to the public consultation meetings), all of which shall be done after the documentation is accepted and approved by KfW. The public consultation meetings are going to be used as a significant means of communication with the relevant stakeholders, whereby these meetings are going to be aimed at obtaining the relevant comments and feedback from these stakeholders. The following set of public consultation meetings is going to be held after delivery of the draft ESIA to KfW.

Additionally, the local municipalities are going to be fully involved and engaged in communication about the public consultation meetings, whereby they are going to have a significant role in terms of communication with the relevant local stakeholders, i.e., local NGOs and local communities. Finally, workers at the HPP Perucica are going to be informed and engaged throughout project implementation, so as to ensure that they are fully aware of all the project activities, their roles and responsibilities in the project, as well as any potential changes and alterations in their work processes and responsibilities in relation to development, operation and maintenance of the new and improved system.

All the above-mentioned stakeholder engagement activities and responsibilities are going to be implemented and monitored throughout the project, including preparation and development of the conceptual design, ESIA development, preparation and finalisation of the main design, as well as all the subsequent construction works, operation and maintenance phase of the project.

## **8. Limitations of this report**

This report has been prepared on the basis of the Preliminary design from 1985, instead on the basis of the Main Design. This represents one of the main limitations of this report, since ESIA's are generally to be prepared on the basis of Main designs, since they provide a detailed project description. However, it is important to note that the current HPP Perucica system has been completely aligned with the design which was set out since the very beginning of its operation, thus all its elements have remained unchanged, whereby the system was initially designed in the way that it meets all requirements for installation of the eight unit.

## **9. Data collection and description of the baseline environment**

During the scoping phase, it was determined that some of existing environmental data and information does not suffice for development of ESIA. Thus, additional studies and surveys were carried out in the project area, including a number of biodiversity surveys (detailed methodology and results are provided in the following sections) and noise survey.

In addition to the abovementioned surveys, baseline data was obtained from EPCG, i.e. from their regular environmental monitoring results; official national and local studies; official national and local data; data provided from Municipality Niksic and Municipality Danilovgrad; and other literature sources. A detailed overview of baseline condition of each aspect of the environment is presented below.

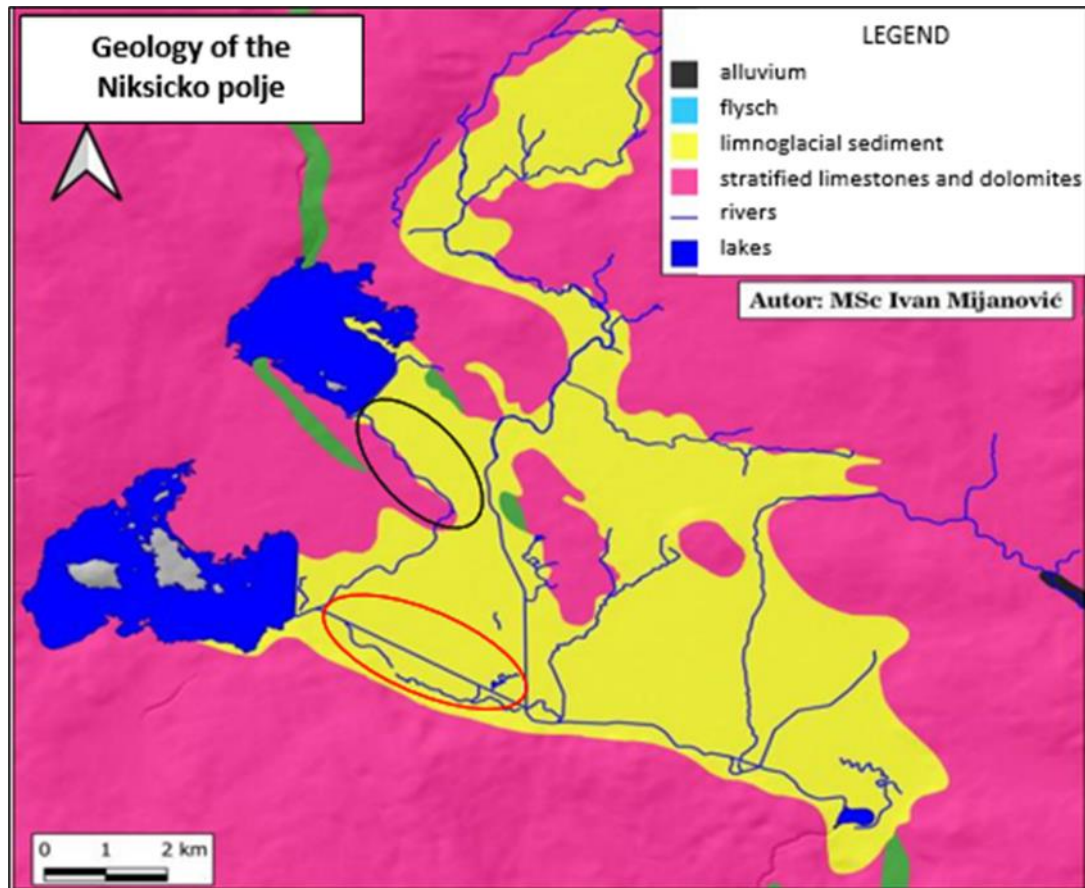
## 9.1 Geomorphological and geological characteristics

### 9.1.1 Geomorphological and geological characteristics

HPP Perucica (location of the Project Areas 2 machine building), which was built not far from Glava Zeta, uses the waters of the Niksic field. On the edge of the Nikšić pole there is a retention basin (location of the Project Areas 1). When it comes to Niksic field, to je is the largest karst field in Montenegro. Its area is 66.5km<sup>2</sup>, and the altitude is from 600m to 660m. Niksic field is a closed karst depression, surrounded by higher terrains with an average altitude of 1,200m. In the mountain range, the following mountain passes stand out: Planinica (685m) towards Donja Zeta, Trubjela (865m) towards the Trebisnica valley, Duga (1,050m) towards Gatacko field, Javorak (1,135m) towards the Piva valley. The field is very diverse, and the hills of "Trebjesa" (752m) and "Studenacka glavica" (684m) stand out in the plain of the field.

The following figure is showing geology of Niksic valley as well as position of the PA 1 (retention basin).





**Figure 12: Geology of Niksic valley - location of the Project Areas (1) retention basin**

(Source: <https://geografijasve.me/2020/04/21/geoloske-i-geomorfoloske-karakteristike-niksickog-polja/>)

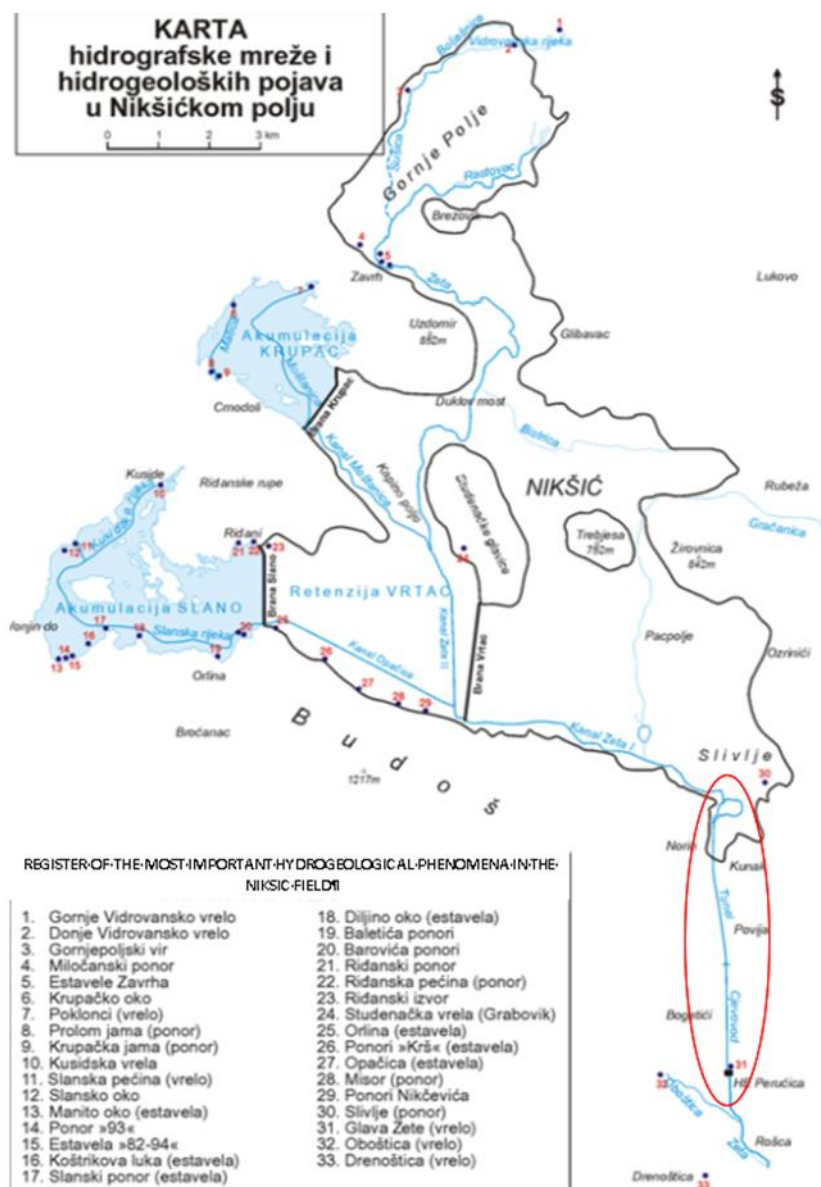
The bottom of the field is a limestone plateau covered with fluvioglacial deposits with an average thickness of 15m. The strong karst spring Vidrovan, which springs in the northern edge of Gornje polje, is the source of the river Zeta, which receives several smaller, mostly occasional flows in the Niksic field.

The mountains, plateaus and valleys that form the framework of the Niksic field are built of rocks of different ages and characteristics. Older Mesozoic deposits predominate in the east and northeast, while Paleozoic shales and eruptions predominate in the Gračanica valley, while younger Mesozoic deposits are found in the higher parts of the mountains. The southern and western edges of the field are dominated by younger Mesozoic limestone deposits, so in terms of relief and hydrology, the Niksic field is a typical area of deep karst. The plain of the field is composed of the youngest Quaternary diluvial and alluvial deposits. Most of the flysch-like deposits are built of shale, plate-like marly limestone that turns into marl and sandy gloss. They are represented below the Ostroski beams in the area of Povija and Kunka, Stubica, as well as in the part of Donja Zeta and in the area between the springs of Perucica and Glava Zete, where they reach a thickness of up to 80m<sup>1</sup>.

<sup>1</sup> Strategic Environmental Impact Assessment for Local Study of Redirection of a Part of the Zeta River Waters into Accumulations Krupac and Slano, Ministry of Sustainable Development and Tourism, Podgorica, February 2020.

### 9.1.2 Hydrological and Hydrogeological Characteristics of the Area

The entire watershed area of Niksic valley watercourse has extreme karst nature and topographically it drains the area of around 850km<sup>2</sup>. Hydro-geologically, this area is much larger, reaching around 1,170km<sup>2</sup>. The main watercourse in Niksic valley is the Zeta River, with the length from its spring to Slivlje ponor to around 20km. In its entire course, the Zeta River receives several small tributaries with much smaller inflows. The following figure showing the hydrological network in the Niksic valley (project areas).



**Figure 13: Hydrological network in the project areas**

**(Source: Main design)**

The first hydrological investigations in Niksic valley watershed began in 1929 with Duklo bridge gauging station, which was equipment only with a gauging staff. All these watercourses show non-uniform water inflow over a year. The reason for that is precipitation

regime, which is the most intensive in autumn and spring. In winter season, heavy snowfalls occur regularly in the watershed.

Summer season is extremely dry and as a result the Zeta tributaries regularly dry up. In the parts of Niksic valley that used to be flooded every year by water from karst aquifers before construction of HPP Perucica, permanent reservoirs were formed by construction of the dams.

All surface watercourses in Niksic valley, forming the former Upper Zeta River are controlled by a hydrological station and their part in water supply to HPP Perucica has been more-or-less accurately defined.

The only measuring point in the system where the Investor and the Institute of Hydrometeorology and Seismology are measuring water levels and discharges is Duklo bridge hydrological station. It is also used for correction, control and determination of discharges of other watercourses in the watershed, having in mind their specific conditions<sup>2</sup>.

Based on the hydrogeological characteristics and functions of the rock masses in the wider area, the following can be singled out:

- Complex of medium to well-permeable rocks of intergranular porosity;
- Poor to medium permeable rock fractured, rarely cavernous porosity;
- Medium to well-permeable rock of crack-cavernous porosity;
- Poorly permeable to impermeable rock.

Cretaceous-Paleogene flysch sediments, Quaternary limnoglacial sediment and rubella are included in the group of poorly permeable to impermeable rocks. In the largest part of the Niksic field, they are covered with Quaternary limnoglacial and glaciofluvial deposits. These sediments are dominated by a clay-marl component, which determines their watertightness. Cretaceous limestones are deposited over the flysch sediments, and a large number of occasional and permanent springs of low yield appear at the contact itself in the wider area. Limnoglacial sediments, which are included in the group of impermeable rocks, are present in the southern part of the Niksic field, and they are represented by clays, sandy clays, clayey sand with conglomerate interlayers. Reds are found along the perimeter of the field or are deposited in most karst forms and sinkholes. Their distribution is quite limited and they are not of great importance from the hydrogeological aspect<sup>3</sup>.

### 9.1.3 Land use

Looking at the wider area, PA1 (retention basin) is partly located in Niksic field. Niksic field is the most important agricultural area in the municipality of Niksic.

The area of the left and right banks of the river Zeta in Niksic field consists of grasslands, meadows and pastures, but also agricultural land. In the period of autumn, winter and spring, these areas are subject to flooding due to high river levels. For this reason, these areas can be used for agricultural production at higher elevations.

For the PA2 (machine building) no Spatial planning documentation has been prepared so far. The built space in the zone of "Glava Zete" consists of tourism facilities i.e., "Glava Zete"

<sup>2</sup> Procurement of Works; Bidding Documents for REHABILITATION OF OPACICA AND MOSTANICA CANALS, PART 2 – Works Requirements, Section VII. Works Requirements, November 2019.

<sup>3</sup> Spatial urban Plan of municipality Niksic until 2020/2025, Podgorica, May 2015

Hotel with ancillary facilities, which is not in function, 6 abandoned collective housing facilities in the contact zone, as well as low-density housing facilities with ancillary facilities, and several infrastructure facilities.

In the zone of “Glava Zete”, a large part of the area is occupied by agricultural land, which stretches along the banks of the Zeta River.

#### 9.1.4 Climate

Climate in Niksic municipality is typical representative of the transitional climate in Montenegro. This is a consequence of its central geographical position and openness to the penetration of the maritime temperature influence, and the disintegration of the relief and the influence of the surrounding high mountains have a great influence.

Landscape fragmentation is causing microclimate diversity, thus there are differences among enclosed valleys (depressions) and the surface areas and mountains, while there are also differences between the parts which are located on the sunny side, and the ones located in the shade.

Relief especially affects the amount of precipitation. Some parts of the municipality of Niksic are more or less open to the influence of the sea, which is an important climatic factor. The artificial lakes Slano, Krupac and Vrtac have certain influences on the climate of the Niksic field, while Lake Bilecko effects on the lower parts of Banjani and Oputne Rudine. Climate of the Niksic field was influenced by the rapid industrialization, growth and expansion of the Niksic and its population after World War II.

The most important climatic elements by which the climate of a certain area is known are: insolation, air temperature, air pressure, relative humidity, clouds, precipitation and winds.

The average annual sun in Niksic is 2,250h, where the highest sunshine in July is 322h, and the lowest is in December 97h. The average annual air temperature in Niksic is 10.7°C. The coldest month is January with 1.3°C, and the warmest is July with 20.5°C.

**Table 5: Average monthly and annual air temperatures and maximum and minimum monthly values (° C)**

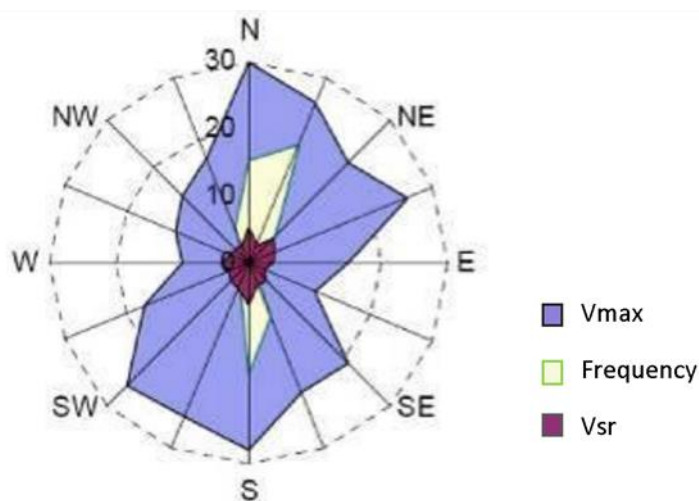
|                | Jan  | Feb | Mar | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov | Dec | Annual |
|----------------|------|-----|-----|------|------|------|------|------|------|------|-----|-----|--------|
| <b>Average</b> | 1.3  | 2.5 | 5.5 | 9.5  | 14.2 | 17.5 | 20.5 | 20   | 16.2 | 11.2 | 6.6 | 2.9 | 10.7   |
| <b>Max</b>     | 4.2  | 5.9 | 8.9 | 12.4 | 16.7 | 19.6 | 24.2 | 23.6 | 20.1 | 13.5 | 9.3 | 4.9 | 24.2   |
| <b>Min</b>     | -2.3 | -3  | 0.3 | 7    | 11.6 | 15.8 | 19.2 | 15.9 | 13.1 | 7.7  | 2.5 | 0.5 | -3     |

As for air humidity and clouds, it can be said that Niksic has moderate relative humidity, which is the lowest during July and August. Cloudiness depends on air humidity, temperature changes, as well as terrain, and minimal cloudiness is present in July and August. The average fog in Niksic is 29 days a year. Fog in the Niksic field occurs mostly above the accumulation lakes and above the rivers, in the immediate vicinity of the Niksic field and around the passes of Planinica, Trubjela and Javorak.

From the places where precipitation is measured in the municipality of Niksic, Grahovo received the largest amount of precipitation, an average of 3,140mm per year, followed by

Nikšić 1,993mm, Velimlje 1,599mm. In all places, the highest amount of precipitation is in November. The share of snow in the total amount of precipitation in Nikšić is 11.8%, while the average annual number of days with snowfall is 19. According to the annual aridity index, the municipality of Nikšić belongs to the humid (wet) areas. It must be noted that during the summer months there is a drought in the karst area.

Nikšić has strong north-south winds. Anticyclonic, rarely cyclonic wind, which usually lowers the temperature, reduces cloudy and humidity, usually blows from the north or northeast direction over the mountains and especially over the Javorak, Planinica, Stitovo passes. The south wind is also quite strong, especially in the Nikšić field. As a result of the relief, the mountains Orjen and Bijela gora, as well as the mountains who are located inside of the Nikšić field sometimes when the south wind blows (through the inner slopes of the mountains in the fields, Nudo valley and the other valleys) there is an increase in temperature, melting snow and occurrence of floods. In the area of the municipality of Nikšić, especially in the western parts closer to the sea, there is a wind mistral, wet and rainy wind.<sup>4</sup>



**Figure 14: The wind rose for Nikšić**

### 9.1.5 Seismicity

The project area (municipality of Nikšić) belongs to the seismically relatively quiet region with a degree of seismic intensity of VII-degree MCS scale (see figure below).

<sup>4</sup> Information on air quality for 2021, Nikšić, February 2022





**Figure 15: Map of Seismic Reionization of Territory of Montenegro**

For the subject area of Nikšić, which is built mostly of Quaternary sediments in the surface part, carbonate rocks (limestone and dolomite) and flysch sediments, the effect of earthquakes on the surface and on buildings depends on several factors. The most important are: the size of the magnitude and the distance from the focus, the geological structure of the terrain as the influence of the local geotechnical environment.

In the project areas (retention basin and machine building), the maximum expected degree of seismic intensity is VII-degree MCS scale, while the level of the expected maximum soil acceleration ( $a_{gmax}$ ) is 0.18.

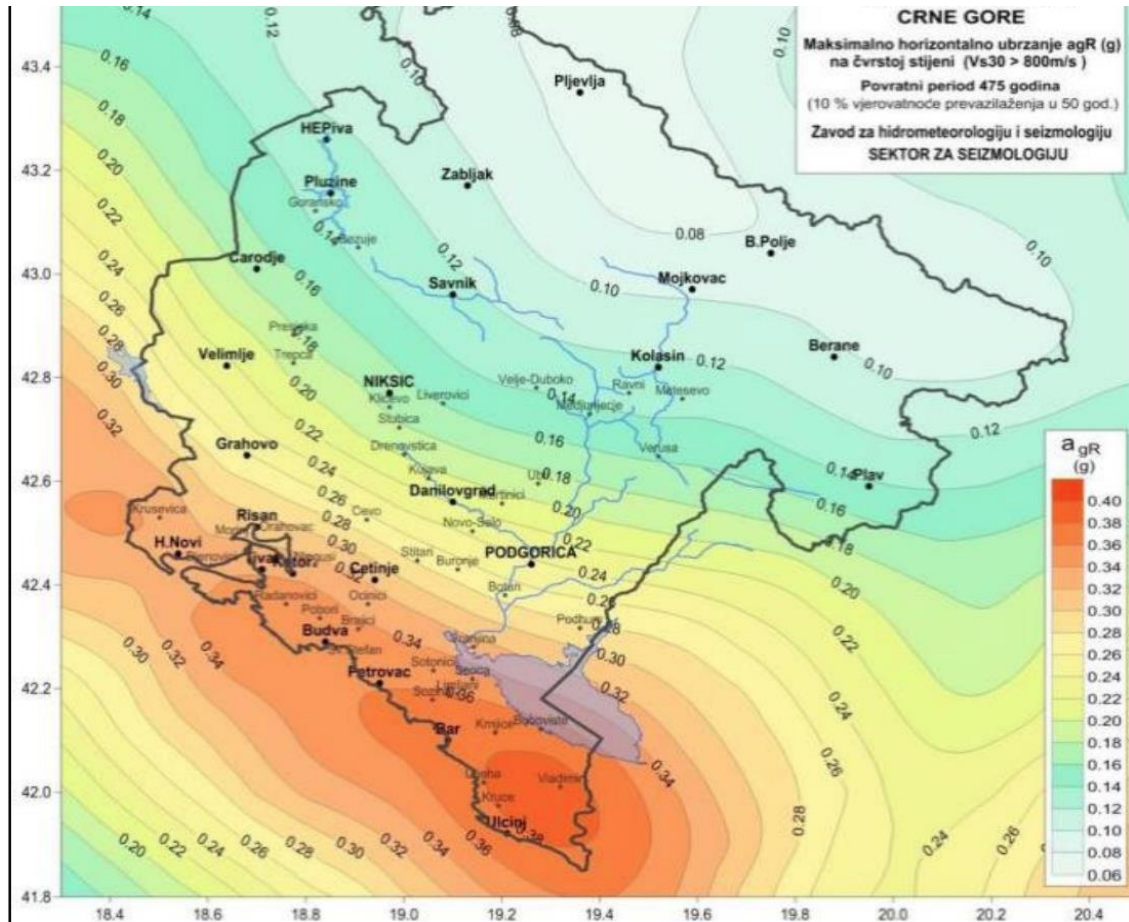


Figure 16: Isolines for a Return Period of 475 Years

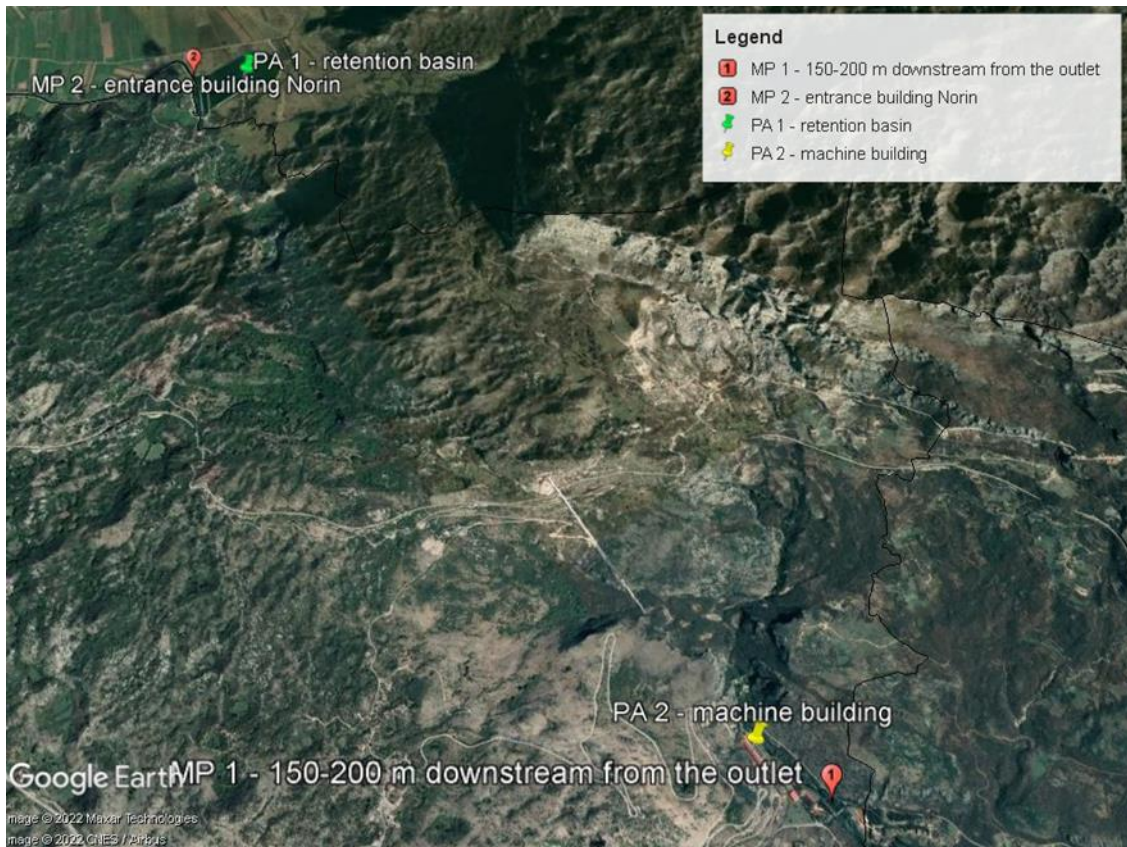
## 9.2 Quality of Physical Environment

The chapters below describe quality and characteristics of each segment of the physical environment.

### 9.2.1 Water Quality

The main watercourse in the PA is Zeta River, with the total length from its spring to Slivlje ponor around 20km. EPCG as the owner of HPP Perucica, is engaging accredited laboratory the Institute of Public Health to perform physical and chemical analysis of surface waters (Zeta River). Measurement is performed at two locations: (1) 150-200 m downstream from the outlet - HPP Perucica and (2) entrance building "Marin krst" - Norin (Figure 17).





**Figure 17: Measurement Points for Zeta River Monitoring**

During 2020, 4 cycles (May, June, September, December) of sampling waters of the Zeta River were performed at locations shown above. Based on the results of laboratory tests and expert consideration, all tested samples met the conditions for good ecological status according to the *Ordinance on the manner and deadlines for determining the status of surface waters* ("Official Gazette of the Republic of Montenegro", No. 25/19 od 30<sup>th</sup> April 2019).

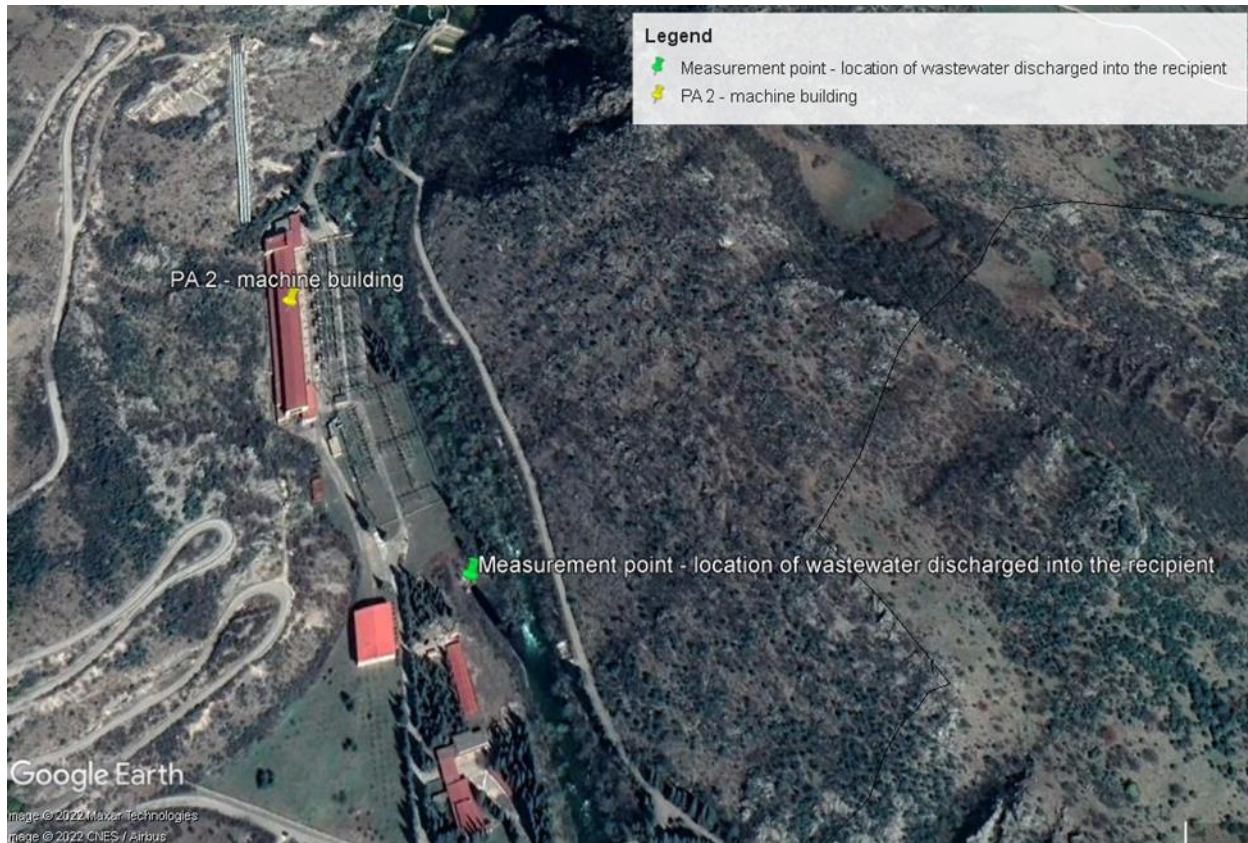
As in previous years during December 2021, sampling of surface water (150-200 m upstream of the outlet and the entrance building Norin) was performed. Based on laboratory tests and expert consideration, the submitted samples, in terms of tested parameters, showed the appropriate quality of surface water.

Also, water quality in the river Zeta is regularly monitored by the state via a fixed monitoring station and classified according to the *Law on Waters* ("Official Gazette of the Republic of Montenegro", No. 27/07 and "Official Gazette of Montenegro" no. 32/11, 47/11, 48/15, 52/16, 55/16, 2/17, 80/17 and 84/18) and *Ordinance on the manner and deadlines for determining the status of surface waters*. Measurement of water quality of the river Zeta is performed by the accredited institution, the Institute of Hydrometeorology and Seismology of Montenegro. Last examination of the physical and chemical parameters of the water quality of the Zeta River, according to the Water Framework Directive, was performed in 2020 on 3 points: Duklov bridge, Danilovgrad, and Vranjske Njive. Measuring point "Duklov bridge" is located about 9km upstream to the PA 1. At this measuring station, the water showed moderate quality status (73.3% of certain parameters showed excellent quality - i.e., very good status, and 20.0% of certain parameters good status, while 6.7% showed moderate status). Measuring point "Danilovgrad" is located about 15km downstream of the PA 2. The water at



this measuring station showed good quality status (93.3% of certain parameters showed excellent quality - i.e., very good status, and 6.7% of certain parameters good status)<sup>5</sup>.

Also, EPCG is engaging accredited laboratory the Centre for Ecotoxicological Research Montenegro (CETI) to perform physical and chemical analysis of waste waters, which is generated by the work of HPP Perucica. Sampling was performed at the site of wastewater discharged into the recipient (*Figure 18*).



**Figure 18: Measuring point for wastewater monitoring**

During 2020, 4 cycles (May, June, September, December) of sampling waste water were performed at location shown above. Physic-chemical analysis of wastewater showed that the examined parameters in the wastewater sample correspond to the conditions for wastewater discharge into the recipient – in accordance with *Rulebook on quality and sanitary-technical conditions for discharge of wastewater into the recipient and public sewerage, manner and procedure of testing the quality of wastewater, minimum number of tests and content of the report on the determined quality of wastewater* ("Official Gazette of Montenegro", No. 45/08 of 31 July 2008, 9/10 of 19 February 2010, 26/12, dated 24 May 2012, 52/12, dated 12 October 2012 I 59/13, of 26 December 2013). Microbiological tests of wastewater were also performed, where the results showed that no microorganisms were present in the tested water.

During 2021, the measurement was done at the same location in the 2 cycles, in October and December. As in the previous year, physic-chemical analysis of wastewater showed that

<sup>5</sup> Annual report II-20, Annual report on water quality in Montenegro in 2020, Institute for Hydrometeorology and Seismology, 2021.

the examined parameters in the wastewater sample correspond to the conditions for wastewater discharge into the recipient.

### 9.2.2 Soil quality

Soil condition monitoring and examination of the content of hazardous and harmful substances in the soil is carried out in accordance with the Law on Environment (*"Official Gazette of Montenegro"*, No. 052/16, 073/19), Law on Agricultural Land (*Official Gazette of the Republic of Montenegro*, "No. 015/92, 059/92, 027/94"; *Official Gazette of Montenegro* "No. 073/10, 032/11) and accordance with the Regulations on allowed concentrations of harmful and hazardous substances in soil and methods for their examination (*"Official Gazette of RME"*, No. 018/97). Also complies with the requirements of the Stockholm Convention on Persistent Organic Pollutants (POPs).

Monitoring is performed according to the annual Monitoring Program prepared by the Environmental Protection Agency. Soil monitoring includes monitoring the content of chemical elements in the soil (cadmium (Cd), lead (Pb), mercury (Hg), arsenic (As), chromium (Cr), nickel (Ni), fluorine (F), copper (Cu), molybdenum (Mo), boron (B), zinc (Zn) and cobalt (Co)) and in the last few years has been improved by introducing additional methodological solutions. Also, monitoring includes monitoring the content of toxic and carcinogenic organic matter in the soil, i.e., persistent organic pollutants (POPs).

In the municipality of Nikšić, within the monitoring program implemented by the Environmental Protection Agency, soil sampling was performed at the following 3 locations:

- Steel Mill landfill - soil sampled at a distance of 300m from the landfill,
- Rubeza,
- Agricultural land near the city landfill "Mislov do".

The results of the soil pollution tests showed the following:

- The analysis of the soil sample from the location near the Zeljezara landfill did not record any exceedances of the prescribed MPC in relation to the content of tested hazardous and harmful substances. The content of all monitored POPs chemicals was outside the detection range, except for polycyclic aromatic hydrocarbons (PAH) which were detected, but in a significantly lower concentration than the normalized value.
- The analysis of the soil sampled at the Rubeza location showed an increased content of *cadmium, lead, chromium, nickel, zinc, boron and fluorine* in relation to the Regulations prescribed by the Ordinance. The content of most of the analyzed POPs chemicals is below the detection limit of the instrument. Of those detected, only the content of polycyclic aromatic hydrocarbons (PAHs) exceeds the prescribed values.
- The results of the analysis of the soil sampled at the location near the city landfill Mislov do (location monitored since 2020) showed an increased content of chromium and boron compared to the prescribed values. The content of all other inorganic parameters does not exceed the standardized MPC. In the soil sample from this location, of the tested POPs chemicals, the only presence of polycyclic aromatic hydrocarbons (PAH) was above the instrument detection line, but significantly below the



Regulated Normal Value. The content of all other analyzed POPs is below the detection limit<sup>6</sup>.



**Figure 19: Locations within which soil sampling was performed**

The nearest location where the soil sampling was performed is about 5km aerial distance from the PA (location near the city landfill Mislov do).

Land from the location near the city landfill Mislov do

In the soil sampled at this location, the increased content of these elements (chromium and boron) has a natural, geological origin. About 90% of total chromium is present only in silicate compounds, while significant amounts of these elements were not found in easily accessible fractions.

Boron is mainly present in the soil in crystalline forms and its bioavailability is mostly affected by soil acidity (pH), which is again directly related to climatic conditions which (alkaline soil reaction, low rainfall and high temperatures) lead to reduced solubility of boron, i.e., to its increased accumulation in the surface layer of the soil.

### 9.2.3 Air Quality

Air quality in Montenegro has been monitored in accordance with European standards since 2009. In accordance with European and Montenegrin legislation related to air protection, for

<sup>6</sup> Information on the state of the environment in Montenegro for 2020, Nature and Environmental Protection Agency, 2021

the purpose of monitoring and assessing air quality, the territory of Montenegro is divided into three air quality zones. Nikšić belongs to the central zone.

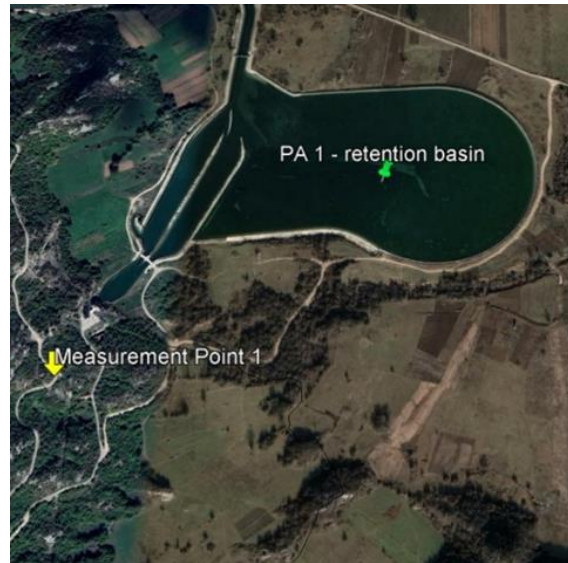
In Nikšić, continuous automatic monitoring has been conducted since mid-2009. The location of the automatic measuring station is located in the yard of the gymnasium "Stojan Cerović" (urban zone). The parameters monitored in the national air quality monitoring network are defined by the Regulation on Determination of the Types of Pollutants, Threshold Values and other Air Quality Standards ("Official Gazette of Montenegro", No. 25/2012) in accordance with relevant European legislation (Directive 2008 /50 /EC and Directive 2004/107/EC). During 2021, Center for Ecotoxicological Research of Montenegro (CETI DOO) implemented the air quality monitoring program of the Municipality of Nikšić (urban zone). The program includes systematic measurement of the immission of pollutants in the air, namely: NO, NO<sub>2</sub>, NO<sub>x</sub>, CO, O<sub>3</sub>, SO<sub>2</sub>, PM<sub>2.5</sub>, PM<sub>10</sub> (Pb, As, Cd, Ni and Ba in PM<sub>10</sub>). Based on the obtained results, out of 12 monitored air quality parameters, for 8 parameters (nitrogen dioxide, ground-level ozone, carbon monoxide, benzene, lead, cadmium, arsenic and nickel) during 2021, no exceeding of limit or target values was recorded at one measuring point.

Exceedances of the limit values have been recorded for powdered substances. The results of measuring the concentrations of suspended PM<sub>2,5</sub> particles indicate a high air load with this pollutant, especially during the winter months, when solid fuels are mainly used for space heating. Also, based on the available reports, an increased content of PM<sub>10</sub> particles can be noted (bearing in mind that the allowed number of exceedances during the calendar year is 35, during 2021, 62 exceedances of the limit values of mean daily concentrations of suspended PM<sub>10</sub> particles (50µg/m<sup>3</sup>) were recorded). It is important to note that the measuring station is located about 8.5 km aerial distance from the project area. As for the project location, it is located in an area that is not surrounded by potential sources of pollutants (there are no industrial or construction facilities). At the same time, the operation of the unit and the production of electricity do not result in the release of gases that can affect the air quality at the microlocation.

#### 9.2.4 Noise Level

Regarding the subject areas affected by the project, no data on noise levels are available. In this regard, in order to determine the zero state of the noise level in the project area, an accredited laboratory CETI Ltd. was hired. The examination of the noise levels in the environment was performed on June 1st and June 2nd, 2022. Measurements of day, evening and night noise levels in the environment were realized at 2 measuring positions, at the nearest residential buildings where it was estimated that the noise level could be the highest.

The first measuring position is located at the Slivlje/Ozrinici site in the immediate vicinity of the retention basin (PA 1), while the second position is at the Bogetici/Glava Zeta site near the machine building (PA 2). The layout of all measuring positions is given in the following figures.



**Figure 20: Position of the measuring position 1 at the Slivlje / Ozrinici site**



**Figure 21: Position of the measuring position 2 at the Bogetići/Glava Zete site**

In accordance to the national legislation, Montenegrin municipalities have adopted decisions on acoustic zoning of their territories. On May 13<sup>th</sup> 2013 Niksic Municipality issued a *Decision on determining the acoustic zones in the Municipality of Niksic*. Therefore, the obtained values of noise levels at the measuring positions were compared with the limit values of noise levels for residential area, mixed use zone and zone under strong influence of traffic, in accordance with the above Decision and *Ordinance on limit values of environmental noise, the method of determining the noise indicators and acoustic zones and methods of assessment the adverse effects*, ("Official Gazette of the Republic of Montenegro", No. 60/11).

The table below is representing the mean values of the series of measured equivalent background (residual) noise levels for day, evening and night ( $L_{day}$ ,  $L_{evening}$  and  $L_{night}$ ) at measuring positions 1 and 2 as well as the corresponding noise level limit values for the specified acoustic zones.



**Table 6: Measured values of day, evening and night noise level indicators at all measuring positions**

| Measurement point | Period  | Measured value of residual noise level<br>Lday/ L evening / L night (dB) | Limit values of noise levels<br>Lday/ L evening / L night (dB) |                |                                 |
|-------------------|---------|--|--|----------------|---------------------------------|
|                   |         |  | Residential area   | Mixed zone use | Zones affected by traffic noise |
| 1                 | Day     | 38   | 55   | 60             | 60                              |
|                   | Evening | 38   | 55   | 60             | 60                              |
|                   | Night   | 36   | 45   | 50             | 55                              |
| 2                 | Day     | 44   | 55   | 60             | 60                              |
|                   | Evening | 41   | 55   | 60             | 60                              |
|                   | Night   | 40   | 45   | 50             | 55                              |

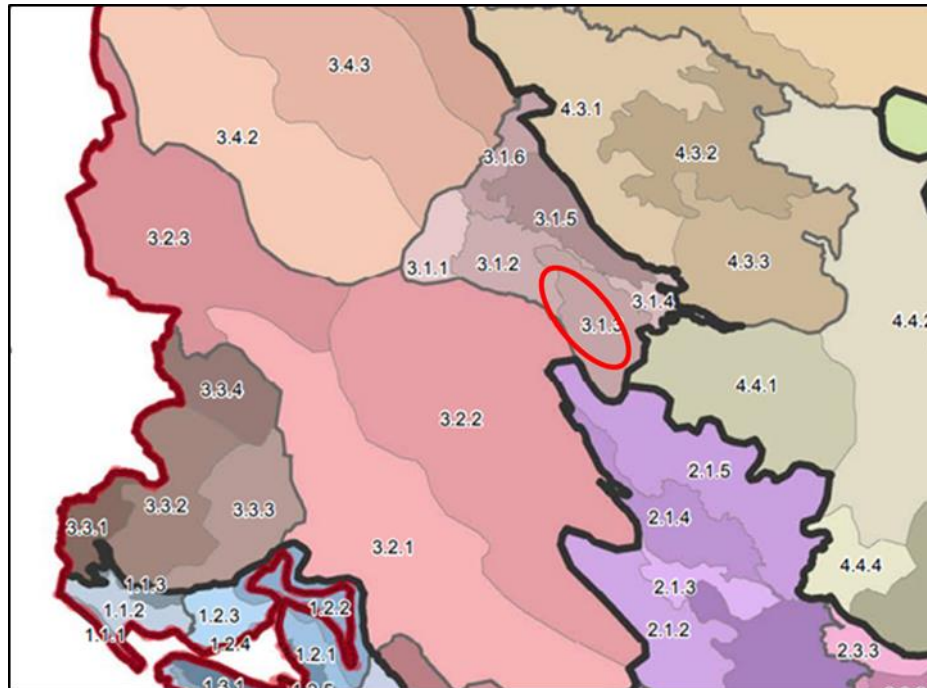
Analysis of the results of measuring the noise level in the environment in order to determine the zero state of the noise level in the project area, shows that at the examined measuring positions day, evening and night noise indicators do not exceed the statutory limit values prescribed for residential zone, mixed zone, zone under strong influence traffic noise<sup>7</sup>.

Therefore, it can be concluded that the possible increase in noise levels during construction will not significantly affect the population, because PA is located in a sparsely populated region. Also, with the application of appropriate measures (such as that the construction works will not be performed during the night), it is expected that the intensity of the impact will be significantly reduced.

### 9.2.5 Landscape Features

According to the "Mapping and Typology of Landscapes in Montenegro", the Project Areas (retention basin and machine building) belongs to karst region. Locally, the area belongs to plain area of Nikšić field and lower mountain areas of Ozrinici and Ostrog area.

<sup>7</sup> Ordinance on limit values of environmental noise, the method of determining the noise indicators and acoustic zones and methods of assessment the adverse effects, ("Official Gazette of the Republic of Montenegro", No. 60/11).



**Figure 22: Typology of the landscape in Project Area**

Within these types of landscape character, forests, meadows and pastures, bare rocky terrains, agricultural fields, devastated areas (quarries, landfills), etc. are observed as landscape elements.

Dominant soil cover: Vegetation types: *Quercus - Carpinetum orientalis petterietosum*, *Quercus - Ostryetum carpinifoliae*, *Ostrya - Quercetum pubescentis*, *Seslerio - Ostryetum carpinifoliae*, *Fagetum montanum seslerietosum* and *Fageto - Abietosum*. Climatogenic communities of the sub-Mediterranean and epimediterranean vegetation zones appear in this region.

In this region, thermophilic forests of oak, Oriental hornbeam, Macedonian oak, *Ostrya carpinifolia* are mainly present, and in the mountains, thermophilic variant of beech forests.

### 9.3 Biological environment

For the needs of ESIA development, biodiversity survey was performed in the area of the Perucica hydroelectric power plant. An initial ecological baseline survey was carried out over 2-3 days in spring 2022 (in the period from May 28<sup>th</sup> to June 5<sup>th</sup>, 2022). The work was carried out by a team of biologists including the specialists for:

- Flora and habitats;
- Batrachology and herpetology;
- Terrestrial invertebrates (insects);
- Mammals' (including bat survey);
- Ornithofauna;
- Ichthyofauna (Zeta River) and
- Macrobenthos (Zeta River).



The work provided an initial overview of the flora and fauna (amphibians, reptiles, mammals, insects, birds and fish) present within the project affected areas. Depending on the need and subject of the survey, the survey was conducted at two locations:

- Location 1 - retention basin - Slivlje/Ozrinici;
- Location 2 - machine building of HPP Perućica - Bogetići.

More information about above mentioned surveys is given below.

### 9.3.1 Flora and habitats

Flora and habitat survey was performed at two locations, on May 28th and 31st, 2022:

- Location 1 - retention basin Slivlje / Ozrinici;
- Location 2 - machine building of HPP "Perućica".

During the survey, the represented flora was listed and habitats were determined. For determination of habitat types, the Manual for the identification of habitat types of Montenegro that are important for the EU was used. Figure 23. shows the determined habitats at the location of Slivlje and its surroundings, and Figure 24. shows the habitats at Glava Zeta, where the machine building and its surroundings are located.



**Figure 23: Habitats – Slivlje**

In accordance with national and European legislation, no endemic, rare and/or protected plants have been recorded in the area of Slivlje. Two Natura 2000 habitats, of low representativeness, were recorded (6510 Lowland Hay Meadows and 92A0 White willow & white poplar galleries). In addition to Natura habitats, in the immediate vicinity of the retention

there are hill forests of white hornbeam *Carpinus orientalis* and neglected meadows overgrown with quack grass *Elymus repens*.

Lowland meadows are widespread in Montenegro. Characteristic species recorded in this type of meadow in Slivlje are: *Trisetum flavescens*, *Festuca pratensis*, *Bromus hordaceus*, *Bromus racemosus*, *Dactylis glomerata*, *Dasypyrum villosum*, *Rhinanthus minor*, *Hordeum murinum*, *Tragopogon pratense*, *Leucanthemum vulgare*, *Sanguisorba minor*, *Lotus corniculatus*, *Trifolium pratense*, *Medicago sativa ssp. falcata*, *Carex caryophylla*, *Carex flacca*, *Medicago minima*, *Ranunculus bulbosus*, *Centaurea jacea*, *Silene vulgaris*, *Galium verum*, *Poa bulbosa*, *Plantago lanceolata*, *Veronica jacquinii*, *Aristolochia clematitis* etc. The meadows around the retention are of low representativeness and the anthropogenic influence is visible, so in order to obtain reference data, hay meadows in the wider area of the retention were investigated.

Galleries of white willows and poplars extend along the course of the Zeta, which is lost in the abyss of Slivlja. White willow *Salix alba* is dominant, followed by narrow-leaved willow *Salix eleagnos*, elm *Ulmus minor*, dogwood *Cornus sanguinea*, *Euonymus europaeus*, *Rosa sempervirens*, *Ligustrum vulgare*, ash *Fraxinus excelsior*, hops *Humulus lupulus* and *Clematis vitalba*, as well as blackberry *Rubus ulmifolius* are present. The habitat is degraded with waste.

In the southwestern part of the retention there are meadows overgrown with the couch grass *Elymus repens*, followed by *Rumex conglomeratus*. This weed inhabits moist habitats but also degraded areas such as neglected fields.

The mountain vegetation is represented by thermophilic forests of Oriental hornbeam *Carpinus orientalis*, followed by ash *Fraxinus ornus*, downy oak *Quercus pubescens*, elder *Sambucus nigra*, and some elements of macchia such as *Phillyrea media*. Oriental hornbeam is widespread in Montenegro.

The bottom of the retention is overgrown with algae from the *Chara* group, and there are also some submerged plants that grow in the waters of the Zeta River, such as *Ranunculus trichophyllus*, *Potamogeton crispus*, *Myriophyllum sp.*, *Ceratophyllum sp.*



Figure 24: Habitats – “Glava Zete”

As for the area near the machine building on the "Glava Zete", there are also no recorded endemic, rare and/or protected plants according to national or European legislation. Two Natura 2000 habitats have been recorded, namely: 92A0 Galleries of white willow and poplar, and Dry meadows or 6220 Pseudosteppe with annual plants (*Thero-Brachypodieta*). The surrounding area, where the machine building and administrative buildings are located, is cultivated with *Cupressus sempervirens* cypress.

White willow *Salix alba* and black poplar *Populus nigra* dominate on habitat 92A0 Gallery of white willows and poplars, and ash *Fraxinus excelsior*, *Quercus robur*, fig *Ficus carica*, black mulberry *Morus nigra*, pomegranate *Punica granatum*, walnut *Juglans regia*, Black locust *Robinia pseudoaccacia* also occur, and climbing plants *Hedera helix* and *Clematis viticella*. It was noticed that some woody species from the nearby hill inhabit the somewhat higher and drier land above the river, such as the terebinth *Pistacia terebinthus* and the Jerusalem thorn *Paliurus spina christii*. Obviously, this habitat type is influenced by humans due to the presence of some atypical plants such as walnuts or pomegranate. The river is clean and fast-flowing, so there are no typical downstream communities in the water.

Habitat type 6220 Pseudosteppe with annual plants (*Thero-Brahypodieta*) is representative only in the part of the meadow southwest of the house across from the HPP Perućica. It is characterized by the following plants: *Avena barbata*, *Bromus hordaceus*, *Aegilops geniculata*, *Aegilops triuncialis*, *Vulpia ligustica*, *Linum tenuifolium*, *Anthoxanthum odoratum*, *Medicago rigidula*, *Medicago minima*, *Medicago arabica*, *Plantago lanceolatum*, etc. Pseudostepa had already been mowed.

In the immediate vicinity, the pseudosteppes are overgrown with pomegranate plantations *Punica granatum*, and some other woody species such as European nettle tree *Celtis australis* are also present.

Downstream on the locality "Ilijin Vir" a photograph was taken of a pseudosteppe that was not mowed, and gallery forests of white willow and poplar (92A0) with *Salix alba*, *Fraxinus angustifolia*, *Acer negundo*, *Cornus sanguinea*, *Morus alba* were also recorded, as well as the habitat 3260 Water courses of plain to montane levels with *Ranunculion fluitantis* and *Callitriche-Batrachion* vegetation with *Ranunculus trichophyllus*, *Berula erecta*, *Menta aquatica*, *Veronica beccabunga* and *Iris pseudacorus*.

In general, based on the conducted survey, it can be concluded that both locations are under strong anthropogenic influence. A complete report on the conducted survey is given in Annex.

### 9.3.2 Batrachology and herpetology

Preparations for survey on amphibians and reptiles included a review of literature data of the wider subject area and their location on the map. The survey was performed at the end of May during two field days (May 28<sup>th</sup> and 31<sup>st</sup>).

Determining the presence of the expected species of amphibians and reptiles in favourable habitats in the subject area was carried out using the visual transect method and the search method using meredov, based on standard methods for assessing the diversity of batrachians and herpetofauna. The search by meredov was performed only in certain cases, for the purposes of species determination. After the determination, the individuals were immediately returned to the habitat.



### 9.3.2.1 Reptiles

During the survey carried out in field, the presence of 8 species of reptiles in the impact zone of the project was determined.

| Species   | National legislation | Endemism           | CITES | IUCN | BERN | Habitats | Note                              |
|---|----------------------|--------------------|-------|------|------|----------|-----------------------------------|
| <b>Chelonia</b>                                     |                      |                    |       |      |      |          |                                   |
| <b>Testudinidae</b>                                 |                      |                    |       |      |      |          |                                   |
| <i>Testudo hermanni</i><br>(Forest Turtle)          | protected species    | –                  | (II)  | NT   | II   | II,IV    |                                   |
| <b>Sauria</b>                                       |                      |                    |       |      |      |          |                                   |
| <b>Lacertidae</b>                                   |                      |                    |       |      |      |          |                                   |
| <i>Podarcis muralis</i><br>(Wall lizard)            | protected species    | –                  |       | LC   | II   | IV       |                                   |
| <i>Lacerta viridis</i>                              | protected species    | –                  |       | LC   | II   | IV       |                                   |
| <b>Ophidia</b>                                      |                      |                    |       |      |      |          |                                   |
| <b>Colubridae</b>                                   |                      |                    |       |      |      |          |                                   |
| <i>Natrix natrix</i><br>(Grass snake)               | protected species    | –                  |       | LC   | III  | –*       | * IV individual island subspecies |
| <i>Natrix tessellata</i><br>(Dice snake)            | protected species    | –                  |       | LC   | II   | IV       |                                   |
| <i>Hierophis gemonensis</i><br>*(Balkan whip snake) | protected species    | Endemic of Balkans |       | LC   |      | –        | * as <i>Coluber gemonensis</i>    |
| <i>Elaphe quatuorlineata</i><br>(Four-lined snake)  | protected species    |                    |       | NT   | II   | II, IV   |                                   |
| <i>Dolichophis caspius</i><br>(Caspian)             | protected species    |                    |       | LC   | II   | IV       |                                   |

| Species    | National legislation | Endemism | CITES | IUCN | BERN | Habitats | Note |
|------------|----------------------|----------|-------|------|------|----------|------|
| whipsnake) |                      |          |       |      |      |          |      |

Karst lizard (*Podarcis melisellensis*) and Balkan spruce (*Hierophis gemonensis*) are endemic to the Balkan Peninsula. The forest turtle (*Testudo hermanni*) and the striped turtle (*Elaphe quatuorelineata*) have the status of almost endangered species (NT) and are listed in Annex II of the Habitats Directive. The forest turtle is also on the CITES list.

### 9.3.2.2 Amphibians

During the survey carried out in field, the presence of 3 species of amphibians was determined in the impact zone of the project. All detected species are protected by national legislation.

| Species  | National legislation | Endemism | CITES | IUCN | BERN | Habitats | Note                      |
|--|----------------------|----------|-------|------|------|----------|---------------------------|
| <b>Anura</b>                                     |                      |          |       |      |      |          |                           |
| <b>Bufonidae</b>                                 |                      |          |       |      |      |          |                           |
| <i>Bufo bufo</i><br>(Brown toad)                 | protected species    | –        | –     | LC   | III  | –        |                           |
| <i>Bufo viridis</i><br>(Green toad)              | protected species    | –        | –     | LC   | II   | IV       | *as <i>Bufo viridis</i>   |
| <b>Ranidae</b>                                   |                      |          |       |      |      |          |                           |
| <i>Pelophylax ridibundus</i><br>(Big Green Frog) | *Protected species   | –        | –     | LC   | III  | V        | *as <i>Rana ridibunda</i> |

According to biologists, the survey area is quite well preserved. The diversity of batrachofauna and herpetofauna is exposed to stronger/weaker human influences. Since these are sensitive groups, any strong negative impact may have consequences for their survival. The most common reasons for the endangerment of amphibians and reptiles are the fragmentation and loss of natural habitats.

The report of the performed survey on amphibians and reptiles can be found in Annex

### 9.3.3 Terrestrial invertebrates (insects)

Insects are the largest group of arthropods and the most widespread group of animals on earth with over a million described species, which is more than half of all known living organisms. Among the groups for which there are data for Montenegro, the most represented are diurnal butterflies (Rhopalocera) and nocturnal butterflies (Noctuidae, Geometridae,



Sphingidae, Pyralidae, Tortricidae, etc.), then dragonflies (Odonata), ants (Formicidae), wasp flies (Syrphidae) as well as certain families or genera of beetles (Carabidae, Scolytidae, Cicindelidae, Chrysomelidae), orthoptera (Orthoptera), and crane fly (Tipulidae), fruit flies (Drosophilidae) Trichoptera, Heteroptera (Hemiptera), Neuroptera, Cicadidae, Aphidae, etc.

Considering that insects represent the most numerous and ecologically diverse group of animals, their ecological characteristics are also very diverse, as well as the methods of collecting and scientific processing of materials. During the survey, a standard entomological net was used to collect certain species of Lepidoptera, Diptera, Hymenoptera, Odonata and certain Coleoptera, and when it comes to survey the river course, transects along which material sampling was carried out were determined. A larger number of specimens, after being determined in the field (determined to the species level) were released, while one part of the specimens was kept, and later determined in laboratory conditions, using a binocular stereo-microscope and adequate professional literature. Standard entomological keys were used for species determination. Specimens that are easily recognizable in the field were recorded without hunting.

In order to assess the insect fauna in the subject area (Perućica hydroelectric power plant), two field days were conducted at the end of May and the beginning of June 2022. In that case, the detailed field tour of narrower zone of accumulation/retention (Slivlje) was performed, with more detailed investigations at several locations. Also, survey was carried out in the area around the Perućica HPP mechanical plant, as well as in a couple of localities downstream from the HPP. Listed below are the species that were registered in the subject areas during the survey. Most of the listed species are registered in both areas.

**Table 7: Overview of registered insect species in the survey area**

| Group/order | Registered species   |
|-------------|--|
| Lepidoptera | <i>Papilio machaon</i> , <i>Iphiclides podalirius</i> , <i>Zerynthia polyxena</i> , <i>Pieris brassicae</i> , <i>Pieris mannii</i> , <i>Pieris napi</i> , <i>Pieris rapae</i> , <i>Anthocharis cardamines</i> , <i>Aporia crataegi</i> , <i>Colias crocea</i> , <i>Gonepteryx rhamni</i> , <i>Leptidea sinapis</i> , <i>Argynnis adippe</i> , <i>Argynnis aglaja</i> , <i>Argynnis paphia</i> , <i>Euphydryas aurinia</i> , <i>Aglais urticae</i> , <i>Issoria lathonia</i> , <i>Polygonia c-album</i> , <i>Vanessa atalanta</i> , <i>Vanessa cardui</i> , <i>Hyphodryas aurinia</i> , <i>Libythea celtis</i> , <i>Callophrys rubi</i> , <i>Melitaea cinxia</i> , <i>Melitaea didyma</i> , <i>Melitaea phoebe</i> , <i>Limenitis reducta</i> , <i>Melanargia galathea</i> , <i>Brintesia circe</i> , <i>Lasiommata megera</i> , <i>Maniola jurtina</i> , <i>Polyommatus icarus</i> , <i>Satyrium w-album</i> , <i>Coenonympha</i> sp, <i>Brenthis</i> sp, <i>Erebia</i> sp., <i>Pyrgus</i> sp., <i>Macroglossum stellatarum</i> , <i>Euplagia quadripunctaria</i> i <i>Saturnia pyri</i> . |
| Coleoptera  | <i>Oryctes nasicornis</i> , <i>Coccinella septempunctata</i> , <i>Melolontha melolontha</i> , <i>Geotrupes stercorarius</i> , <i>Trichius fasciatus</i> , <i>Cetonia aurata</i> , <i>Forficula auricularia</i> , <i>Ocypus olens</i> , <i>Meloe</i> sp., <i>Geotrupes</i> sp., <i>Cicindela</i> sp., <i>Cybister lateralimarginalis</i> , <i>Hydrophilus piceus</i> , <i>Tropinota</i> sp, <i>Ruptelia maculata</i> , <i>Carabus</i> sp., <i>Pterostichus</i> sp.  |
| Odonata     | <i>Calopteryx virgo</i> , <i>Sympetrum striolatum</i> , <i>Sympetrum meridionale</i> , <i>Gomphus vugatisimus</i> , <i>Ischnura elegans</i> , <i>Lestes barbarus</i> , <i>Coenagrion puella</i> , <i>Coenagrion</i> sp., <i>Orthetrum cancellatum</i> , <i>Anax imperator</i> , <i>Crocothemis aerithraea</i> , <i>Caliaeschna microstigma</i> , <i>Pyrrhosoma naysiphula</i> .  |

| Group/order | Registered species  |
|-------------|---|
| Mantodea    | <i>Mantis religiosa</i> , <i>Empusa fasciata</i> .  |
| Hymenoptera | The presence of a large number of individuals was recorded from the Hymenoptera: honey bees ( <i>Apis mellifera</i> ), violet carpenter bee ( <i>Xylocopa violacea</i> ), wild bees ( <i>Apidae</i> ), and wasps ( <i>Vespidae</i> ), then European hornet ( <i>Vespa crabro</i> ), several species of bumblebees ( <i>Bombidae</i> ), as well as several species of ants ( <i>Formicidae</i> ).  |
| Diptera     | A species of mosquitoes ( <i>Culicidae</i> ), crane fly ( <i>Tipulidae</i> ), fly ( <i>Muscidae</i> ). Of the hover fly ( <i>Syrphidae</i> ) are registered: <i>Cheilosia flaviceps</i> , <i>Cheilosia ranunculi</i> , <i>Chrysotoxum cautum</i> , <i>Episyrphus balteatus</i> , <i>Eristalis tenax</i> , <i>Eristalis arbustorum</i> , <i>Eristalis similis</i> , <i>Malanostoma mellinum</i> , <i>Meliscaeva auricolis</i> , <i>Microdon devius</i> , <i>Neoascia podagrica</i> , <i>Pipizella sp.</i> , <i>Helophylus trivittatus</i> , <i>Scaeva pyrastris</i> , <i>Sphaerophoria scripta</i> , <i>Syritta pipiens</i> , <i>Syrphus ribesii</i> . |
| Hemiptera   | Several species of the family Pentatomidae have been recorded.  |
| Orthoptera  | <i>Anacridium aegyptum</i> , <i>Gryllus campestris</i> , <i>Gryllotalpa gryllotalpa</i> , <i>Tettigonia sp.</i> , (as well as several species from the Acrididae and Tettigoniidae families).   |

Of the species recorded during the survey, according to the national legislation (Decision on protection of rare, declining, endemic and endangered plant and animal species (Official Gazette of the Republic of Montenegro 76/06), the following species are protected: *Papilio machaon*, *Iphiclides podalirius* and *Oryctes nasicornis*. Both types of butterflies were recorded in the surveyed areas<sup>8</sup>. According to published data, the species *Lucanus cervus*, *Cerambyx cerdo* and *Saga natoliae* have been recorded in the vicinity of Glava Zeta, and they could also be expected in the wider vicinity of the subject area. When it comes to species of international importance, *Zerynthia polyxena* (its larvae) have been recorded on plant species of the genus *Aristolochya* in several locations around the Slivlje reservoir, and near the machine plant (Perućica) and downstream to Glava Zeta. Also, in several locations, a plant of the species *Euplagia quadripunctata* was recorded, whose presence in those locations was expected, while the species *Euphydryas aurinia* was recorded on the herbaceous vegetation above the bank of the Zeta River near the HPP "Perućica". According to published data, the species *Cordulegaster heros* (a species from Annexes II and IV of the EU Habitats Directive) was recorded at several locations in the middle course of the Zeta River, which, based on the assessment of habitat types, could also be expected at the surveyed site (surroundings of the hydroelectric power plant and downstream).

The report of the invertebrate's fauna in the HPP Perućica area can be found in Annex 18.4. In addition to the presented survey results, the report also foresees the possible impacts of the project on insects during the construction/operational phase, and also presents the protection measures that the contractor should adhere to during the implementation of the project.

<sup>8</sup> The coordinates of the surveyed areas are given in the attachment 18.4. Supporting technical data/supporting special studies (results), Report: ASSESSMENT OF THE STATE OF THE INVERTEBRATE FAUNA (INSECTS) IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"

### 9.3.4 Mammals survey

Bat survey was performed at two locations, as follows:

- Location 1 - retention basin Slivlje / Ozrinići, the survey was performed during May 28<sup>th</sup> 2022 and May 29<sup>th</sup>, 2022.

Location 2 - machine building of HPP "Peručica", the survey was performed on May 31<sup>st</sup> 2022 and June 01<sup>st</sup> 2022.

In addition to field survey, the survey methods for the purposes of this study included cabinet work. Namely, the survey was conducted by the following methods:

- Habitat map analysis (Corine, Natura 2000), Google Earth;
- Review of the literature in order to determine the presence of certain species of bats in the subject area;
- Research and inspection of potential shelters (abandoned houses, tree hollows, etc.) with the aim of finding bats;
- Recording the bat sounds using ultrasonic detector Pattersson D500X Ultrasound Detector / Recorder Mk I, with visual detection, using transects;
- Analysis of bat echolocation signals using literature and Bat Sound Pro 4 software.

During the survey of the bat fauna, at both locations, a total of 12 species of bats were registered. The following table shows the registered bat species at location 1 and location 2.

**Table 8: List of identified species in the subject areas with protection status**

| No. | Species                                      | Location                 | Protection status (IUCN / Habitats Directive) |
|-----|--|--------------------------|---|
| 1.  | <i>Hypsugo savii</i>                         | Location 1<br>Location 2 | LC/ Annex IV                                  |
| 2.  | <i>Nyctalus noctula</i>                      | Location 1<br>Location 2 | LC/Annex IV                                   |
| 3.  | <i>Nyctalus leisleri/Eptesicus serotinus</i> | Location 1               | LC/ Annex IV/ LC/ Annex IV                    |
| 4.  | <i>Eptesicus serotinus</i>                   | Location 1<br>Location 2 | LC/ Annex IV                                  |
| 5.  | <i>Barbastella barbastellus</i>              | Location 1<br>Location 2 | NT/ Annex II and IV                           |
| 6.  | <i>Myotis emarginatus</i>                    | Location 2               | LC/ Annex IV                                  |
| 7.  | <i>Myotis daubentonii</i>                    | Location 1<br>Location 2 | LC/ Annex IV                                  |
| 8.  | <i>Miniopterus schreibresii</i>              | Location 1               | NT/Annex II and IV                            |
| 9.  | <i>Pipistrelus kuhlii</i>                    | Location 1               | LC/Annex IV                                   |
| 10. | <i>Pipistrellus kuhlii/nathusii</i>          | Location 2               | LC/Annex IV                                   |
| 11. | <i>Pipistrellus pipistrellus</i>             | Location 2               | LC/Annex IV                                   |

| No. | Species                  | Location                 | Protection status (IUCN / Habitats Directive) |
|-----|--------------------------|--------------------------|---|
| 12. | <i>Tadarida teniotis</i> | Location 1<br>Location 2 | LC/ Annex IV                                  |

Near location 1 (retention basin Slivlje/Ozirnici) two suitable bat shelters were found: a roadside cave (42.43 43.9N 18.5749.8E) and an abandoned house (42.4325.2N 18.5846.1 E). During the survey, no bats were found in both shelters, although it has all the conditions for a bat shelter. Older guano remains have been found in the abandoned house, indicating that bats are using this location as a winter shelter.

Two potential bat shelters were found at 2 locations near the machine building: a tunnel through the hill, across from the HPP Perućica machine building (42 ° 40'20.43 "N 18 ° 59'47.20" E) and cave - indentation in the rock near the project area (42 ° 40 "27 .78" N 18 ° 59'47.46 "E).

In general, both locations (1 and 2) are located in areas that are important for the bat fauna, both in terms of habitat diversity for different species and as a rich feeding and shelter for bats. The report on the performed bats survey can be found in Annex.

### 9.3.5 Ornitofauna

Survey methods for the purposes of this study included cabinet survey and field survey. As part of the cabinet work, relevant literature data on the birds of the wider Nikšić field and the Glava Zeta locality were collected. The field survey was carried out in the form of a linear transect, which was chosen to cover all habitats. In addition, observations were made from high points in order to detect birds of prey and water birds in the retention basin and along the Zeta channel.

Through the analysis of literature data and field work on June 4th and 5th, 2022, 110 bird species were found in the subject area of Slivlje and Glava Zete. According to the global IUCN classification, four species have an unfavorable protection status; according to the Birds Directive, 22 species are on Annex I; 11 species have a negative trend in Montenegro (declining), while 20 species are on the latest list of endangered species in Montenegro (EPA, 2022). During the field work in June 2022, 29 species were found in the field.

The table below shows the species observed during fieldwork on June 4<sup>th</sup> and 5<sup>th</sup> 2022.

**Table 9: Species identified in the area of Slivlje and Glava Zeta with endangered and protected status**

| Bird species in the vicinity of the subject area | Domestic name | Decision on protection, Republic of Montenegro 2006 | Convention on Migratory Species | EU Directive (2009/147/EC) | IUCN Global endangered status | IUCN status of Montenegro |
|--|---------------|---|---------------------------------|----------------------------|-------------------------------|---------------------------|
| <i>Ardea cinerea</i>                             | Gray heron    | RCG   |                                 |                            |                               | VU                        |
| <i>Buteo buteo</i>                               | Common        | RCG   | II                              |                            |                               | LC                        |
| <i>Coccothraustes</i>                            | Hawfinch      | RCG   |                                 |                            |                               | LC                        |
| <i>Columba livia</i>                             | Cave pigeon   |   |                                 | II/1                       |                               | LC                        |
| <i>Corvus corax</i>                              | Raven         | RCG   |                                 |                            |                               | LC                        |

| Bird species in the vicinity of the subject area | Domestic name       | Decision on protection, Republic of Montenegro 2006 | Convention on Migratory Species | EU Directive (2009/147/EC) | IUCN Global endangered status | IUCN status of Montenegro |
|--|---------------------|---|---------------------------------|----------------------------|-------------------------------|---------------------------|
| <i>Corvus cornix</i>                             | Gray crow           |   |                                 | II/2                       |                               | LC                        |
| <i>Delichon urbica</i>                           | Common house martin | RCG   |                                 |                            |                               | LC                        |
| <i>Dendrocopus</i>                               | Village             | RCG   |                                 | I                          |                               | LC                        |
| <i>Emberiza cia</i>                              | Rocky bunting       | RCG   |                                 |                            |                               | LC                        |
| <i>Erithacus</i>                                 | The robin           | RCG   | II                              |                            |                               | LC                        |
| <i>Fringilla</i>                                 | Common              | RCG   |                                 | I*                         |                               | LC                        |
| <i>Garrulus</i>                                  | Eurasian jay        |   |                                 | II/2                       |                               | LC                        |
| <i>Lanius collurio</i>                           | Russian             | RCG   |                                 | I                          |                               | LC                        |
| <i>Larus</i>                                     | Yellow-legged       | RCG   |                                 | II/2                       |                               | LC                        |
| <i>Larus</i>                                     | An ordinary         | RCG   |                                 | II/2                       |                               | CR                        |
| <i>Motacilla alba</i>                            | White               | RCG   |                                 |                            |                               | LC                        |
| <i>Oenanthe</i>                                  | Mediterranean       | RCG   | II                              |                            |                               | LC                        |
| <i>Oenanthe</i>                                  | An ordinary         | RCG   | II                              |                            |                               | LC                        |
| <i>Parus major</i>                               | Great tit           | RCG   |                                 |                            |                               | LC                        |
| <i>Passer</i>                                    | House               | RCG   |                                 |                            |                               | LC                        |
| <i>Passer</i>                                    | Polish sparrow      | RCG   |                                 |                            |                               | LC                        |
| <i>Phalacrocorax</i>                             | Great               | RCG   |                                 |                            |                               | NT                        |
| <i>Pica pica</i>                                 | Magpie              |   |                                 | II/2                       |                               |                           |
| <i>Streptopelia</i>                              | Dove                |   |                                 | II/2                       |                               | LC                        |
| <i>Sylvia</i>                                    | Black-headed        | RCG   | II                              |                            |                               | LC                        |
| <i>Sylvia cantillans</i>                         | Red-throated        | RCG   | II                              |                            |                               | LC                        |
| <i>Sylvia</i>                                    | An ordinary         | RCG   | II                              |                            |                               | LC                        |
| <i>Turdus merula</i>                             | An ordinary         | RCG   | II                              | II/2                       |                               | LC                        |

The overall overview of the ornithofauna, established on the basis of the performed survey and on literature data, with the vulnerability status and protection status, is given in Annex 18.4, as well as a complete report on the performed survey of birds in the subject area.

The subject area of the southern Nikšić field and Glava Zeta was anthropogenically modified in the middle of the last century with the aim of exploiting hydrological capacities. Such a large intervention resulted in significant changes in the natural features of the original ecosystem, however, due to the incomplete efficiency of the system, part of the area has retained the original character of wet habitats. The mentioned area has retained a rich bird fauna due to the variety of habitats and favorable geographical location. Significant populations of migratory waterfowl regularly appear on the artificial lakes, while characteristic terrestrial species have adapted to the new conditions and resources. The anthropogenic impacts of the HPP Perućica infrastructure have not changed for decades. Changes in water levels and their ecological effects are still largely the result of natural factors. In these conditions, a certain habituation, i.e. adaptation of the ornithofauna, especially species that have a wider ecological value, has occurred, however, the development of their populations is limited by unstable environmental factors. The described reconstruction of the Slivlje basin, which implies changes aimed at more efficient water management, is therefore not interpreted as a significant negative effect on the ornithofauna.

As for the area near the machine building, the installation of the new aggregate will also not have significant effects on the ornithofauna. At this location, mostly synanthropic species that tolerate the presence of humans were found. The location of the plant itself is not problematic due to the presence of a migratory corridor in the Zeta valley, as it is located in a deep canyon outside the flyover zone.



### 9.3.6 Ichthyofauna

The field tour and survey of the ichthyofauna, in the project affected area, were carried out on June 2nd, 2022 and June 3rd, 2022. The surveyed area covered 200 meters of the upper course of the Zeta River, from the confluence of Zeta and Perućica to the water intake for HPP Perućica.



**Figure 25: Surveyed area (location of Zeta and Perućica confluence)**



**Figure 26: Surveyed area (location of water intake for HPP Perućica)**

In the area of 200 meters, only sea trout (*Salmo faroides*) were registered during the survey, which is very numerous in that section. According to literature data, it is stated that the eel *Anguilla Anguilla* can also be registered in this area, especially around the small dam.

The following table provides an overview of expected species, based on literature data (Marić, 2019), as well as an overview of established species.

**Table 10: List of assumed and determined species**

| No. | Species name (Latin name)                 | Endemism | Endangered (IUCN) | Identified species |
|-----|---|----------|-------------------|--------------------|
| 1.  | <i>Salmo faroides</i> Karaman, S., 1937   |          | Not evaluated     |                    |
| 2.  | <i>Salmo marmoratus</i> Cuvier, 1829      |          | LC                |                    |
| 3.  | <i>Salmo zetensis</i> Hadžišće, 1962      | Yes      | EN                | Yes                |
| 4.  | <i>Anguilla anguilla</i> (Linnaeus, 1758) |          | CR                |                    |

Since this part is inhabited by trout species, which have no tolerance for changes in water quality (pollution), they require clear and clean water rich in oxygen. Considering the planned works in the machine building, which is located at a greater distance from the riverbed, it is considered that the works will not have an impact on the ichthyofauna. A complete report on the ichthyofauna survey is given in Annex.

### 9.3.7 Macroinvertebrates

A significant component of the Zeta River ecosystem makes the biocenosis of animals designated as aquatic macroinvertebrates. These are organisms that, at least in one part of their life cycle, inhabit aquatic ecosystems (bottom, detritus, macrophytes, filamentous algae) and that can be caught with a net size >200 µm (Rosenberg and Resh, 1993). Aquatic macroinvertebrates include several faunistic-ecological groups of organisms of different forms, the most common of which are insects.

The aquatic macroinvertebrate fauna of the Zeta River has not been sufficiently investigated so far, therefore data on their number and distribution in this area/locality are insufficient. The survey was carried out near the machine building, at two points:

- Locality T1 - 42°40'8.49"N, 18°59'47.63"E
- Locality T2 - 42°40'4.33"N, 18°59'48.34"E

During the field tour, on the transect of the Zeta River according to the stated coordinates, the watercourse was found in hydrological and biological natural and preserved condition. The river and its riverbed are clean, partly overgrown with moss, with a richly developed riparian zone.

Aquatic macroinvertebrate fauna of the Zeta River, during May 2022, was collected by dragging a manual plankton net three times by 50 cm, so that with each move a sample was collected from an area of 10 dm<sup>2</sup>. In this way, samples from a large number of different microhabitats were collected, which resulted in a greater diversity of aquatic

macroinvertebrates. One of the objectives of this survey was to determine the composition and structure of the aquatic macroinvertebrate community at the surveyed site.

**Table 11: Qualitative composition of aquatic macroinvertebrates at the survey sites (T1-T2) of the Zeta River (May, 2022)**

| Sampling sites/taxa         | T1 | T2 | EPHEMEROPTERA            | T1 | T2 |
|-----------------------------|----|----|--------------------------|----|----|
| <b>TURBELLARIA</b>          |    |    | <i>Ephemerella sp.</i>   |    | +  |
| <i>Dugesia sp.</i>          | +  | +  | <i>Heptagenia sp.</i>    |    | +  |
| <b>OLIGOCHAETA</b>          |    |    | <b>HEMIPTERA</b>         |    |    |
| Naididae                    |    |    | <i>Aphelocheirus sp.</i> |    | +  |
| <i>Nais sp.</i>             | +  | +  | <b>PLECOPTERA</b>        |    |    |
| <i>Stylaria sp.</i>         |    | +  | <i>Isoperla sp.</i>      | +  | +  |
| Tubificidae                 |    |    | <i>Protonemura sp.</i>   |    | +  |
| <i>Limnodrilus sp.</i>      |    | +  | <b>DIPTERA</b>           |    |    |
| <b>HIRUDINEA</b>            |    |    | <i>Eloeophila sp.</i>    | +  | +  |
| <i>Glossiphonia sp.</i>     |    | +  | <i>Hexatoma sp.</i>      |    | +  |
| <b>MOLLUSCA</b>             |    |    | <i>Antocha sp.</i>       |    | +  |
| <i>Ancylus fluviatilis</i>  | +  | +  | Tipulidae                | +  | +  |
| <i>Teodoxus fluviatilis</i> | +  |    | Tabanidae                |    | +  |
| <i>Radomaniola curta</i>    |    | +  | Culicidae                | +  | +  |
| <i>Bithynia radomani</i>    |    | +  | Chironomidae             |    |    |
| <b>CRUSTACEA</b>            |    |    | <i>Orthocladus sp.</i>   | +  | +  |
| <i>Gammarus balcanicus</i>  |    | +  | Dixidae                  |    |    |
| <i>Asellus aquaticus</i>    | +  | +  | <i>Dixa sp.</i>          | +  | +  |
| Cl. INSEKTA                 |    |    | Ceratopogonidae          |    | +  |
| <b>ODONATA</b>              |    |    | <b>COLEOPTERA</b>        |    |    |
| <i>Cordulegaster sp.</i>    |    | +  | Elmidae                  |    |    |
| <b>TRICHOPTERA</b>          |    |    | <i>Elmis sp.</i>         |    | +  |
| <i>Hydropsyche sp.</i>      | +  | +  | <b>HETEROPTERA</b>       |    |    |
| <i>Limnephilus sp.</i>      |    | +  | Velidae                  |    | +  |
| <i>Leptocerus sp.</i>       |    | +  | Hebrididae               |    | +  |
| <b>EPHEMEROPTERA</b>        |    |    | <b>MEGALOPTERA</b>       |    | +  |

| Sampling sites/taxa | T1 | T2 | EPHEMEROPTERA | T1 | T2 |
|---------------------|----|----|---------------|----|----|
| <i>Baetis sp.</i>   | +  | +  | HIDRACHNIDIA  | +  | +  |

During this survey along the transect, a total of 35 different taxa of aquatic macroinvertebrates were found. Considering the fact that some groups are not determined to the species level (only to the genus level (*Hidrachnidia*, *Heteroptera*, *Ceratopogonidae*) or the determination was made only to the family level (*Diptera*), the actual number of species is higher. Most taxons belong to the group of insects (73%), which is a general characteristic of fast-flowing streams with a sandy-rocky bed.

At locality T1, the order *Amphipoda*, together with the insect orders *Ephemeroptera*, *Plecoptera*, *Trichoptera* and *Diptera*, accounts for more than 60% of the total abundance. According to the number of isolated taxa, the *Mollusca* and *Diptera* groups dominate with 7 identified taxa. The other groups are represented by one taxon each out of a total of 4 isolated in this locality.

At locality T2, the most diverse group is also represented by *Mollusca* and *Diptera* with a total of 12 taxons. However, it is joined by the order *Ephemeroptera*, *Trichoptera* and *Oligochaeta* with 3 each, *Plecoptera* and *Heteroptera* with 2 identified taxons each, while other groups are represented by 1 taxon each. The dominance of the population of the *Mollusca* group at the T2 locality is joined by the group of *Amphipoda* and *Diptera*, and together they make up over 80% of the total number of individuals sampled at that locality.

A detailed report on the macrozoobenthos state of the Zeta River is given in Annex.

#### 9.4 Socioeconomic and cultural environment

According to the last census that was carried out in 2011 in Montenegro, total population size of the country was 620.079. However, the latest population size estimates, for 2020, show that the population size is 621.306. This project is going to be implemented on the territory of Municipality Nikšić and Municipality Danilovgrad. Nikšić is the second biggest city in Montenegro, with population of 72.449 in 2011, whereby the latest population size estimates for 2020 show that Nikšić has the population size of 68.736. Danilovgrad is a relatively smaller municipality, and its population in 2011 was 18.473, while the estimate for 2020 shows that its population size is 18.287.

When it comes to the project location, works are going to be carried out at two locations: the main machine building in Bogetici and retention basin in Slivlje/Ozrinici. The machine building is located on the border between the territories of Municipality Nikšić and Municipality Danilovgrad, while the retention basin is located on the territory of Municipality Nikšić. Map presenting the two locations is provided below.





**Figure 27: Location of the retention basin and machine building**

The machine building belongs to the Cadastral Municipality (CM) Bogetici, while the retention basin belongs to the CM Ozrinici. It is important to emphasise that both objects which are going to be a part of the construction works are located in specific micro locations which are located at a significant distance from any type of residential objects, whereby the specific micro location of the retention basin is otherwise defined as Slivlje – Norin.

The latest available official statistical data for Montenegro dates back to the 2011 Census, which was carried out by the Statistical Office of Montenegro (MONSTAT)<sup>9</sup>. Number of households in CM Bogetici is 22, while there are 592 households in Ozrinici. An overview of the population size and distribution by gender is provided in the table below.

**Table 12: Population in settlements in the project area**

| Settlement | Male | Female | Total |
|------------|------|--------|-------|
| Bogetici   | 43   | 32     | 75    |
| Ozrinici   | 1034 | 1023   | 2057  |

As it has been previously mentioned, the project activities are going to be carried out at micro locations which are not surrounded by any residential objects, whereby the closest residential objects are located at a distance of more than 1km from both micro locations.

<sup>9</sup> <https://www.monstat.org/eng/page.php?id=56&pageid=56>

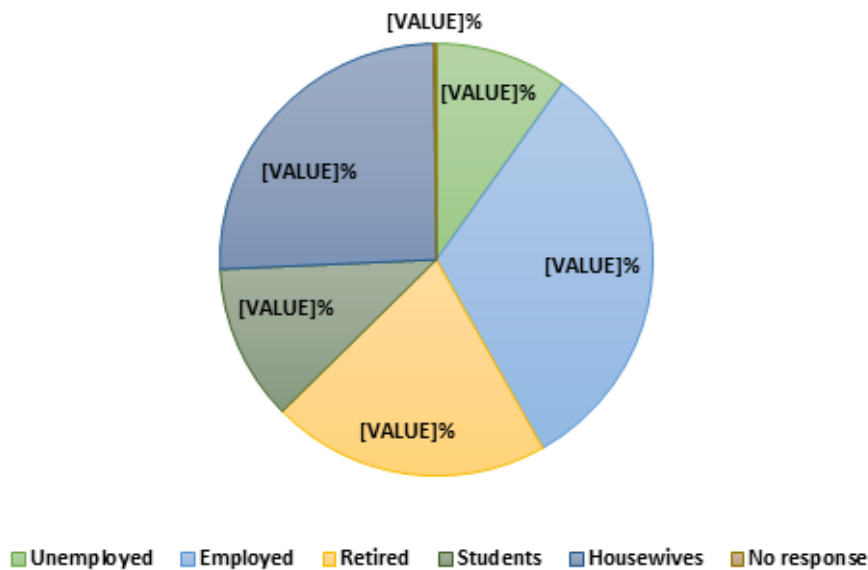


### 9.4.1 Economic activities

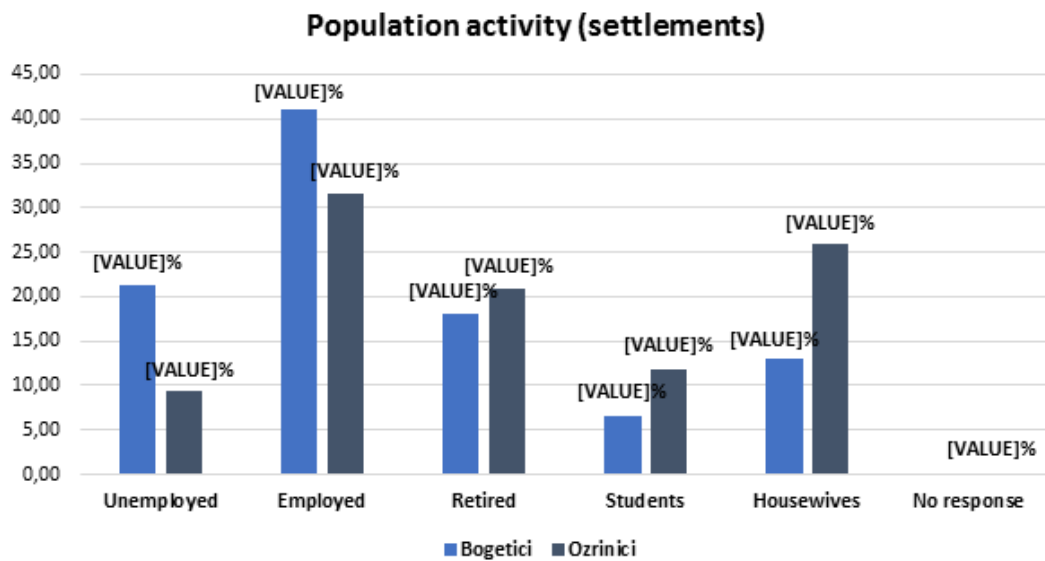
Socio-economic data for the project-specific locations is scarce, especially taking into account the fact that the last census in Montenegro was carried out in 2011. However, data about economic activity of population of Ozrinici and Bogetici is presented below.

Population activity in settlements in the project area is not characterised by a rather high employment rate, since data from the latest 2011 Census shows that 31.96% of the overall population in these two settlements is employed. Group with the second highest share in the overall population structure are housewives, who represent 25.52% of the overall population in the two settlements, which is followed by the retired people (20.79%) and students (11.70%).

**Population activity (total)**



When data about population activity is disaggregated by settlements, it shows that population of Bogetici is characterised by higher share of the employed population than Ozrinici (40.98% compared to 31.62%), but that Bogetici is also characterised by higher share of the unemployed population than Ozrinici (21.31% compared to 9.44%)



## 10. Project Policy Framework and Standards

In Montenegro, the Constitutional Law particularly defines environmental protection. Article 1 of the Constitution, among other things, defines Montenegro as an ecological state. Article 23 of the Constitution of Montenegro defines that “everyone has the right to a healthy environment”.

The framework of the environmental legislation of Montenegro is laid down in the Law on Environment (“Official Gazette of Montenegro”, No. 52/16). The Law regulates principles of environmental protection and sustainable development, instruments and measures for environmental protection and other issues of importance for the environment.

### 10.1 Policy and international conventions and agreements

Major steps have been taken in Montenegro during the last decade towards alignment with the EU environmental legislation, and also toward integration of environmental considerations in other policies.

With regards to policy documents, the Montenegro prepared the main strategic documents for different areas. The List of relevant national policies is presented in the Table given below.

**Table 13: Relevant strategic documents adopted by the Government of the Montenegro**

| <b>Strategic documents adopted by the Government of the Montenegro</b> |  |
|--|--|
| Energy Development Strategy until 2030                                 | Strategy determines long-term development goals and guidelines for the development of energy supply and satisfaction while respecting technological and economic criteria, in accordance with environmental protection conditions; directions of energy infrastructure development and measures to encourage the use of renewable energy sources and increasing energy efficiency  |
| Energy policy of Montenegro until 2030                                 | Main priorities of the Montenegrin Energy Policy are security in the energy supply, development of the competitive energy market and sustainable energy development. Some of the key strategic commitments of the Montenegrin Energy Policy are maintenance, rehabilitation and modernization of existing and construction of new infrastructure for production, transmission and distribution of energy on the principles of fulfilment of international technical standards, energy efficiency, reduction of losses and its negative impact on environment, energy efficiency and renewable sources of energy. |
| National Renewable Energy Action Plan to 2020                          | The NREAP to 2020 defines dynamic of utilization of natural resources, as well as the planned use of technologies required to meet the national target for the share of energy produced from renewable sources in the gross final energy consumption. The Directive 2009/28/EC envisages preparation of the National Renewable Energy Action Plan pursuant to the adopted template.  |
| Water Management Strategy for the period 2016-2035                     | The Strategy emphasizes the importance of risk assessment as part of the management of flood risks and flood control measures and the need to include climate change and its impacts on water flows. It includes various goals to regular maintenance and control of watercourses, drainage, efficient and continuous monitoring and forecasting of floods, anti-erosion protection and soil conservation.   |

Montenegro has ratified a number of international treaties and conventions along with the ongoing process of transposing EU law into the National legal and policy framework. Further details regarding the relevant Conventions are outlined below.

Aarhus convention is part of the national legal system from 2009. Access to justice in respect of environmental matters is governed by several pieces of legislation, which fully transposed relevant provisions of the EU legislation governing public access to environmental information and public participation in making decisions on environmental matters, while these are also aligned with Aarhus Convention.

The Global Climate Change Initiative was launched in 1992 with adoption United Nations Framework Convention on Climate Change (UNFCCC). The implementation of the UNFCCC general objective is further defined by the Kyoto Protocol, which entered into force in February 2005. The Kyoto Protocol represents a step in the direction of reversing the global

trend of rising GHG emissions. The Protocol set legally binding quantified targets for developed, industrialized countries to reduce their GHG emissions on average by 5% by 2012 (in relation to 1990).

Both the UNFCCC and the Kyoto Protocol are based on the principle of common but differentiated responsibilities of developed and developing countries (grouped in different Annexes of the Convention/ Protocol) for the previous increase in GHG concentrations in the atmosphere and global warming as well as for future action towards resolving the problem of climate change.

Montenegro has ratified the Espoo Convention on Environmental Impact Assessment and its two amendments and the SEA Protocol to the Espoo Convention (the Protocol on the Strategic Environmental Assessment to the Convention on the Environmental Impact Assessment) (OGM, 02/09).

Convention for the Protection of Human Rights and Fundamental Freedoms was ratified by Montenegro in 2003, whereby the main aim of this convention is to ensure implementation of objective standards and achievement of rights of individuals to seek protection from misuse of authorities.

The European Social Charter guarantees achievement of fundamental social and economic rights, without any discrimination. Rights guaranteed by the Charter are: the right to work, the right to social and medical assistance, the right to the social, legal and economic protection of the family, while the right to protection and assistance for migrant workers and their families are especially important.

## 10.2 International/KfW Environmental and Social Standards and Guidelines

Taking into account the fact that this project is being implemented in accordance with KfW requirements and KfW Sustainability Guideline Assessment and management of Environmental, Social, and Climate Aspects: Principles and Procedures (2021), this aspect of the international regulatory framework is going to be taken into account and complied with throughout implementation of the project. However, the guiding principles are still going to be defined in light of Montenegrin regulatory and legislative framework, whereby the principal legislative, regulatory and strategic national framework is provided in the section below.

The ESIA Study will be conducted also in alignment with the following International Requirements and Guidelines:

- EU Acquis on environmental and social issues;
- Sustainability Guideline Assessment and management of Environmental, Social, and Climate Aspects: Principles and Procedures 2021;
- IFC Performance Standards for cooperation with the private sector and their General and sector-specific Environmental, Health and Safety (EHS) Guidelines as well as the Core Labour Standards of the International Labour Organization (ILO);
- Guidelines on Incorporating Human Rights Standards and Principles, Including Gender, in Programme Proposals for Bilateral German Technical and Financial Cooperation;
- The Fundamental Conventions of the International Labour Organization (ILO) as well as IFC Performance Standard 2 on Labour and Working Conditions;

- World Bank Operational Policies: OP/BP 4.01, Environmental Assessment; OP/BP 4.02, Environmental Action Plans; OP/BP 4.04, Natural Habitats; OP 4.07, Water Resource Management; OP/BP 4.36, Forests;
- World Bank Environmental and Social Framework (ESF), which applies to all new World Bank investment project financing, and the Environmental and Social Standards (ESS);
- UN Basic Principles and Guidelines on Development-based Evictions and Displacement (namely 42, 49, 52, 54 and 60) and guidance provided within the IFC Handbook for Preparing a Resettlement Action Plan (2002) and World Bank Involuntary Resettlement Sourcebook (2004).

## **11. Description of the legislative and regulatory framework and requirements, including a gap analysis with international standards**

The chapters below provide a detailed description of all the applicable national and international legislative and regulatory requirements, as well as the identified gaps.

### **11.1 National Environmental and Social Legislation**

The framework of the legislation in the field of the environment of Montenegro is set out in the "Law on the Environment of Montenegro" (Official Gazette of Montenegro, No. 12/96 and 52/16). This law declares that Montenegro is envisaged as an ecological state and that the authorities should work to upgrade the quality of the human environment, reduce all factors that negatively affect the life and health of people and prevent harmful effects on humans. The law also prescribes the principles of polluters and payment users.

Also, "Law on Environmental Impact Assessment of Montenegro", (Official Gazette of Montenegro, No. 80/05, 40/10, 73/10, 40/11, 27/13, 52/16 and 75/18), defines activities that are the subject of the Environmental Impact Assessment (EIA), Preliminary assessment procedures, public participation in decision-making, procedures for assessment and verification of the and the Environmental Impact Assessment criteria for evaluation reports. The law is fully in line with the EU directives regulating this area. In addition, the following legislation in the field of the environment are also relevant:

- Law on the Strategic Environmental Impact Assessment (SEA) (Official Gazette of the Republic of Montenegro, No. 80/05 and Official Gazette of Montenegro, No. 40/11, 59/11, 52/16);
- Law on the Environmental Impact Assessment (EIA) (Official Gazette of Montenegro, No. 75/18);
- Law on Nature Protection (Official Gazette of Montenegro, No. 54/16);
- Law on Waste Management (Official Gazette of Montenegro No. 80/05, 80/05, 64/11, 39/16), with accompanying regulations;
- Law on Air Protection (Official Gazette of Montenegro, No. 25/10, 40/11, 43/15);



- Law on Spatial Planning and Construction of Buildings (Official Gazette No. 064/17, 44/18 and 63/18);
- Law on Liability for Environmental Damage (Official Gazette of Montenegro, No. 27/14);
- Law on Integrated Pollution Prevention and Control – IPPC (Official Gazette of Montenegro, No. 80/05, 54/09, 42/15, 54/16);
- Ordinance on Allowed Quantities of Hazardous and Noxious Substances and Methods for their Examination (Land Quality) Ordinance (Official Gazette of Montenegro No. 18/97).

Water quality is governed by an extensive legal framework, while the key legislation is the Law on Waters (Official Gazette of Montenegro No. 084/18). The Law regulates the legal status and integrated water, coastal land and water facilities management, conditions and methods of water activity and other significant issues of management and water resources (regulates status and the ways for managing all types of water, water resources, as well as other matters of relevance for water resources management). Water management duties are under this Law assigned to a separate state administration body within the MARD – Water Administration. Also, water management is regulated in several regulations and they regulate different aspects of water treatment:

- Regulations on the Content of the Programs for the Construction of Collector Systems and Plants for the Treatment of Municipal Wastewater (Official Gazette of Montenegro No. 31/18);
- Regulation on the classification and categorization of surface and groundwater (Official Gazette of Montenegro, No. 2/07);
- Regulation on the method for determining the boundaries of water lands (Official Gazette of Montenegro, No. 25/12);
- Regulation on the method of categorization and categories of water facilities and their management and maintenance (Official Gazette of Montenegro, No. 15/08);
- Regulation on the manner and deadlines for determining the status of surface waters (Official Gazette of Montenegro, No. 25/19);
- Regulation on the manner and deadlines for determining the status of ground waters (Official Gazette of Montenegro, No. 52/19);
- Regulation on the manner and deadlines for implementing measures to ensure the conservation, protection and improvement of bathing water quality (Official Gazette of Montenegro, No. 28/19);
- Regulation on the manner and conditions for measuring the quantity of wastewater discharged into the receiver (Official Gazette of Montenegro, No. 24/10).

When it comes to the national social legislation, it is important to note the aspects of human rights and freedoms. The Law on Protector of Human Rights and Freedoms of Montenegro (Official Gazette of Montenegro, No. 42/2011 and 32/2014) defines competence, authorities, method of operation and activities which shall be taken by the Protector of Human Rights and Freedoms of Montenegro in terms of protection of human rights and freedoms which are guaranteed by the Constitution, laws, certified international contracts on human rights and generally accepted international law rules, as well as all other matters of relevance.

## 11.2 National and International Labour and OHS legislation

The main legislation that covers labour and working conditions issues is the Law on Safety and Health at Work (Official Gazette of Montenegro, No. 34/14, 44/18). Supervision of implementation of the Law on Safety and Health at Work (Official Gazette of Montenegro, No. 34/14, 44/18) and other applicable regulations is conducted by the Labour inspection, through the Labour inspectors for occupational safety and health at work, if the law does not establish that the supervision of such regulations in specific activities is performed by other authorities.

*EU directives in the field of occupational health and safety:*

- Directive 99/92/EC - risks from explosive atmospheres
- Directive 92/58/EEC - safety and/or health signs
- Directive 89/656/EEC - use of personal protective equipment
- Directive 89/655/EEC - use of work equipment
- Directive 89/654/EEC - requirements at construction sites
- Directive 2006/95/EC - electrical equipment
- Directive 2006/42/EC - new machinery directive
- Directive 2001/95/EC - Product safety
- Directive 94/9/EC - Protective systems - potentially explosive atmospheres
- Directive 90/396/EEC - Appliances burning gaseous fuels
- Directive 89/686/EEC - personal protective equipment
- Directive 89/106/EEC - construction products
- Directive 87/404/EEC - simple pressure vessels
- Directive 85/374/EEC - liability for defective products
- Directive 84/527/EEC - welded unalloyed steel gas cylinders
- Directive 84/526/EEC - aluminium alloy gas cylinders
- Directive 84/525/EEC - seamless, steel gas cylinders
- Directive 2006/15/EC - indicative occupational exposure limit values
- Directive 2004/37/EC - carcinogenic or mutagenic substances at work
- Directive 2000/39/EC - indicative occupational exposure limit values
- Directive 2006/25/EC - artificial optical radiation
- Directive 2004/40/EC - electromagnetic fields and waves
- Directive 2003/10/EC - noise
- Directive 2002/44/EC – vibration
- Directive 96/29/EEC - ionizing radiation
- Directive 2000/54/EC - biological agents at work
- Directive 90/269/EEC - manual handling of loads
- Directive 2003/88/EC - Working time

- Directive 92/85/EEC - pregnant workers
- Directive 92/57/EEC - temporary or mobile construction sites

*By-laws in the field of occupational health and safety in accordance with national legislation:*

- Rulebook on the Plan of Measures for Occupational Safety and Health (Official Gazette of Montenegro, No. 38/19);
- Rulebook on the manner and procedure of workplace risk assessment (Official Gazette of Montenegro No. 43/07);
- Rulebook on the manner and procedure of training employees for safe work (Official Gazette of Montenegro No. 57/06);
- Rulebook on the procedure and deadlines for carrying out periodical inspections and control of the means for work, means an equipment for personal safety at work, and work conditions (Official Gazette of the Republic of Montenegro No. 71/05)
- Rulebook on keeping records from the area of safety at work (Official Gazette 67/05);
- Rulebook on Personal Protective Equipment (Official Gazette of Montenegro, No. 17/15);
- Rulebook on general safety at work measures from electrical hazards in structures intended for work, in working premises and in work site (Official Gazette of the Republic of Montenegro 6/86 and 16/86);
- Rulebook on the Content of the Study on Preparatory construction (Official Gazette of Montenegro 80/08);
- Rulebook on special safety at work measures for constructions intended for work and auxiliary premises (Official Gazette of the Socialist Republic of Montenegro 27/87);
- Rulebook on occupational safety measures on temporary or mobile construction sites (Official Gazette of Montenegro 20/19);
- Rulebook on occupational safety at loading and unloading of cargo (Official Gazette SRCG 13/08);
- Rulebook on the manner of keeping and contents of the construction diary and the construction book (Official Gazette of Montenegro 68/18);
- Rulebook on the form of a board with information on the issued building permit (Official Gazette of Montenegro, No. 68/08);
- Rulebook on Workplace Safety Measures (Official Gazette of Montenegro, No. 040/15);
- Rulebook on transportable pressure equipment (Official Gazette of Montenegro 001/16);
- Rulebook on the content and manner of keeping records of explosive substances (Official Gazette of Montenegro, No. 026/15 of May 26, 2015);
- Rulebook on Technical Requirements and Procedures for Conformity Assessment, Signs and Manner of Marking of Explosives (Official Gazette of Montenegro 045/15, 068/15);

- Rulebook on the use of means and equipment for personal protection at work (Off. Gazette of Montenegro, no. 040/15);
- Rulebook on Signs for Occupational Health and Safety (Official Gazette of Montenegro, No. 024/15);
- Rulebook on the Content of Measures for Specific Employee Health Care (Official Gazette of the Republic of Montenegro, No. 044/06);
- Decision on the adopted Montenegrin standards in the field of safety, protection and environment (personal protective equipment) (Official Gazette of Montenegro, No. 043/08);
- Decision on the adopted Montenegrin standards in the field of personal protection of equipment (Official Gazette of Montenegro, No. 038/08);
- Rulebook on security measures for the manual handling of loads (Official Gazette of Montenegro, No. 29/15);
- Rulebook on safety measures when using work equipment (Official Gazette of Montenegro, no. 27/15);
- Rulebook on Occupational Health and Safety Measures against Chemical Exposure Risks (Official Gazette of Montenegro 81/16)
- Rulebook on Occupational Health and Safety Measures against Noise Exposure Risks (Official Gazette of Montenegro 37/16);
- Rulebook on Occupational Health and Safety Measures against Vibration Exposure Risks (Official Gazette of Montenegro 24/16);
- Rulebook on Occupational Health and Safety Measures against Carcinogens and Mutagens Exposure Risks (Official Gazette of Montenegro 60/16);
- Rulebook on measures and norms concerning safety at work with work tools (Official Gazette of the Socialist Federal Republic of Yugoslavia 18/91);
- Rulebook on safety at work during loading and unloading (Official Gazette of the Socialist Republic of Montenegro 13/88);
- Rulebook on provisioning means, meals, and transportation of workers from the place of accommodation to the place of work and back (Official Gazette of the Socialist Republic of Montenegro 5/86);
- Rulebook on the manner and procedure of carrying out initial and periodical specialist medical examinations of workers (Official Gazette of the Socialist Republic of Montenegro 25/80);
- Rulebook on equipment and procedure for the provision of first aid and on organisation of industrial accident aid service (Official Gazette of the Socialist Federal Republic of Yugoslavia 21/71);
- Rulebook on Signs for Occupational Safety and Health (Official Gazette of Montenegro 24/15);
- on safety at work measures and norms concerning noise at working premises (Official Gazette of the Socialist Federal Republic of Yugoslavia 21/92);
- Rulebook on special safety at work measures and on technical measures for acetylene generators and acetylene stations (Official Gazette of the Socialist Federal Republic of Yugoslavia 6/67, 29/67, 27/69 and 52/90);

- Rulebook on equipment and procedure for the provision of first aid and on organisation of industrial accident aid service (Official Gazette of the Socialist Federal Republic of Yugoslavia 21/71).

### 11.3 EIA and ESIA process and procedures

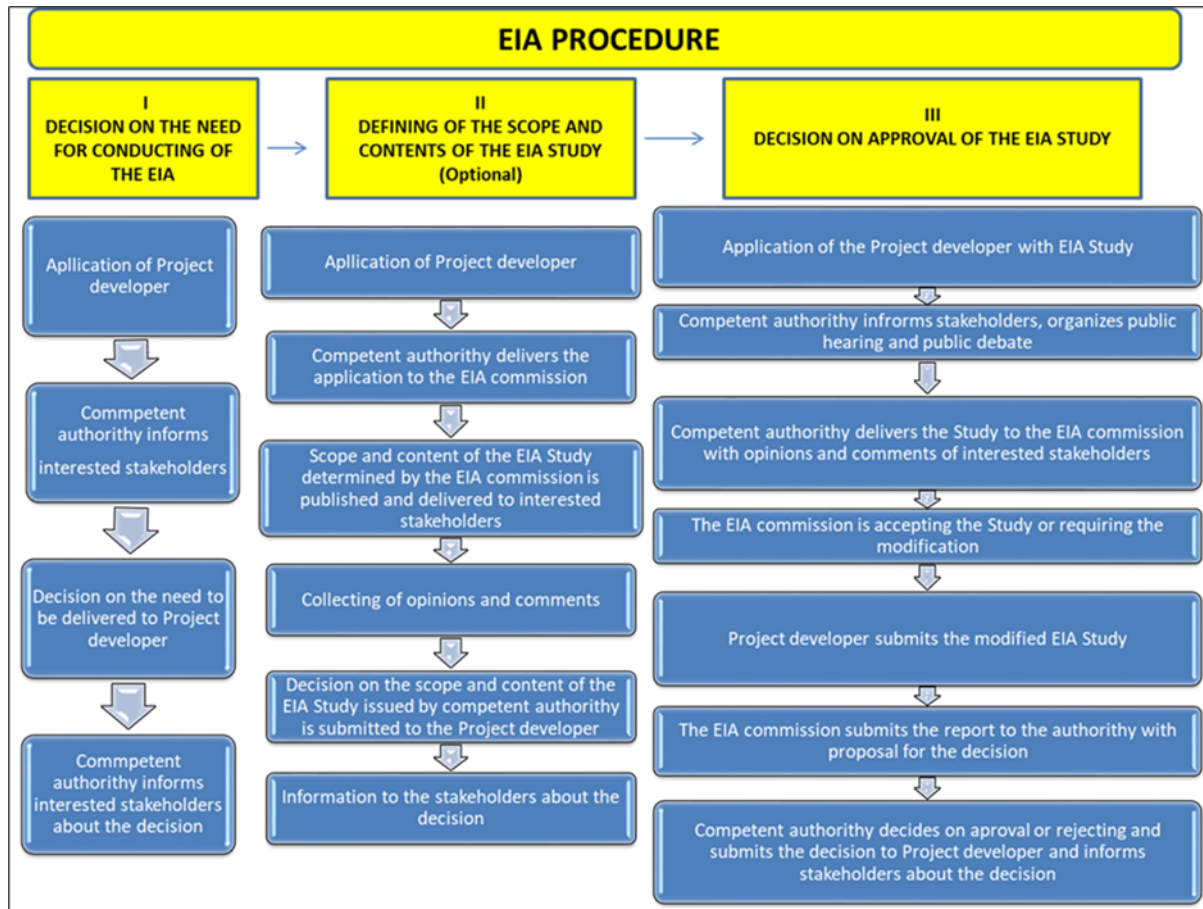
An Environmental Impact Assessment (EIA) for certain projects is required to be carried out in Montenegro in accordance with the Montenegrin Law on EIA and associated secondary legislation. This Law and the associated secondary legislation set out the requirements for undertaking environmental assessments of potential environmental impacts of public and private projects which are likely to have a significant impact on the environment before development consent / construction permit is granted in the form of an approval for project implementation. Hence, it is required that before development consent is granted for certain types of projects, an EIA has to be carried out. The EIA process is meant to anticipate potential environmental harm and to avoid or mitigate such harm while balancing environmental, social and economic objectives. The whole EIA process includes three specific procedures. They are the following:

1. Screening as the stage of determining whether an EIA is required;
2. Scoping as the stage of determining the scope or extent of the environmental impact assessment;
3. Review as the stage of reviewing the EIA study to see if it has been undertaken to an acceptable standard and in accordance with the legal requirements.

According to Montenegrin Legislation, the EIA Procedure is shown schematically as a flowchart in Figure 3.1 below. This procedure is in full compliance with the EU EIA Directive (2011/92/EU) and the general implementation in the world. The NEPA is the competent authority for the EIA process for projects where project development consent (e.g. construction permit) is issued by a state (national) authority. The local self-government unit responsible for environmental protection is, the competent authority for other projects for which approvals, permits and licenses are issued by local authorities.

The types of projects that require an EIA are determined by the “Decree on determining projects for which an environmental impact assessment shall be carried out” - EIA Decree (Official Gazette of Montenegro, No. 20/07 and 47/13, 037/18). Under the EIA Decree, projects are classified in two groups (lists): projects listed in List 1 are all subject to compulsory EIA while for projects in List 2 the assessment contains an element of discretion, noting that an EIA procedure will, in any event, be required for projects with potentially significant environmental impacts. The public and other parties are to be consulted in all stages of the EIA procedure.





**Figure 28: EIA Procedure in Montenegro**

The benchmark for the Environmental and Social Impact Assessment (ESIA) will be the KfW Development Bank. KfW Bank Policy and IFC (International Finance Corporation) standards on environmental and social protection measures are the backbone of its support to sustainable poverty reduction. The aim of these protective measures is to prevent and mitigate undue damage to people and their environment. These measures provide guidelines to the Bank and the loan beneficiary in the identification, preparation and implementation of programs and projects.

These policies include the following:

- Environmental Assessment (OP 4.01)
- Natural Habitats (OP 4.04)
- Indigenous Peoples (OP 4.10)
- Physical Cultural Resources (OP 4.11)
- Involuntary Resettlement (OP 4.12)
- Forests (OP 4.36)
- Safety of Dams (OP 4.37)

#### OP 4.01 Environmental Assessment (EA)

The Bank requires Environmental Assessment (EA) for projects proposed for obtaining the Bank support, in order to ensure that they do not have, or mitigate potential negative environmental impacts. The EA is a process in which breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. The EA evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. The EA takes into account the natural environment (air, water and land); human health and safety; social aspects; and trans-boundary and global environmental aspects. The main result of the assessment is an environmental and social management plan that defines measures to be adopted by the project partner or the financed enterprise to protect the environment and human health in order to prevent undesirable impacts, to reduce them to an acceptable level, or to offset them.

The OP 4.01 Environmental Assessment consists of the following basic elements:

- Screening
- Environmental assessment (EA) documentation
- Public consultation
- Disclosure
- Review and approval of EA documentation
- Conditionality in loan agreements
- Arrangements for supervision, monitoring, and reporting

The Bank classifies the proposed projects into three major categories, depending on the type, location, sensitivity, scale of the project and the nature and magnitude of its potential environmental impacts.

- Category A: The proposed project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area which is broader than the sites or facilities subject to physical works. For category A projects, it is mandatory to analyse and appraise any negative ecological and social consequences as part of an independent environmental and social impact study (ESIS) and to draw up an environmental and social management plan (ESMP);
- Category B: Potential adverse environmental impacts of the proposed project on human population or environmentally important areas - including wetlands, forests, grasslands, or other natural habitats - are less adverse than the Category A projects. These impacts are site specific; few if any of them are irreversible; and in most cases migratory measures can be designed more readily than Category A projects. For category B projects, the need for and the scope, priorities and depth of an ESIS have to be determined on a case-by-case basis;
- Category C: The proposed project is likely to have minimal or no adverse environmental impacts. Category C projects usually do not require any additional analysis within the meaning of this Guideline or any further ESIA procedures. However, category C projects should be monitored for any relevant changes over their life cycle.

The categorisation into A, B and C projects follows the international standards of the IFC (International Finance Corporation)/World Bank and is subject to an internal verification by a non-market unit. The categorisation determines the scope and depth of the project assessment.

Depending on the project, a range of instruments can be used to meet the KfW Bank's EA requirement: environmental and social impact assessment (ESIA), regional or sectoral EA, environmental audit, hazard or risk assessment, and environmental and social management plan (ESMP). EA applies one or more of these instruments, or elements of them, as appropriate. When the project is likely to have sectoral or regional impacts, sectoral or regional EA is required. For the purposes of this Project, an ESIA shall be prepared.

The OP/BP 4.01 Environmental Assessment includes the following three annexes:

- Annex A: Definitions
- Annex B: Content of an Environmental Assessment Report for a Category A project
  - Executive summary
  - Policy, legal, and administrative framework
  - Project description.
  - Baseline data
  - Environmental impacts
  - Analysis of alternatives
  - Environmental management plan (EMP). Covers mitigation measures, monitoring, and institutional strengthening (as outlined in OP 4.01, Annex C)
  - Appendices (list of EA report preparers—individuals and organizations, references, record of interagency and consultation meetings, tables/figure presenting the relevant data referred to or summarized in the main text, list of associated reports (e.g., resettlement plan or indigenous people's development plan))
- Annex C: Environmental Management Plan
  - Mitigation
  - Monitoring
  - Institutional measures
  - Implementation Schedule and Cost Estimates

## 11.4 EU Directives

Horizontal environmental legislation of the EU was transposed into the legal system of Montenegro in 2005. At the time when the Strategy was prepared, the major share of the EU horizontal legislation transposed, included six laws and implementing acts. These pieces of legislation are as follows:

- Directive 2001/42/EC (SEA);

Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (SEA), has been fully implemented through the Law on Strategic

Environmental Assessment since 2008 at both national and local levels. Strategic environmental assessment is carried out for all plans and programmes where their implementation may have impacts on the environment. As of 2009, Montenegro is a party of the SEA Protocol.

- Directive 2011/92/EU (EIA), which codified Directive 85/337/EEC and its amendments by Directive 97/11/EC, Directive 2003/35/EC and Directive 2009/31/EC and as amended by 2014/52/EU (EIA);

Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment is fully implemented through the Law on Environmental Impact Assessment (EIA) and its accompanying implementing acts. Impact assessment is carried out for all new projects and for their amendments. Since 2008, the Law has been implemented at both national and local levels. Two lists of projects have been compiled – List I for which EIA is mandatory and List II for which EIA may be required. Moreover, cross-border procedure is also carried out in order to inform the other states if implementation of a project may have a significant environmental impact. Montenegro is a Party of the Espoo Convention, since 2009.

- Directive 2003/4/EC (access to environmental information);

Directive 2003/4/EC on public access to environmental information and repealing Council Directive 90/313/EEC is implemented through the Law on Environment and Free Access to Information at a national and local level.

- Directive 2003/35/EC (public participation and access to justice in EIA procedures and procedures for the issuance of IPPC permits);

Directive 2003/35/EC facilitates public participation in respect of the drawing up of certain plans and programmes relating to the environment. Regarding public participation and access to justice, Council Directives 85/337 and 96/61 have been fully transposed through the Law on Strategic Environmental Assessment and Law on Environmental Impact Assessment.

- Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (“the Habitats Directive”) and Directive 2009/147/EC on the conservation of wild birds (“the Birds Directive”).

The two principal EU Directives relating to nature conservation are the Habitats Directive and the Birds Directive. The Habitats Directive promoted a network of Special Areas of Conservation to protect the 220 habitats and approximately 1000 species listed in Annex I and II of the Directive. These are considered to be of European interest. Together with Special Protection Areas which are designated under the Birds Directive, these form a network of protected sites across the European Union called Natura 2000.

The main EU legal acts regulating water management are:

- Water Framework Directive 2000/60/EC;
- Council Directive 91/271/EEC on urban waste water treatment;
- EU Directive 2008/105/EC on environmental quality standards in the field of water policy;
- Directive 2006/11/EC of the European Parliament and the Council on pollution caused by certain hazardous substances discharged into the aquatic environment;
- Directive 2006/118/EC of the European Parliament and the Council on groundwater protection against pollution and quality impairment;

- Waste Framework Directive 2006/12/EC amended with EU Directive 2008/98/EC on waste management;
- Water Framework Directive.

The main EU legal act regulating the water area is the Water Framework Directive 2000/60/EC (WFD). The WFD establishes main objectives and guidelines of the water management policy that establish integrated water management in the EU, and emphasizes the need for further integration of water protection and sustainable management, and other policies in the fields of energy, transport, agriculture, fisheries, regional policy and tourism, too. The directive particularly promotes cooperation and joint action at Union and local level as well as the level of information, consultation and public involvement, including the users, too.

- Urban Waste Water Directive 91/271

Main directive objective is to protect the aquatic environment from negative impacts of urban waste water.

- Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment 2006/11

Directive relates to the Member States obligation to undertake activities to eliminate hazardous substances listed in the Directive 7 as well as to reduce the pollution of waters with hazardous substances in accordance with the Directive provisions.

The main EU legal acts related to social issues are:

- Directive 89/654/EEC - workplace requirements, concerning the minimum safety and health requirements for the workplace (first individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC);
- Directive 2003/10/EC on minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise);
- Directive 1989/391/EEC on the introduction of measures to encourage improvements in the safety and health of workers at work.

## 11.5 Gaps between the International ESIA Requirements and Montenegrin EIA Procedure

The Montenegrin requirements for the EIA procedure are quite similar to the requirements of the KfW, but there are some differences which are presented in the below Table.

**Table 14: Gaps between the International ESIA Requirements and Montenegrin EIA Procedure**

| <b>Subject</b>   | <b>Montenegrin requirements</b>  | <b>International Requirements</b>  |
|------------------|--|--|
| <b>Screening</b> | <i>Categorization and screening are based on the EIA decree with the List 1 of installations and facilities requiring an EIA and List 2 of activities for which the Ministry or local authority determine whether an</i> | <i>Screening is based on the type, location, sensitivity, and scale of the proposed project, identifying key issues including any resettlement and cultural property concerns.</i> |



| Subject  | Montenegrin requirements   | International Requirements  |
|--|--|---|
|  | EIA is necessary.  |   |
| <b>Categorization and EA documentation content</b> | <p><u>Category 1. (Significant impact)</u><br/>Installations and facilities to be assessed for their impact on the environment requiring full EIA (List 1). The study must also incorporate the comments and suggestions of governmental and non-governmental organizations as well as the results of the public consultations.</p> <p><u>Category 2. (Moderate impact)</u><br/>Ministry (or local authority) screens the project and decides whether an EIA is required (List 2). The law defines facilities/installations which undergo screening and criteria for screening, such as size, cumulative impact, use of natural resources, sensitivity, etc.</p> <p><u>Category 3. (Low impact or no impact)</u><br/>All facilities and installations below the threshold levels regulated in the EIA decree.<br/>The EIA procedure is not required.</p> | <p><u>Category A:</u><br/>Projects likely to have significant adverse environmental impacts that are sensitive (irreversible).<br/>Full Environmental Assessment is required, usually an ESIA. The Environmental and Social Management Plan (ESMP) is an integral part of the ESIA.</p> <p><u>Category B:</u><br/>Projects with environmental impacts less adverse than those of category A. These impacts are site-specific and, in most cases, mitigation measures can be designed more readily than for category A projects. Scope of Environmental Assessment (EA) is usually narrower than in Category A projects. Usually, only an ESMP is required.</p> <p><u>Category C:</u><br/>Projects with minimum or no adverse impact.<br/>No EA is required</p>  |
| <b>Public consultation and disclosure</b>          | <p>Public consultations are the responsibility of the competent institutions.</p> <p>Projects from list 1:<br/>Public disclosure and public consultation will be held after EIA is submitted to the competent authority.</p> <p>Projects from list 2:<br/>Projects from list 2 are made publicly available after the documentation regarding the decision on EIA procedure is made available. Depending on the screening results (if decision is taken that an EIA is required), projects from the List 2 undergo public disclosure and public consultation, just like the projects from the List 1.</p> <p>For Projects for which an EIA is required, EIA should be disclosed 15</p>  | <p>The borrower is required to consult project affected groups and local NGOs about the project's environmental and social impacts and take their views into account.</p> <p>For Category A projects:<br/>It is necessary to hold public consultations at least twice: (1) shortly after the screening and before the terms of reference are finalized; and (2) once a draft EA study is prepared.</p> <p>Information on the proposed objectives, project description and potential impacts are provided for the initial public consultations. After finalizing the draft of the Environmental Assessment report, it is necessary to disclose the document, in the local language. In addition, for Category A projects, the borrower makes the EA Report draft publicly available for project-affected people.</p> |

| Subject                               | Montenegrin requirements   | International Requirements   |
|---------------------------------------|--|--|
|                                       | <p><i>calendar days prior to the public consultation. The public discussion shall be organized and chaired by the Competent Authority.</i></p>   | <p><i>For Category B projects:</i></p> <p><i>It is necessary to hold public consultations at least once during the EIA procedure.</i></p> <p><i>Reports are to be made available to the NGOs and project-affected people. The disclosure process is complete only after the EA report is officially received by the KfW.</i></p> |
| <p><b>EIA review and approval</b></p> | <p><i>The Competent Authority shall decide on granting the approval or rejecting the application for approval of the EIA Study, based on the report and proposals of the EIA Commission. The Competent Authority is obliged to inform the organizations and public concerned about its decision.</i></p>   | <p><i>Before formal clearance of environmental and social aspects of the project, the KfW reviews the results of the EA (especially consultations, ESMP and institutional capacities), ensuring that the EA is consistent with the ToR.</i></p>  |
| <p><b>Mitigation monitoring</b></p>   | <p><i>For projects requiring an EIA, mitigation measures and monitoring are described in the EIA study, which are also included in the Environmental Permit.</i></p> <p><i>For other categories for which an Environmental Permit is issued, measures for protection of air, water, soil, flora and fauna, waste management etc., and monitoring, are included in the permit itself.</i></p> | <p><i>Mitigation measures are included in the ESMP. Obligation to carry out the ESMP and additional measures contained in the ESMP needs to be included in the tender documentation/contract.</i></p>  |

When comparing the international safeguard requirements with the EIA legislation of Montenegro, the most important difference, which is significant for the Project, is related to the public consultation. According to the international guidelines, projects in the category “A” will require two public consultations, while they only require one according to the legislation of Montenegro. Following the international requirements, the NEPA as a borrower consults project-affected groups and local NGOs in the form and language that are understandable and accessible to the group being consulted at least twice: (i) shortly after the environmental screening; and (ii) once the draft of the EA report is prepared. The public consultation also should be provided during Project implementation (construction and operation).

## 12. ESIA Approach and Assessment Methodology

This ESIA was prepared in accordance with KfW Sustainability Guideline Assessment and Management of Environmental, Social and Climate Aspects: Principles and Procedures (2021), as well as with all the pertaining environmental and social standards stipulated by the World Bank Group (IFC standards), the International Labour Organisation (ILO), as well as the relevant national legislative, strategic and regulatory framework.

Assessment methodology was based on a diligent approach to establishing the baseline and assessing impacts related to each of the eight IFC performance standards. Thus, the initial activity included preparation of the project Scoping Report, which included initial identification, analysis and assessment of all environmental and social project impacts. Data and information for the Scoping Report were obtained from secondary sources of baseline data, i.e. the officially and publicly available environmental and social data and studies related to the project area. In accordance with findings from the scoping phase, additional studies were required in order to obtain all the relevant data and information. Thus, additional noise and biodiversity surveys were carried out for the purpose of preparation of ESIA, whereby the supplemental data and information that were obtained were used for preparation of this ESIA.

## 12.1 Area of influence

Potential area of influence (Aoi) of the Project includes the geographical area that potential impacts of the Project could extend. The area of influence may be different for different types of impacts and different environmental components (physical, biological, social) (World Bank ESMAP, December 2012). The Aoi is defined for physical, biological environment, and socioeconomic environment that has been covered as the study area in this ESIA.

In this regard, the Aoi for physical and biological environment includes the Project footprint 1) retention basin (PA 1) and 2) machine building (PA 2).

In terms of the socioeconomic environment, the Aoi includes the close-by settlements, mainly Ozrinici. The close vicinity of the Project area and the Aoi can be seen in Figure 29.



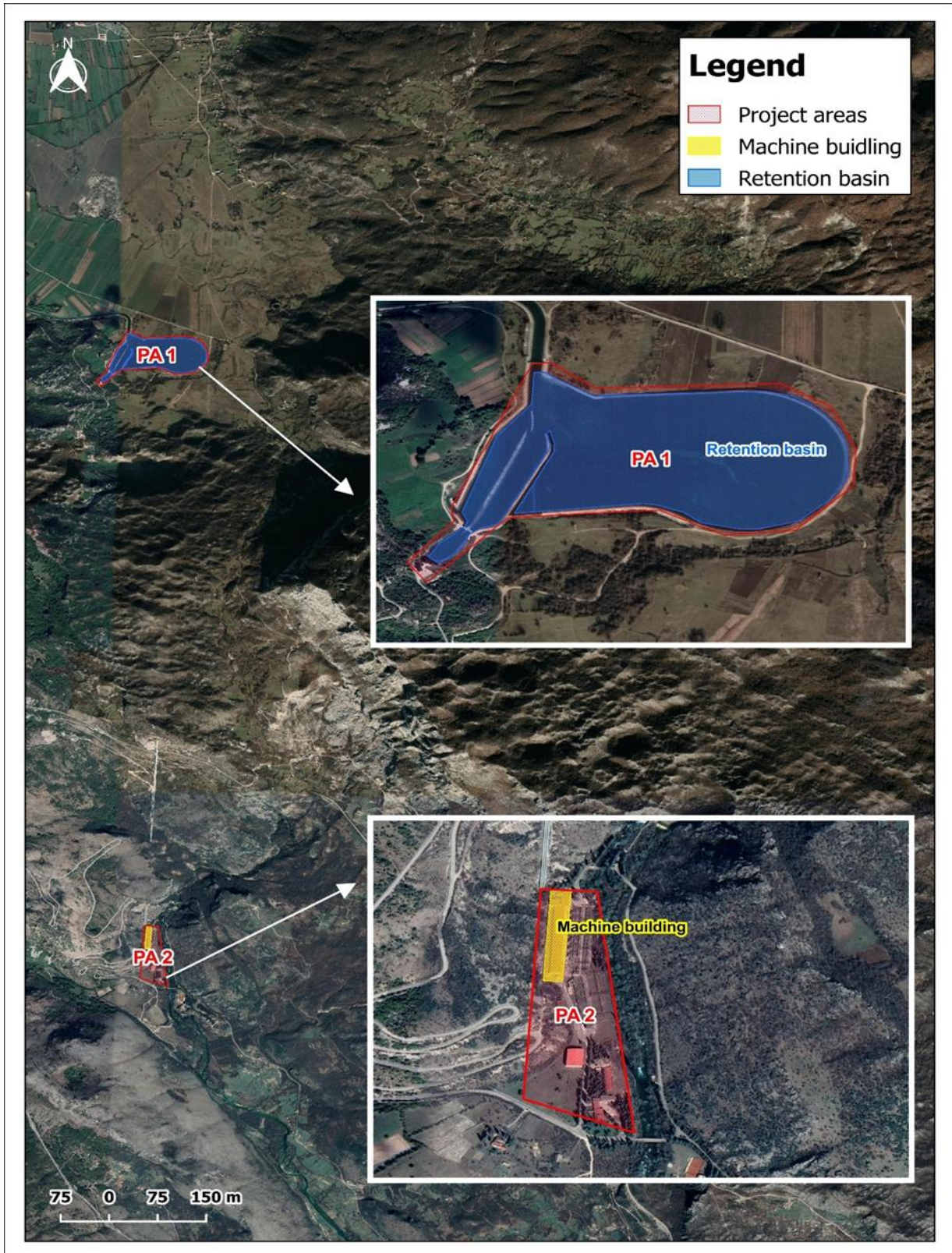


Figure 29: Area of influence

## 12.2 Impact Assessment Approach

The assessments of possible environmental and social impacts that the Project should manage during the activities to be carried out in the construction and operation phases are described in the following sections. Table 15 presents an interaction matrix that summarizes each environmental and social element and the possible actions that might cause an impact (negative or positive) at different stages of the Project.

In order to assess the impacts of the Project a two-step approach was used including the determination of the baseline conditions of the environment (covering social environment as well) before implementation of the Project and determination of the changes in the environment caused by the Project activities. In this context, as step 1, Chapter 9 presented data on environmental quality, among other information. In the same chapter, parameters of pollution generated by the long-term operation of the HPP are given and trends/changes in some of those are analyzed. These analyses represent the baseline conditions at the start of the proposed Project, but not the zero state which would represent the state prior to the beginning of operation of the HPP.

As step 2, impacts are assessed and the magnitude (e.g., wide, local and restricted) and severity (e.g., high, medium, low) of the impacts are taken into consideration when determining the significance of the impact. The magnitude is classified based on the extent of the impact, while the severity is categorized according to the sensitivity of the receiver/source exposed to the impact, as much as possible. A significance matrix that is given in Table 15 combines the sensitivity information with the magnitude of impacts. The significance of the impact is first designated without mitigation measures and then evaluated with proposed mitigation measures. This evaluation would serve to determine the significance of the residual impacts (impact left after employing mitigation measures).

While it is important to identify the initial significant impacts associated with the Project, the key focus of impact assessment has been to define the significance of residual impacts after the application and/or consideration of mitigation measures. In this regard, a summary table is provided at the end of this Chapter to indicate the potential significance of impacts and residual impacts.



**Table 15: Impact Interaction Matrix (before Mitigation Measures)**

| Source of Impact and Activity   | Environmental and Social Factors |                  |             |                        |                 |                        |                           |                 |                          |                             |                                |                  |
|---|----------------------------------|------------------|-------------|------------------------|-----------------|------------------------|---------------------------|-----------------|--------------------------|-----------------------------|--------------------------------|------------------|
|   | Environmental                    |                  |             |                        |                 |                        |                           | Social          |                          |                             |                                |                  |
|   | Surface Water                    | Soil Environment | Groundwater | Background Noise Level | Air Environment | Biological Environment | Landscape and Visual Env. | Protected Areas | Local Socioeconomic Env. | Community Health and Safety | Occupational Health and Safety | National Economy |
| Works on the reconstruction of the retention basin (demolition of the existing concrete walls and construction of new ones) | Yellow                           | Yellow           |             | Yellow                 | Yellow          | Yellow                 | Yellow                    |                 |                          |                             | Yellow                         |                  |
| Works on the reconstruction of the present tailrace channel of Unit U8 near the machine building                            | Yellow                           |                  |             | Yellow                 | Yellow          | Yellow                 |                           |                 |                          |                             | Yellow                         |                  |
| Transport and installation of equipment for installation of Unit U8 (machine building)                                      |                                  |                  |             | Yellow                 |                 |                        |                           |                 |                          |                             | Yellow                         |                  |
| Generation and Disposal of Waste  | Yellow                           | Yellow           | Yellow      |                        |                 | Yellow                 | Yellow                    |                 |                          | Yellow                      | Yellow                         |                  |
| Traffic – Construction Vehicles   |                                  |                  |             | Yellow                 | Yellow          | Yellow                 |                           |                 |                          | Yellow                      | Yellow                         |                  |
| Vehicle/equipment use and maintenance   | Yellow                           | Yellow           | Yellow      |                        |                 | Yellow                 |                           |                 |                          | Yellow                      | Yellow                         |                  |
| Supplementary operations (maintenance)  |                                  |                  |             |                        |                 |                        |                           |                 |                          |                             |                                |                  |
| Employment of Workforce   |                                  |                  |             |                        |                 |                        |                           |                 | Green                    |                             |                                | Green            |

|  |                          |
|--|--------------------------|
|  | Possible Negative Impact |
|  | Possible Positive Impact |

The overall aim of implementation of mitigation measures is to bring the residual impacts to acceptable levels. In terms of designing mitigation measures; avoid (make changes so that the impacts are avoided altogether), minimize (apply measures to reduce size of the impacts), repair (take action to repair and/or restore the affected environment) and offset (measures to offset or compensate for the impact) mitigation hierarchy has been followed.

**Table 16 : Impact Significance Matrix\***

| Sensitivity of Receptor | Magnitude of Impact |        |        |                 |
|-------------------------|---------------------|--------|--------|-----------------|
|                         | High                | Medium | Low    | Negligible/None |
| High                    | Red                 | Red    | Yellow | Light Blue      |
| Medium                  | Red                 | Yellow | Green  | Light Blue      |
| Low                     | Yellow              | Green  | Green  | Light Blue      |

\* Adapted from Scottish Natural Heritage – A handbook on environmental impact assessment, 2013

## 13. Assessment of environmental and social impacts and risks of project facilities and activities

The sections below represent an assessment of individual aspects of environmental and social impacts and risks related to project implementation.

### 13.1 Water quality

In terms to impacts that can occur during the execution of works, it is expected that the greater load will be in project area 1 (retention basin). Namely, the project envisages the upgrading of the retention basin as well as the demolition of the existing walls. As a result of the execution of these works, it can come to water turbidity and physical load of the water due to the uncontrolled release of materials/waste from the demolition that occurs at the specified location. Also, impacts on water are possible in the area of the machine building as a result of reconstruction works on the outflow channel. Inadequate management of excavated material can cause pollution of the Zeta River. Also, potential impacts of the project on surface and groundwater quality would be during the construction phase due to uncontrolled disposal of waste, potential leakage from construction vehicles/equipment's maintenance and fuelling, and soils reaching the surface water as sediments.

The use of construction vehicles during the HPP operation phase (during basin cleaning and HPP maintenance) can represent a potential hazard. Namely, in the event of an accident situation, if the oil/fuel gets into the river or the surrounding habitats, it can lead to ecosystem pollution. Apart from accidental situations, no negative effects on water quality are expected during the operational phase.

Table 17 summarizes the anticipated impacts on surface and groundwater quality.

**Table 17: Impacts on Water Resources (Surface Water and Groundwater)**

| Affected Ecosystem Component         | Source of Impact   | Project Phase | Definition of Potential Impact      | Type of Impact | Impact Significance Before Mitigation | Extent of impact      |
|--------------------------------------|--|---------------|-------------------------------------|----------------|---------------------------------------|-----------------------|
| Surface waters (channels and rivers) | Water turbidity of the Zeta River, downstream of the retention basin, due to the execution of works (upgrade-concrete works and demolition of existing walls). | Construction  | Change of water quality (pollution) | Negative       | Medium                                | Direct<br>Temporary   |
|                                      | Uncontrolled disposal of waste, oil and fuel leakage from construction vehicles, sediments (soil) reaching surface waters by runoff.                           | Construction  | Change of water quality (pollution) | Negative       | Medium                                | Indirect<br>Temporary |
|                                      | Water pollution in accidental situations - spilling of oil/fuel from the construction vehicles.  | Operation     | Change of water quality (pollution) | Negative       | Low                                   | Direct<br>Temporary   |
| Groundwater                          | Uncontrolled disposal of   | Construction  | Change of                           | Negative       | Medium                                | Indirect              |

| Affected Ecosystem Component | Source of Impact  | Project Phase | Definition of Potential Impact | Type of Impact | Impact Significance Before Mitigation | Extent of impact |
|------------------------------|---|---------------|--------------------------------|----------------|---------------------------------------|------------------|
|                              | waste, oil and fuel leakage from construction vehicles. |               | water quality (pollution)      |                |                                       | Temporary        |

### 13.2 Hydrology/water regime

Nikšić field, which provides water to HPP Perucica, is located in the western part of Montenegro, at 600-630 m asl. The surface of the catchment area is 850 km<sup>2</sup>. The sources which are located in the northern and eastern part of the field mostly form 4 water courses. These watercourses are: Zeta, Mostanica, Opacica and Gračanica, which flow along the southern border of the Field, where they mostly sink into the numerous chasms.

River Zeta is created in Gornje Polje, out of confluence of river Susica and Rastovac. Susica, which is a bigger water course, is created out of confluence of river Vidrovan and Boljasnica. Zeta generally flows in the southern direction, up to the village Zavrh, where it loses a part of its water in the existing estavelles, whereby the water later occurs in accumulation Krupac. Zeta turn towards the east from this point on, and flows towards settlement Glibavac, all while creating smaller and bigger meanders. Its further course is generally oriented towards south-east (from Vukov bridge it runs through a concrete canal) all the way to tunnel Budos, from which point it starts flowing towards south-east and east, all the way up to the retention basin. Zeta is brought to the HPP Perucica from the retention basin via a tunnel and pipelines. During the dry period, all watercourses in the Nikšić field dry out, except from Zeta and Grabovik. However, during extremely dry years, Zeta also dries out because low stream flow goes into aquifers in the riverbed.

Water levels are highest during spring and autumn, while it often dries out during summer.

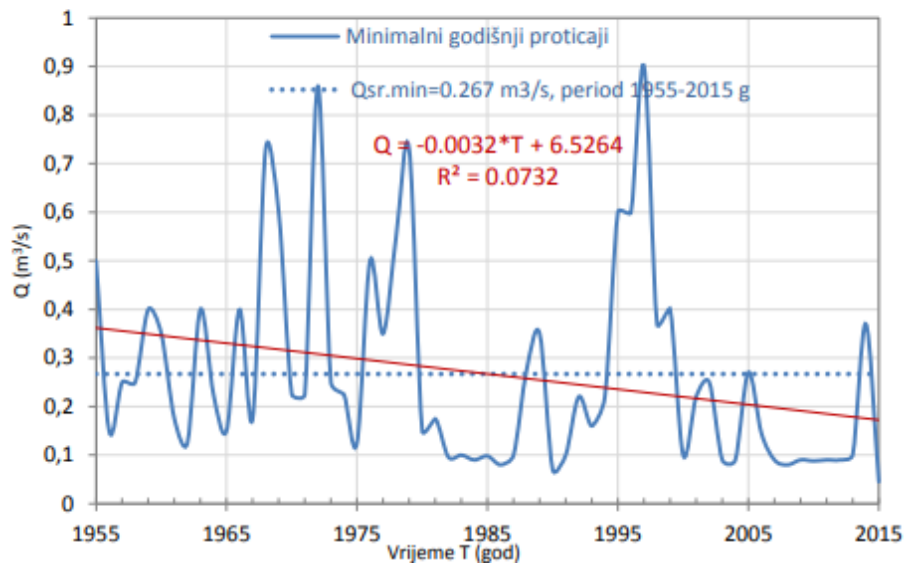
|                              |                         |
|------------------------------|-------------------------|
| Catchment area               | 850 km <sup>2</sup>     |
| Average annual precipitation | 2072 mm/m <sup>2</sup>  |
| Median annual stream flow    | 49,74 m <sup>3</sup> /s |

#### ACCUMULATIONS

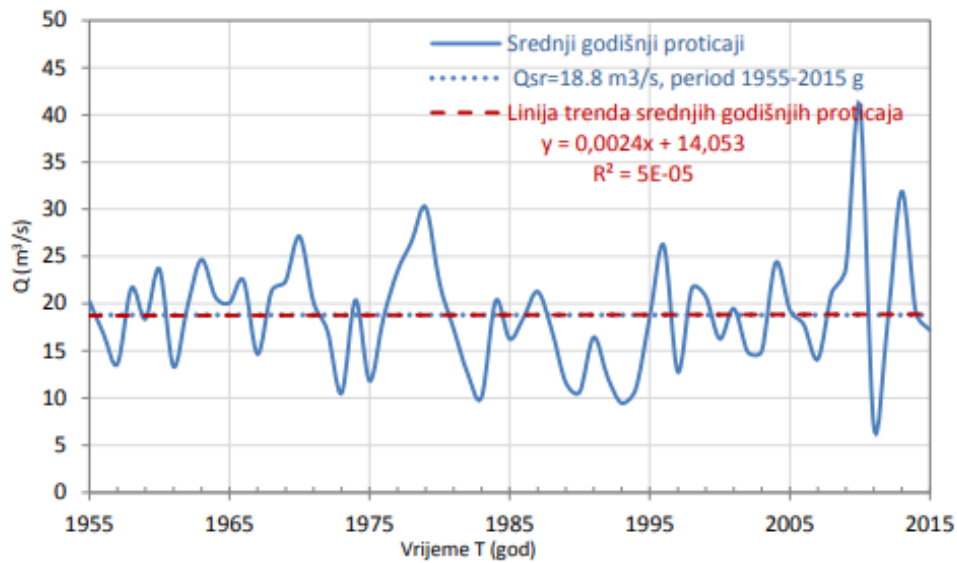
|        |                                     |
|--------|-------------------------------------|
| Krupac | 42 x 10 <sup>6</sup> m <sup>3</sup> |
| Slano  | 111.20 x 10 <sup>6</sup> m          |
| Vrtac  | 71.90 x 10 <sup>6</sup> m           |

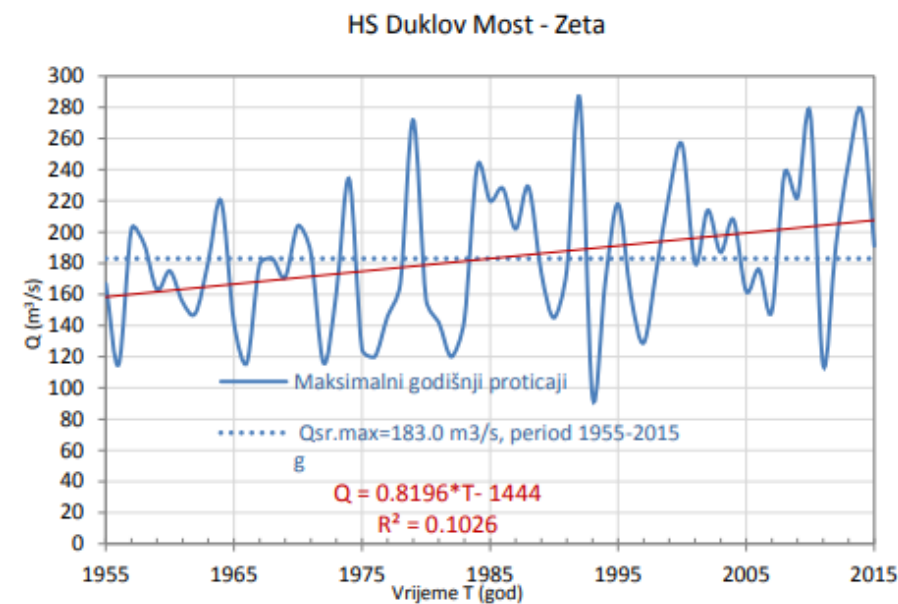
Measurement of water level, i.e. calculation of water flow in River Zeta in Nikšić Filed, is carried out at hydrological profile "Duklov Bridge", and these measurements have been done since 1929. The highest water flow on this profile was recorded on 12<sup>th</sup> October 1964 (307 m<sup>3</sup>/s) and on 25<sup>th</sup> September 1984 (580 m<sup>3</sup>/s).

## HS Duklov Most - Zeta



## HS Duklov Most - Zeta





Small distance between the Nikšić field and Donja Zeta, i.e. aerial distance of around 4 km, as well as a 530 m declination, provided very favourable opportunities for construction of a derivative hydro-energy facility.

Hydro-energy system of HPP Perucica was built on prominently karst area, which is characterised by all the attributes that a terrain could possibly have. Additionally, the system spans over a rather large area, which contributes to its exploitation in extremely complex hydrological-hydraulic conditions. HPP Perucica was put into operation in 1960, while its current phase of development was reached in 1976. Its operation is based on use of water potential of water courses in catchment of Gornja Zeta and the difference in altitude of more than 500 m between the Nikšić field and the Bjelopavlička plain. The accumulation that is being used includes 225 million cubic meters of water.

Measuring stations which are used for the needs of HPP Perucica:

- station "Accumulation Krupac"
- station "Canal Moštanica"
- station "Accumulation Slano"
- station "Canal Opačica"
- station "Canal Zeta 1"
- station "Retention basin"
- station "Marin Krst – pre-retention basin"
- station "Marin Krst – gate chamber"
- station "Vodostan"
- station "Turbine pit I and II"
- station "Outflow water from the power generation units I-VII"
- station "Outflow water from the power generation unit VIII"
- station "Duklov bridge"
- station "Zeta – Perućica"
- station "Trebjesa" at Gračanica River



- station "Straševina" at Mrkosnica River

For the purpose of this reconstruction and modernisation, it is necessary to check the lowest operation level on physical model at 602 m asl, in front of the entry point facility Marin Krst, whereby the measurement shall be made for the flow of 80.75 m<sup>3</sup>/s, which represents a very important parameter for all the previous and further analyses.

**Table 18: Impacts on hydrology**

| Affected Ecosystem Component | Source of Impact                          | Project Phase | Definition of Potential Impact  | Type of Impact | Impact Significance Before Mitigation | Extent of impact    |
|------------------------------|---|---------------|---|----------------|---------------------------------------|---------------------|
| Flooding                     | Construction works at the retention basin | Construction  | Water contaminated if works are not carried out during the dry season | Negative       | Medium                                | Direct<br>Temporary |

### 13.3 Soil quality

The locations where the project will be implemented are relatively flat. Given the terrain characteristics, the project type and the project area, no change in the topography of the local terrain can be expected. There is no tendency for the landslide in any segment at the subject location. It can be said that the soil in project area 1 (near the retention basin) is partially degraded, and therefore there will be no major change in the soil quality on the routes where machines move. Generally, when we talk about changing the soil, we mean the smallest possible changes such as compaction soil, due to the use of construction machinery and equipment. The impacts of planned reconstruction work on soil and land are generally insignificant due to their short-term nature and low intensity.

The installation of Unit 8 will be carried out in the machinery building, and therefore will not have an impact on the land. The replacement of electrical parts on the switchyard will not harm environmental values due to the situation that all works are concentrated on the existing switchyard. It is important to note that the locations of the project area are EPCG territories.

The potential impact on soil can be reflected in an accident situation. Namely, as a result of spilling oil from machines, pouring oil, improper waste disposal etc., soil pollution can occur.

The main impacts on soil quality would be during the construction phase (so limited duration). Most of the above-mentioned potential impacts could be easily controlled with standard measures. For example, forming designated areas with containment for vehicle washing, maintenance (such as oil changing, etc.), fuelling would prevent spilling of oil and fuel into the surrounding soil, and groundwater. In case of accidental oil and fuel spillage necessary emergency actions such as cleaning off the spilled oil using an absorbent and removal of the contaminated surface layer of the soil would be implemented. Table 19 summarizes the potential impacts of the Project on soil quality.

**Table 19: Impacts on Soil Quality**

| Affected Ecosystem Component | Source of Impact   | Project Phase | Definition of Potential Impact                     | Type of Impact | Impact Significance Before Mitigation | Extent of impact    |
|------------------------------|--|---------------|--|----------------|---------------------------------------|---------------------|
| Soil                         | Inadequate maintenance and fuelling of the vehicles and construction machinery at non designated areas, uncontrolled waste disposal and etc. | Construction  | Soil contaminated by spillage and natural drainage | Negative       | Medium                                | Direct<br>Temporary |
|                              |  | Operation     | Soil contaminated by spillage                      | Negative       | Medium                                | Direct<br>Temporary |

### 13.4 Air quality

Main impact of the project activities on air quality would be dust generation and exhaust gas emissions.

During construction phase dust would be generated from the dry surfaces with no vegetation coverage due to wind and operation of vehicles on these surfaces. In addition, solid particles will be created during concrete drilling, concrete breaking, loading, auxiliary works and material transport, and their immediate impact can be reflected in the local change of air quality at the construction site and in its immediate surroundings. Exhaust gases would be generated by the construction vehicles and equipment's. These impacts have a local character.

Considering that information about the number and type of machines that will be used during the execution of the works will be given in method statement of Contractor, it is not possible to precisely estimate the emissions and composition of the gases. The emissions from construction vehicles are estimated based on the specifications and standards regarding the drive motors of the construction equipment's/machines -which can be assumed to be used on the construction site. All drive machines must meet the norms for the emission limits stipulated by EU Directive 97/68/EC, which defines standards for manufacturers. The emissions provided below were estimated according to the standard values for off-road machinery, i.e., construction equipment for the standardised allowed emissions of CO, HC, NOx and PM10. Thus, construction machinery to be used would meet the guidelines for the EU Stage III/III b standards.

Table 20 with the Stage III B emission standard shows general values of the emission of harmful gasses and dust (particulate matter), which were calculated according to data about the prevised working machines and their respective machine hours (calculation in line with EU Stage III). Considering that calculated emissions will represent the maximum allowed values, actual levels of emission will be lower. Thus, the estimated emissions may be seen as the so-called worst-case scenario in terms of emission of exhaust gasses.

**Table 20: Stage III B Emission Standard for Non- Road Diesel Engines**

| Cat. | Power kW      | Date         | CO    | HC   | NO <sub>x</sub> | PM    |
|------|---------------|--------------|-------|------|-----------------|-------|
|      |               |              | g/kWh |      |                 |       |
| L    | 130 ≤ P ≤ 560 | 2011 January | 3.5   | 0.19 | 2.0             | 0.025 |
| M    | 75 ≤ P < 130  | 2012 January | 5.0   | 0.19 | 3.3             | 0.025 |
| N    | 56 ≤ P < 75   | 2012 January | 5.0   | 0.19 | 3.3             | 0.025 |
| P    | 37 ≤ P < 56   | 2013 January | 5.0   | 4.7* |                 | 0.025 |

\*NO<sub>x</sub>+HC

At this moment, it can be concluded that the number of construction vehicles, which will be used at the same time at the project site, will be the largest during the works on retention basin, during the demolition of the existing walls and the reconstruction of the outflow channel. It is assumed that loaders, excavators, trucks and bulldozers will be used during these activities.

Given that it is a temporary impact, effective period of operation of machines and the number of working days, it can be assumed that the use of these construction machines will not cause significant negative impacts on air quality in this area.

During the operational phase, there will be no impact on the air. The operation of the unit and the production of electricity do not result in the release of gases that can affect the air quality at the micro location.

Table 21 presents the potential impacts on air quality and impact significance.

**Table 21 Impacts on Air Quality**

| Affected Ecosystem Component | Source of Impact                                  | Project Phase | Definition of Potential Impact | Type of Impact | Impact Significance Before Mitigation | Extent of impacts   |
|------------------------------|---|---------------|--------------------------------|----------------|---------------------------------------|---------------------|
| Air                          | Dust generation                                   | Construction  | Change of air quality          | Negative       | Medium                                | Direct<br>Temporary |
|                              | Exhaust gas emissions from construction machinery | Construction  | Change of air quality          | Negative       | Low                                   | Direct<br>Temporary |

### 13.5 Noise and vibration

On May 13<sup>th</sup> 2013 Niksic Municipality issued a "Decision on determining the acoustic zones in the Municipality of Niksic" (Decision number: 07-353-215), which carried out the acoustic zoning of the territory of this municipality. Also, the Assembly of Danilovgrad Municipality issued a "Decision on determining the acoustic zones in the Municipality of Danilovgrad" (Decision number: 03-030-104/1 dated 04/12/2016; "Official Gazette of Montenegro - Municipal Regulations", No. 19/2016 of April 28<sup>th</sup>, 2016) which carried out the acoustic

zoning of the territory of the Danilovgrad Municipality. The project area is not covered by the aforementioned Decisions. Therefore, previous noise level measurements for these subject areas were analyzed for three different zones, namely: a residential zone, a mixed-use zone and zone under strong influence of traffic.

Given that there is no precise data on the construction machinery that will be used for the execution of the works, it is not possible to precisely identify the strength of the impact. However, it can be assumed that the level of noise emitted on the construction site during the execution of the works will exceed the level of noise permitted for the residential zone. Namely, during the reconstruction of the junction of the Zeta 1 channel and the retention basin, it is planned to demolish certain walls and connect the basin, while in the machine building, apart from the installation of the new Unit 8, work will be performed on the reconstruction of the already existing outflow channel. Therefore, it is assumed that standard machines (loaders, trucks, bulldozers...) will be used, which, due to simultaneous operation, can produce noise that would exceed the limit values prescribed by the Law at the location itself.

Considering the distance of the nearest buildings intended for housing, it can be safely said that the works at the HPP Perućica will not significantly increase the noise level that can negatively affect the population. Namely, in project area 1 (location near the retention basin), the nearest facilities are located at a distance of over 400m aerial, while the nearest residential facilities at the location near the machine building are located at a distance of about 500m aerial. It is important to note that excessive noise, when talking about a harmful effect on humans, is any noise whose sound pressure level exceeds 90 dB(A).

During the execution of works on PAs, there will be the appearance of noise and vibrations due to the operation of construction machines, movement of construction machinery and during the demolition of the existing concrete walls and construction of new ones. However, by maintaining engine efficiency and following traffic regulations, this negative impact can be minimized. Although it is a temporary impact, it is not expected that this impact will significantly endanger the local population.

Based on the characteristics of PA 1, i.e., the facilities located within the subject location, no noise emissions are expected during the operational phase. When it comes to PA2, despite the fact that it is an already existing facility, which emits a certain level of noise, the installation of another unit will not significantly increase the noise level in that area.

According to the assessment made as part of the "Feasibility Study", from 2007 (which was made for the installation of Unit 8), the noise in the engine room will not exceed the permitted level of 85 dB(A), measured at a distance of 2m from the turbine housing.

Namely, noise will be limited by the appropriate selection of equipment and, if necessary, additional measures to the following values:

- Engine room, 1 m from the source, max 85 dB
- Command room, and such max. 55 dB

In this regard, the installation of the eighth unit in HPP Perućica does not change practically anything in terms of the impact on the environment, which results from the existing situation.

**Table 22: Noise Impacts**

| Affected Ecosystem Component | Source of Impact                        | Project Phase | Definition of Potential Impact | Type of Impact | Impact Significance Before Mitigation | Extent of impact                  |
|------------------------------|---|---------------|--------------------------------|----------------|---------------------------------------|-----------------------------------|
| Local Communities            | Construction machinery generating noise | Construction  | Increase in noise levels       | Negative       | <b>Medium</b>                         | <b>Direct</b><br><b>Temporary</b> |

## 13.6 Biodiversity

Based on survey performed by biologists in the period May-June 2022, the general comment is that both project areas are under anthropogenic influence. It can be said that natural vegetation and wildlife will not be greatly affected by the reconstruction works since the dominating plant ecosystem along the facilities is poor grass vegetation. Construction works only cover small areas during relatively short time.

### 13.6.1 Flora

Both locations (Slivlje/Ozrinići and Glava Zeta) are under strong anthropogenic influence. In the wider area of the retention there are representative hay meadows and fields. Along with the retention, there are overgrown meadow that are not mowed and that are slowly overgrown with trees. Zeta riverbed, which is lost in the Slivlje abyss in the northern part of the Ozrinići area, is covered with waste and garbage. Channel Zeta 1 also brings plastic and other waste that is visible on the retention grids. Anthropogenic influence is also visible on Glava Zete in the vicinity of the HPP Perućica. Meadows, i.e., pseudo-steppes are not mowed or maintained, which leads to their overgrowth.

During the works in the retention basin, it is planned to demolish certain walls and connect the basin. In that case, concrete waste will be created, which, if improperly/uncontrolledly disposed of in the surrounding area (meadows), can have a negative effect on the flora. Also, during the execution of the works, the mechanization will have an impact on the surrounding meadows.

During the installation of new electrical and mechanical equipment in the machine building, dust will be created that will settle on the plants (flora). During the execution of these works, waste will be created, which if deposited outside the plant, i.e. of the fenced area of HPP Perućica, can have a negative impact on the surrounding habitats.

The realization of the planned activities will lead to an increase in water flow, and a greater amount of precipitation in autumn and spring, which can cause habitat flooding.

### 13.6.2 Fauna

Impacts during the construction, reconstruction and operation of hydro power plants arise as a result of: changes in the morphology of the river and river habitats, obstacles to the migration and spread of protected animal species, disruption of sediment dynamics, changes in the ecologically acceptable flow regime, changes in the flow regime due to the operation of



peaker hydropower plants, changes in the cycle of seasonal flooding, changes in the chemical composition and temperature of water, injury and death of certain animals, displacement and disturbance, impacts on terrestrial species and habitats, and finally cumulative impacts (EU, 2018).

Given that the project sites involve the reconstruction of the existing HPP, that is, the requirements are minor, the potential impacts on fauna during the construction phase and the operation phase are listed below:

- during the execution of the works, due to noise and vibrations, fauna may be disturbed in the project area, which may lead to a decrease in their numbers at the locations;
- the use of mechanization on the construction site can cause damage to certain habitats (the effect of irreversible loss of habitat and its fragmentation is possible);
- due to the execution of works on the outflow channel, there is a possibility of physical turbidity of the downstream water flow, which may have a negative impact on the ichthyofauna of the Zeta River;
- the works can lead to turbidity of the water, which can have a negative impact on the reproductive phase of amphibians;
- during the execution of works in the surveyed area, the mortality of certain species of amphibians and reptiles is expected when crossing the road;
- possible spillage of fuel and oil from the machinery/vehicles in the event of accidental situations, may represent an additional danger to the entomofauna, but also to the living world as a whole, as well as to underground water;
- the realization of the planned activities will lead to an increase in the water level before the dam, and in cases of more abundant water inflows, especially during prolonged rainfall, there may be overflow and eventual flooding, which may have negative effects on the animal world downstream, either directly - by flooding the preferred habitat or indirectly - changes in microclimatic conditions.

Table 23 summarizes the potential impacts on ecosystem and flora and fauna together with significance of impacts.

**Table 23: Impacts on Ecosystem/Flora and Fauna**

| Affected Ecosystem Component | Source of impact  | Project Phase | Definition of Potential Impact  | Type of Impact | Impact Significance Before Mitigation | Extent of impact    |
|------------------------------|---|---------------|---|----------------|---------------------------------------|---------------------|
| Flora                        | Improper/uncontrolled disposal of construction waste (concrete) in the project area | Construction  | Destruction of surrounding residents and meadows  | Negative       | Medium                                | Direct<br>Permanent |
| Habitats and Flora/Fauna     | Execution of works on the outflow channel   | Construction  | Physical turbidity of the downstream water flow, negative impact on the amphibians and ichthyofauna of the Zeta River | Negative       | Medium                                | Direct<br>Temporary |
|                              | Impacts from vehicle  | Construction  | Disturbance of  | Negative       | Medium                                | Direct              |

| Affected Ecosystem Component | Source of impact   | Project Phase | Definition of Potential Impact  | Type of Impact | Impact Significance Before Mitigation | Extent of impact    |
|------------------------------|--|---------------|---|----------------|---------------------------------------|---------------------|
|                              | movements (including transport of people and equipment) and use of machinery and equipment   |               | fauna due to noise, direct mortality due to Road Traffic Accidents (RTAs) and degradation of habitats due to soil compaction, dust spreading and destruction of vegetation or the ingress of non-native invasive species. |                |                                       | Temporary           |
|                              | Land take due to improper disposal of waste at the construction site, parking of construction machines at the place of work execution                      | Construction  | Loss of habitats<br>Disturbance of fauna species  | Negative       | Medium                                | Direct<br>Temporary |
|                              | Reduction of the abundance of fauna at the construction site (movement of terrestrial fauna away from the construction site during the construction phase) | Construction  | Loss, fragmentation and degradation of existing habitats and loss of flora populations  | Negative       | Medium                                | Direct<br>Temporary |

### 13.7 Archaeological/cultural heritage

There are no cultural nor archaeological sites in the project area. However, it is important to note that there are two objects of local and national historical and cultural heritage outside of the project area – Tsar's Bridge in Nikšić and Ostrog Monastery in Danilovgrad. These sites are not going to be affected by the project in any way, but it is important to note their existence since the access roads to these two locations must be kept uninterrupted throughout the entire project lifecycle.

### 13.8 Communal infrastructure

Nikšić and Danilovgrad are connected via the Main Road M-18, which is one of the main and most frequent roads in Montenegro. Additionally, these two municipalities are connected via a local road, which runs from the area near Slivlje retention basin, through settlement Povija and further provides a connection to Bogetici and the overall Danilovgrad area. This network of local and regional roads must be kept uninterrupted for regular traffic throughout all project phases, whereby all measures related to safety and organisation of construction traffic must be defined by the contractor so as to ensure full compliance with all the relevant national and international traffic safety measures and requirements.

### 13.9 Waste and surplus material

Waste generated during the construction can be divided into 2 main categories accordingly to the type of works:

- Waste generated during the reconstruction of the hub Zeta I channel – retention basin – intake structure (construction rubble, concrete, polluted soil, etc.)
- Other waste (municipal and mixed waste)

Also, on the basis of assumptions on the machinery which will be engaged at the project site, the following types of waste can be produced (during construction phase):

- waste engine oils (13 02 06\* synthetic motor oils, gearbox and lubricating oils)
- oil filters (16 01 07\*oil filters)
- absorbents and wiping cloths (15 02 02\* absorbents, filter materials (including oil filters that are not otherwise specified) wiping cloths, protective clothing, which are contaminated with dangerous substances)

If waste is handled in an uncontrolled manner, it can have a direct impact on the quality of land and water, as well as on the state of biodiversity. Therefore, the waste generated during the execution of works on the Project can be temporarily disposed of at a previously defined location within the construction site or immediately removed from the location of execution of the works, i.e., hire an authorized company that will take over and remove the waste.

Management of all types of waste generated on the construction site must be carried out in accordance with the previously prepared Waste Management Plan.

Occasional hazardous waste can be generated in the operational phase, during maintenance operations, cleaning of drainage facilities and separators, and cleaning of accidental spills. The management of the mentioned types of waste will be carried out in accordance with the EPCG Waste Management Plan. Table 24 summarizes the potential impacts and impact significance of waste generation.

**Table 24: Waste Generation and Disposal Impacts**

| Affected Ecosystem Component      | Source of Impact   | Project Phase                             | Definition of Potential Impact   | Type of Impact | Impact Significance Before Mitigation | Extent of impact    |
|-----------------------------------|--|---|----------------------------------|----------------|---------------------------------------|---------------------|
| Local communities and environment | Waste generation on site activities which is classified as non-hazardous waste | Construction                              | Generation and disposal of waste | Negative       | Low                                   | Direct<br>Temporary |
|                                   | Waste generated due to use of machinery (hazardous waste)                      | Construction                              | Generation and disposal of waste | Negative       | Medium                                | Direct<br>Temporary |
|                                   |  | Operation (maintenance of the facilities) | Generation and disposal of waste | Negative       | Medium                                | Direct<br>Temporary |

### 13.10 Local residents and community safety

Local communities, i.e. populated areas are located at a distance of more than 1km from each of the project micro locations – Slivlje retention basin and machine building. Thus, no disturbance is expected in terms of local residents and community safety during project implementation.

A positive impact that is expected to be experienced by the wider local communities is related to local employment and local procurement of construction material. Thus, this project is expected to cause positive impacts on the communities in the wider project area, as well as on local economies of Niksic and Danilovgrad, since the Contractor shall implement local employment and local procurement measures during construction. Thus, the Contractor shall develop an employment and procurement policy, which is going to give advantage to the local employees and suppliers throughout construction.

### 13.11 Occupational Health and Safety

As the key authority, the Directorate for Occupational Health and Safety at the Ministry of Economic Development and Tourism of Montenegro, among other things, performs the activities related to monitoring, inspecting, and encouraging development of Occupational Health and Safety (OHS), preparing regulations in the field of OHS, monitoring and implementing ratified conventions and EU Directives in the field of OHS, preparing professional basis for development of a national program for development of occupational safety and monitoring its implementation. Supervision of implementation of the Law on Safety and Health at Work (“Official Gazette of Montenegro”, No. 34/14, 44/18) and other applicable regulations is conducted by the Labour inspection, through the Labour inspectors for occupational safety and health at work, if the law does not establish that the supervision of such regulations in specific activities is performed by other authorities.

### 13.11.1 Health and safety at work – legislative and regulatory requirements

The Contractor monitors and implements the requirements of OHSAS 18001 standard. The Contractor follows national regulations in the field of occupational health and safety in accordance with the Law on Safety and Health at Work („Official Gazette of Montenegro“ No. 34/14, 44/18).

According to the national legislation, occupational health and safety means the provision of working conditions that do not lead to occupational injuries, occupational diseases and diseases related to work and which create the conditions for full physical and mental protection of employees.

### 13.11.2 OHS responsibilities and compliance

The project owner (EPCG), the contractor and any and all sub-contractors are jointly responsible for ensuring compliance with and implementation of all the relevant national and international laws and regulations from the area of OHS. This includes both management measures and reporting and investigating any incidents, i.e. implement international OHS standards in all contracts. With regards to workers' health and safety, the contractor will identify potential risks before commencement of works. The emergency response provisions will include a Site Safety Plan, which will also indicate a contact person available in the event of an accident. Site Safety Plan is submitted to the Project Owner (or Supervision Consultant) for approval.

Contractor will ensure the following in terms of workers'/occupational health and safety:

|  |
|--|
| The Contractor is obliged to develop Occupational Health and Safety Plan, which is going to be aimed at ensuring protection of workers, population and any and all people in the vicinity of the project area during construction and operation phase. |
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|--|
| The Contractor is obliged to develop and implement a Human Resource Policy, which is going to prevent discrimination, corruption, promotion of equal employment opportunities. |
|--|

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|--|
| The Contractor is obliged to develop a Labour and Working Conditions Management Plan which is going to define all employees' responsibilities during construction, including mandatory implementation of all OHS measures during construction, ethical standards, etc. |
|--|

|  |
|--|
| Contractor is obliged to develop Emergency Preparedness and Response Plan, which is going to define measures for prevention and resolution of any potential OHS, environmental and any other construction-related emergencies. |
|--|

|  |
|--|
| Contractor is to include a provision for safe working environment and safety measures and personal protective equipment (PPE) for all workers in their Site Safety Plan, including gloves, hard hats, goggles, ear protection and safety footwear. |
|--|

|  |
|--|
| Site Safety Plan is to include a provision for first aid to be administered on site and a trained person must be engaged in line with the Law on Occupational Health and Safety („Official Gazette of MNE“, No. 034/14 and 44/18). |
|--|

|  |
|--|
| Safety Labour Management Plan (SLMP) is required to ensure health and safety provisions. |
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|---|
| Contractor shall perform all project activities in line with the SLMP and all Montenegrin laws and by-laws regarding health and safety. |
|---|

|   |
|---|
| Contractor shall provide potable water supply to its workers, toilets and water supply for washing. |
|---|



The abovementioned responsibilities will outline the Project's commitment to working conditions and good management of relationships with the workers. The Project will also have a local content policy that supports hiring workers from within the local area to the extent practical. Following the effective implementation of the above Plans, no significant effects are predicted.

The following responsibilities must be complied with by EPCG and the Contractor:

- The Project will comply with all national labour, social and occupational health and safety laws, as well as the requirements of PS2 on Labour and Working Conditions. The contractor will prepare a Labour Management Plan to action this. Emphasis will also be placed on measures to ensure that workers are free of any discrimination, regardless of race, religion or belief, gender, disability, age, nationality, sexual orientation or ethnicity.
- The Construction Contractor will prepare and implement an Occupational Health and Safety (OHS) Plan for the works, based on the identification of key hazards, and ensure appropriate emergency preparedness and response planning.
- There will be clear OHS terms and conditions in subcontractor and worker contracts, and regular audits will be undertaken of all construction sites to verify the effectiveness of prevention and control strategies.
- All workers will be appropriately trained, and provided with appropriate personal protective equipment (PPE) for their job.
- A formal workers' Grievance Response Mechanism will be established for workers to raise any concerns for resolution.

The Contractor is required to develop Occupational Health and Safety Plan (OHS Plan). The Health and Safety Management Plan should include information on a wide range of OHS topics relevant to the project, including: basic project information, human and material resources, hazardous materials control, identified risks to the project and measures to eliminate them, various traffic regulations, codex and restrictions, information on safety, hygiene, ergonomics, medicine and first aid, accident procedures, etc.

The Contractor shall provide his project personnel with personal protective equipment in accordance with the planning documentation in the field of occupational health and safety, primarily in accordance with the Act on risk assessment at work and the Rulebook on the use of means and equipment for personal protection at work ("Official Gazette of Montenegro", no. 040/15).

Employees use personal protective equipment and equipment at work, or in the performance of their jobs and work activities, where the hazards and / or damages, or risks to occupational health and safety cannot be eliminated or sufficiently reduced by providing protection measures. The contractor should provide the employee with personal protective equipment, which should:

- made in accordance with the regulations governing the general safety of the product;
- are purposefully designed to eliminate or reduce risks in the workplace and as such that they do not increase existing or create new risks to the protection and health of the employee;
- correspond to existing conditions at the workplace;
- meet the specific ergonomic requirements of the workplace and the health of the employee;
- be made so that the employee can use them properly and easily after adjusting, repairing, finishing, etc. When employees, due to the dangers and hazards to which they are exposed, have to use different personal protective equipment at the same

time, the Contractor should ensure that they are mutually adaptable and effectively protect the employee from the dangers and hazards at work to which he is exposed;

- health centre, medical equipment and distribution of medical staff.

The Contractor shall provide a first aid room for personnel on the project with the provision of medical supplies in accordance with the Rulebook on equipment and procedure for the provision of first aid and on organisation of industrial accident aid service (Official Gazette of the Socialist Federal Republic of Yugoslavia 21/71).

- Medical treatment which can be carried out on terrain

The Contractor shall provide sufficient number of first aid personnel in accordance with the Rulebook on equipment and procedure for the provision of first aid and on organisation of industrial accident aid service (Official Gazette of the Socialist Federal Republic of Yugoslavia 21/71).

- Ambulance, communications

The Contractor will provide a first aid room at the construction site, while the outpatient treatment of the staff will be performed in a specialized medical facility with which the Contractor will conclude the Contract.

- Reference Hospital

The Contractor shall conclude a Health Care Services Agreement with an accredited medical institution for the treatment of staff on the project. The Contractor shall take the necessary measures and designate employees for first aid, fire protection and evacuation of employees depending on the type of workplace and activity, as well as on the number of employees and presence of other persons, in accordance with national law and regulations and standards regulate this field. Liaison with external services is essential, especially with regard to first aid, medical emergencies, rescue and fire protection.

First aid is provided by specially trained first aid personnel for injured or severely ill workers. Workers in workplaces with increased risk of injury and health damage must be trained to be able to help themselves if they are in danger or if they are injured or suddenly ill.

### **Health impact assessment**

Health impacts may occur in relation to workers who are going to be hired on site, but the Contractor shall work jointly with EPCG on development and implementation of the abovementioned OHS plans and procedures in order to ensure prevention and mitigation of the potential health impacts. Duly implementation and supervision of implementation of the abovementioned mitigation and prevention measures is going to ensure that the OHS impacts on workers and other project employees are going to be minimised and/or avoided.

When it comes to the general health of the wider communities, it is important that the Contractor includes the general health impact prevention measures related to prevention of risks, emergencies and hazards on construction site (e.g. spilling of toxic matters in the environment) which could spread and endanger the wider communities. Additionally, all the ongoing construction heavy load traffic shall be organised in accordance with the national traffic safety measures in order to prevent occurrence of any potential safety hazards during transport of machines and construction material, whereby all the heavy trucks shall be

covered and properly secured during transport in order to prevent any spilling or dispersion of construction supplies and material (e.g. oil, sand, rocks, etc.).

This project is not going to cause any direct impacts on health and safety of workers or the local communities, provided that all the prevention and mitigation measures are properly implemented. This is due to the fact that this project is going to be implemented at locations which are located at a significant distance from the populated areas, whereby the construction works do not include any large-scale construction activities that could lead to causing health and safety hazards.

**Table 25: Health and Safety impacts**

| Affected Ecosystem Component | Source of Impact        | Project Phase | Definition of Potential Impact | Type of Impact | Impact Significance Before Mitigation |
|------------------------------|-------------------------|---------------|--------------------------------|----------------|---------------------------------------|
| Health and safety            | Construction activities | Construction  | Accidents                      | Negative       | <b>Medium</b>                         |

### 13.12 Climate change impacts

It is generally known that water with its high heat capacity can significantly change the climatic characteristics of an area. This influence is particularly pronounced in the area above the water surface and in a narrow strip around the water area itself. These impacts are as follows: less temperature fluctuations on a daily and annual basis, an increase in air humidity and a slight increase in the amount of precipitation. In addition, the speed of local winds increases.

Increased air saturation with moisture can have harmful consequences in certain periods of plant development during the flowering period. Then it is difficult to open the anthers and it is difficult to transfer the pollen by the wind, as well as the transfer of pollinating insects. Increased air humidity is very suitable for the development of various plant pests. However, the advantage of air humidity is that it has a significant role in the frost period. It prevents the occurrence of frost in spring and autumn. If the air humidity is higher, the formation of dew occurs, thereby reducing the possibility of frost.

When it comes to the realization of this project, the works themselves will take place on a small area at the retention basin and near the machine building. It is important to note that the works will be carried out on existing facilities (there is no new retention), and the nature of the works is such that they cannot have any influence on meteorological parameters and climatic characteristics.

Eventually, the drilling and breaking of the existing concrete at PA1 may lead to an immediate increase in the concentration of powdery substances in the working environment. Particles in the air can have some effect on the weather conditions near the ground. They affect the intensity of solar radiation that reaches the ground, by scattering the sun's rays into different wavelengths depending on the size of the particles, their concentration, nature and other characteristics, while adsorbing part of the solar energy.

The optical effect of the particles influence in the atmosphere is also known, which is reflected in the creation of haze, turbidity and reduced visibility. Considering the scope of the

works, it can be said that the concentration of powdery substances will be negligible, and therefore the impact on the environment will be negligible. However, if haze, turbidity and reduced visibility occur at the location, this phenomenon will be limited both spatially and temporally.

The positive side of the project is the fact that the implementation of the project increases the capacity to produce electricity from renewable energy sources and thus reduces the emission of SO<sub>2</sub>, NO<sub>x</sub> and CO<sub>2</sub> from thermal power plants that would otherwise be emitted in the absence of the project. Therefore, the project reduces greenhouse gas emissions (GHG - Greenhouse gases) and contributes to the fight against climate change at the regional and global level.

## 14. Mitigation and Management of Impacts and Risks

Management of environmental and social issues on the project is divided into two functional groups which are Mitigation Plan and Monitoring Plan. The major purpose of this chapter is to document key environmental and social issues, the actions to be taken to address them adequately, as well as the schedule and person/unit responsible for implementation and monitoring.

The following tables (Table 26 and Table 27) present the Environmental Mitigation Plan measures and the Environmental Monitoring Plan.

## 14.1 Mitigation Plan (including implementation and monitoring responsibilities)

**Table 26: Mitigation Plan**

| Aspect  | Impact Significance Before Mitigation | Mitigation Measures  | Installation cost                      | Operation cost                         | Installation responsibility                             | Operation responsibility                                | Significance of Residual Impacts |
|---|---------------------------------------|--|--|--|---|---|----------------------------------|
| <b>Land Preparation and Construction Phase</b>    |                                       |  |  |  |   |   |                                  |
| Surface and Groundwater Resources – Water Quality | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Storage construction waste and handling of fuels, oils and other hydrocarbons will be controlled, involving measures to prevent soil and water contamination. Designs will include storage for waste (material from the demolition) on sealed surfaces and within secondary containment and refuelling of all plant, vehicles and machinery will not be allowed within 50 m of any watercourse.</li> <li>Maintaining, refuelling and cleaning of construction machinery will be carried out at dedicated locations (defined before the works commence) with proper containment and drainage and related waste material would</li> </ul> | To be included in the Contractor's bid | To be included in the Contractor's bid | Contractor, supervised by EPCG and supervision engineer | Contractor, supervised by EPCG and supervision engineer | Low                              |



| Aspect | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost | Operation cost | Installation responsibility | Operation responsibility | Significance of Residual Impacts |
|--------|---------------------------------------|---|-------------------|----------------|-----------------------------|--------------------------|----------------------------------|
|        |                                       | <p>be stored at a controlled area</p> <ul style="list-style-type: none"> <li>• Driving of machinery within surface water, streams or on their banks will be prevented.</li> <li>• Checking all machines and equipment for leaks prior to use.</li> <li>• Construction works should be carried out during the summer months, when the water level is low.</li> <li>• In the case of accidental situations (oil/fuel spillage from the machines in surface waters), it is necessary to carry out urgent rehabilitation and restore the location to its original state, prepare a report and take corrective and preventive measures.</li> <li>• If, during the execution of the works, the water becomes very cloudy, the works must be stopped until the appropriate clarity of the water is achieved.</li> <li>• It is strictly forbidden to</li> </ul> |                   |                |                             |                          |                                  |

| Aspect       | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost                      | Operation cost                         | Installation responsibility                                       | Operation responsibility                                | Significance of Residual Impacts |
|--------------|---------------------------------------|---|--|--|---|---|----------------------------------|
|              |                                       | discharge polluting and waste materials into the water.   |  |  |   |   |                                  |
| Hydrology    | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Carry out all construction works during the dry season (summer season)</li> <li>Measuring water levels at the measuring stations</li> <li>Monitoring water levels and reducing outflow, i.e. operation of HPP Perucica accordingly in order to avoid flooding in case of otherwise high water levels caused by heavy rainfall</li> </ul>   | To be included in the Contractor's bid | To be included in the Contractor's bid | EPCG, in cooperation with the Contractor and supervision engineer | Investor, EPCG  | Low                              |
| Soil Quality | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Limiting the construction area to the minimum amount of space needed</li> <li>Removal, storage and handling of topsoil (especially at the location of outflow channel) in such a manner that it would be used during finishing works</li> <li>Parking, washing, maintenance and fuelling of the construction machinery would be done at designated sites with concrete ground and in the event that soil is</li> </ul> | To be included in the Contractor's bid | To be included in the Contractor's bid | Contractor, supervised by EPCG and supervision engineer           | Contractor, supervised by EPCG and supervision engineer | Low                              |

| Aspect                | Impact Significance Before Mitigation | Mitigation Measures  | Installation cost | Operation cost    | Installation responsibility | Operation responsibility  | Significance of Residual Impacts |
|-----------------------|---------------------------------------|--|-------------------|-------------------|-----------------------------|---------------------------|----------------------------------|
|                       |                                       | <p>contaminated by spillage, affected layer would be removed in line with the relevant regulation</p> <ul style="list-style-type: none"> <li>All packaging waste material for oil and other petroleum derivatives would be stored at a controlled area.</li> <li>Storage and handling of fuels, oils and other hydrocarbons would be done at designated areas with solid grounds (not soil) and located at least 50 m away from any watercourse.</li> <li>Opening of non-controlled and unplanned access roads to any part of the Project site will be forbidden.</li> <li>Systematic collection of solid waste during construction (including municipality waste and construction waste and other types of waste) would be undertaken and wastes would be disposed at licensed facilities specified by national authorities.</li> </ul> |                   |                   |                             |                           |                                  |
| Air Quality (Exhaust) | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>To perform frequent watering of the working area (especially</li> </ul>   | To be included in | To be included in | Contractor, supervised by   | Contractor, supervised by | Low                              |

| Aspect           | Impact Significance Before Mitigation | Mitigation Measures  | Installation cost                      | Operation cost                         | Installation responsibility                             | Operation responsibility                                | Significance of Residual Impacts |
|------------------|---------------------------------------|--|--|--|---|---|----------------------------------|
| gasses and dust) |                                       | <p>during the demolition of the walls in the retention basin). Water intended for this purpose must be used in quantities that will not result in generation of run-off.</p> <ul style="list-style-type: none"> <li>Speed limits will be enforced on the Project area and public roads to limit the levels of dust generation.</li> <li>Vehicles delivering material will be covered.</li> <li>All vehicles, equipment and machinery used for construction will be regularly maintained and inspected/certificate to ensure that the exhaust emission levels conform to the standards prescribed.</li> <li>Loading and unloading will be carried out without scattering</li> </ul> | the Contractor's bid                   | the Contractor's bid                   | EPCG and supervision engineer                           | EPCG and supervision engineer                           |                                  |
| Noise            | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Construction time will be limited to day-hours (07.00 to 19.00).</li> <li>Use of modern equipment and machines with noise suppressors.</li> <li>Regular maintenance of construction vehicles and</li> </ul>   | To be included in the Contractor's bid | To be included in the Contractor's bid | Contractor, supervised by EPCG and supervision engineer | Contractor, supervised by EPCG and supervision engineer | Low                              |

| Aspect                            | Impact Significance Before Mitigation | Mitigation Measures  | Installation cost                      | Operation cost                         | Installation responsibility                             | Operation responsibility                                | Significance of Residual Impacts |
|-----------------------------------|---------------------------------------|--|--|--|---|---|----------------------------------|
|                                   |                                       | <p>equipment.</p> <ul style="list-style-type: none"> <li>Avoiding the simultaneous operation of several noisy machines, when possible.</li> <li>Using natural acoustic barriers or screens around the machines, such as trees and topographical factors.</li> <li>Limiting the speed of vehicles on unpaved roads for transportation of materials.</li> <li>Leaving engines idling at the site will be avoided unless absolutely necessary.</li> </ul> |  |  |   |   |                                  |
| Ecosystem /<br>Flora and<br>Fauna | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Carrying out the systematic collection of construction waste and its temporary disposal at a previously defined location or directly taken over by an organization specialized in taking over that type of waste.</li> <li>To perform frequent watering of the working area (especially during the demolition of the walls in the retention basin).</li> <li>Scattering of wastes with the wind</li> </ul>      | To be included in the Contractor's bid | To be included in the Contractor's bid | Contractor, supervised by EPCG and supervision engineer | Contractor, supervised by EPCG and supervision engineer | Low                              |



| Aspect | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost | Operation cost | Installation responsibility | Operation responsibility | Significance of Residual Impacts |
|--------|---------------------------------------|---|-------------------|----------------|-----------------------------|--------------------------|----------------------------------|
|        |                                       | <p>within and out of the project area will be prevented by collecting and temporary storage of waste at designated areas.</p> <ul style="list-style-type: none"> <li>In order to allow fauna elements to continue their natural inhabitanancies in the surrounding area noise levels will be kept at minimum.</li> <li>Measures would be taken to prevent animal deaths in the project area and on the access roads and new roads would not be opened to the extent possible</li> <li>Driving of machinery within surface water, streams or on their banks will be prevented.</li> <li>Construction works should be carried out during the summer months, when the water level is low.</li> <li>In the case of accidental situations (oil/fuel spillage from the machines in surface waters), it is necessary to carry out urgent rehabilitation and restore the location to its original state, prepare a report and take</li> </ul> |                   |                |                             |                          |                                  |

| Aspect           | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost                      | Operation cost                         | Installation responsibility                             | Operation responsibility                                | Significance of Residual Impacts |
|------------------|---------------------------------------|---|--|--|---|---|----------------------------------|
|                  |                                       | <p>corrective and preventive measures.</p> <ul style="list-style-type: none"> <li>If, during the execution of the works, the water becomes very cloudy, the works must be stopped until the appropriate clarity of the water is achieved.</li> <li>It is strictly forbidden to discharge polluting and waste materials into the water.</li> <li>Removed vegetation should be kept to a minimum.</li> <li>If during the work you find the nest of an animal, stop the work and consult experts – biologists</li> <li>Use already existing roads to avoid further habitat fragmentation and degradation.</li> </ul> |  |  |   |   |                                  |
| Waste Generation | <b>Low</b>                            | <ul style="list-style-type: none"> <li>Systematic collection of solid waste during construction (including municipality waste and construction waste, and other types of waste) would be undertaken and wastes would be disposed at licensed facilities specified by national authorities or handed over to a company</li> </ul>  | To be included in the Contractor's bid | To be included in the Contractor's bid | Contractor, supervised by EPCG and supervision engineer | Contractor, supervised by EPCG and supervision engineer | Low                              |

| Aspect | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost                      | Operation cost                         | Installation responsibility                             | Operation responsibility                                | Significance of Residual Impacts |
|--------|---------------------------------------|---|--|--|---|---|----------------------------------|
|        |                                       | <p>authorized to collect the subject waste.</p> <ul style="list-style-type: none"> <li>All packaging waste material for oil and other petroleum derivatives would be stored at a controlled area.</li> <li>Scattering of wastes with the wind within and out of the project area will be prevented by collecting and temporary storage of waste at designated areas.</li> <li>Incineration or burying of wastes by any means at site and/or dumping of wastes to nearby roads or water resources will absolutely prohibited.</li> </ul> |  |  |   |   |                                  |
| Other  |                                       | <p>It is necessary for the contractor to prepare additional sub-plans according to the characteristics and methodology of the works, i.e.:</p> <ul style="list-style-type: none"> <li>Contractor to develop and adhere to a <b>Method statement</b> for construction works in retention basin that includes pollution prevention and control management along with specific measures to control waters and</li> </ul>   | To be included in the Contractor's bid | To be included in the Contractor's bid | Contractor, supervised by EPCG and supervision engineer | Contractor, supervised by EPCG and supervision engineer | -                                |

| Aspect | Impact Significance Before Mitigation | Mitigation Measures  | Installation cost | Operation cost | Installation responsibility | Operation responsibility | Significance of Residual Impacts |
|--------|---------------------------------------|--|-------------------|----------------|-----------------------------|--------------------------|----------------------------------|
|        |                                       | <p>prevent contamination;</p> <ul style="list-style-type: none"> <li>• Preparing site specific <b>Emergency Plans</b> to respond to any incidents or spillages of hazardous material to water and soil environment;</li> <li>• Before starting the works, prepare a <b>Construction/Hazardous Waste Management Plan</b> in accordance with National legislation.</li> <li>• Before starting the works, prepare <b>Occupational Health and Safety Management Plan</b> and make it abiding for all the subcontractors.</li> <li>• Before starting the works, the Contractor shall develop a <b>Traffic Management Plan</b>, which is going to ensure safety and security of both workers and all other road users in the project area.</li> <li>• Before starting the works, the Contractor shall develop a <b>Local Employment and Local Procurement Policy</b>, with the aim of engaging with the local workforce and suppliers</li> </ul> |                   |                |                             |                          |                                  |

| Aspect  | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost | Operation cost | Installation responsibility | Operation responsibility | Significance of Residual Impacts |
|---|---------------------------------------|---|-------------------|----------------|-----------------------------|--------------------------|----------------------------------|
|   |                                       | throughout construction.  |                   |                |                             |                          |                                  |
| <b>Operation Phase</b>                            |                                       |   |                   |                |                             |                          |                                  |
| Surface and Groundwater Resources – Water Quality | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Regular maintenance of channels and removal of mixed waste that reaches to the retention basin.</li> <li>Regular control and maintenance of HPP to prevent accidental situations.</li> </ul>   | EPCG              | EPCG           | EPCG                        | EPCG                     | Low                              |
| Hydrology   | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Measuring water levels at the measuring stations</li> <li>Monitoring water levels and reducing outflow, i.e. operation of HPP Perucica accordingly in order to avoid flooding in case of otherwise high water levels caused by heavy rainfall</li> </ul> | Investor, EPCG    | Investor, EPCG | Investor, EPCG              | Investor, EPCG           | Low                              |
| Soil Quality                                      | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Regular control and maintenance of HPP to prevent accidental situations.</li> </ul>  | EPCG              | EPCG           | EPCG                        | EPCG                     | Low                              |
| Noise   | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Engines and other noisy parts of the equipment should be equipped with mufflers.</li> <li>Site personnel should be informed about the need to minimize noise and about the health hazards of</li> </ul>  | EPCG              | EPCG           | EPCG                        | EPCG                     | Low                              |



| Aspect                      | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost | Operation cost | Installation responsibility | Operation responsibility | Significance of Residual Impacts |
|-----------------------------|---------------------------------------|---|-------------------|----------------|-----------------------------|--------------------------|----------------------------------|
|                             |                                       | exposure to excessive noise   |                   |                |                             |                          |                                  |
| Ecosystem / Flora and Fauna | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>During the operational phase, it is necessary to constantly monitor the amount of outlet water, so that there are no significant variations in the water level of the Zeta River, downstream of the HPP.</li> <li>It is also necessary to adopt a set of measures in accidental situations and in cases of heavy rainfall that can cause an increase in the water level, flooding and changes in the speed of the river flow, which can have a negative impact on biodiversity.</li> <li>Control water flow especially in months of heavy rainfall to prevent flooding.</li> </ul> | EPCG              | EPCG           | EPCG                        | EPCG                     | Low                              |
| Waste Generation            | <b>Medium</b>                         | <ul style="list-style-type: none"> <li>Systematic collection of solid waste during operation (including mixed waste that reaches to the retention basin) would be undertaken and wastes would be disposed at licensed facilities specified by national authorities</li> <li>All packaging waste material for oil and other petroleum derivatives</li> </ul>   | EPCG              | EPCG           | EPCG                        | EPCG                     | Low                              |

| Aspect | Impact Significance Before Mitigation | Mitigation Measures   | Installation cost | Operation cost | Installation responsibility | Operation responsibility | Significance of Residual Impacts |
|--------|---------------------------------------|---|-------------------|----------------|-----------------------------|--------------------------|----------------------------------|
|        |                                       | would be stored at a controlled area.   |                   |                |                             |                          |                                  |
| Other  |                                       | <p>The Project Holder is obliged to prepare the following sub-plans:</p> <ul style="list-style-type: none"> <li>Preparing specific <b>Emergency Plan</b> to respond to any incidents or spillages of hazardous material into environment.</li> <li>EPCG is obliged to prepare and implement the <b>Waste Management Plans</b> in accordance with National legislation.</li> </ul> | EPCG              | EPCG           | EPCG                        | EPCG                     | -                                |

## 14.2 Monitoring Plan (including implementation and monitoring responsibilities)

**Table 27: Environmental and Social Monitoring Plan**

| Phase, item                                    | What parameter is to be monitored?   | Where is the parameter to be monitored?   | How is the parameter to be monitored? /type of monitoring equipment        | When is the parameter to be monitored? (frequency of measurement or continuous)  | Why is the parameter to be monitored? (optional)  | Installation cost                       | Operation cost | Installation and Operation responsibility |
|--|--|---|--|--|---|---|----------------|---|
| <b>Land Preparation and Construction Phase</b> |  |   |  |  |   |   |                |   |
| Surface Water Quality                          | According to the Decree on classification and categorization of water ("Official Gazette of the Republic of Montenegro" No. 14/96 and 2/07) – Parameters such as; suspended solids, COD, BOD5, TOC, total mineral oils, pH, turbidity, temperature, color, smell...) | At two reference points:<br>1. channel Zeta I (before it flows into the retention basin)<br>2. 150-200 m downstream from the outflow channel - HPP Perucica | Physicochemical analysis performed by a certified and competent laboratory | The frequency of measurements will be determined after the methodology of the works, the duration of the works and the period of the works are known | Ensuring compliance with national legislation and international requirements                      | Included in the bid from the Contractor | -              | Contractor supervised by EPCG             |
| Hydrology                                      | Water level  | At the designated/existing water level monitoring stations  | Existing water level measuring infrastructure which is managed by EPCG     | Quarterly and/or as necessary  | Ensuring efficient operation of the HPP and prevention of flooding in the event of heavy rainfall | EPCG                                    | EPCG           | EPCG                                      |
| Air Quality                                    | Dust   | Construction areas, route of trucks and settlements in  | Visual control   | Daily  | -   | -                                       | -              | Contractor                                |

| Phase, item                     | What parameter is to be monitored?   | Where is the parameter to be monitored?   | How is the parameter to be monitored? /type of monitoring equipment | When is the parameter to be monitored? (frequency of measurement or continuous)  | Why is the parameter to be monitored? (optional)                             | Installation cost                       | Operation cost | Installation and Operation responsibility |
|---------------------------------|--|---|---|--|--|---|----------------|---|
|                                 |  | the vicinity of project site  |   |  |  |   |                |   |
| Air Quality<br>(Exhaust gasses) | PM <sub>10</sub> , SO <sub>2</sub> , NO, NO <sub>2</sub> , CO <sub>x</sub> | Construction areas, nearest sensitive receptors (settlements in the vicinity of project site) | Measurement performed by a certified and competent laboratory       | One measurement before the start of the works,<br><br>One measurement during the most intensive works on PA1 (retention basin)   | Ensuring compliance with national legislation and international requirements | Included in the bid from the Contractor | -              | Contractor supervised by EPCG             |
| Noise                           | Noise level (dB)   | Construction sites, nearest sensitive receptors   | Measurement performed by a certified and competent laboratory       | One measurement before the start of the works, One measurement during the most intensive works on PA1 and PA2<br><br>Note: Measurement of noise levels during the execution of the works should be carried out and in case of complaints / grievances of the interested local population and organizations | Ensuring compliance with national legislation and international requirements | Included in the bid from the Contractor | -              | Contractor supervised by EPCG             |

| Phase, item                    | What parameter is to be monitored?   | Where is the parameter to be monitored?             | How is the parameter to be monitored? /type of monitoring equipment | When is the parameter to be monitored? (frequency of measurement continuous) | Why is the parameter to be monitored? (optional)  | Installation cost                       | Operation cost | Installation and Operation responsibility |
|--------------------------------|--|---|---|--|---|---|----------------|---|
| Ecosystem /<br>Flora and Fauna | Flora and fauna  | Construction sites and vicinity                     | Visual control  | Daily  | -   | -                                       | -              | Contractor                                |
| Waste Generation               | <ul style="list-style-type: none"> <li>- List of hazardous materials/chemicals supplied, stored and used (including information on type and amount/ volume)</li> <li>- Type (i.e., municipal, packaging, waste oil) and amount of waste disposed of</li> <li>- Waste management / disposal agreements done with licensed companies</li> <li>- Waste Management Plans</li> <li>- Temporary Waste Storage Areas</li> </ul> | Construction site, storage areas and project office | Site Audit  | Quarterly  | Checking efficiency of impact minimization precautions and functioning of waste management plan | Included in the bid from the Contractor | -              | Contractor supervised by EPCG             |
| <b>Operation phase</b>         |  |   |   |  |   |   |                |   |
| Surface water                  | Sampling and performing laboratory analysis to determine the parameters stipulated by the  | At two reference points:<br>(1) 150-200 m           | Measurement performed by a certified and competent                  | Quarterly  | The results are compared to the requirements in   | EPCG                                    | EPCG           | EPCG                                      |



| Phase, item     | What parameter is to be monitored?  | Where is the parameter to be monitored?  | How is the parameter to be monitored? /type of monitoring equipment | When is the parameter to be monitored? (frequency of measurement or continuous) | Why is the parameter to be monitored? (optional)  | Installation cost | Operation cost | Installation and Operation responsibility |
|-----------------|---|--|---|---|---|-------------------|----------------|---|
|                 | legislation (suspended solids, COD, BOD5, TOC, total mineral oils, pH, turbidity, temperature, color, smell...) | downstream from the outlet - HPP Perucica and (2) entrance building "Marin krst" - Norin | laboratory  |   | terms of the defined MPC values. Comparative analysis with the results from the previous period, with the aim of monitoring the pollution trends, effects of the protective measures which have already been implemented and establishing new protective measures |                   |                |   |
| Noise           | Noise level (dB)  | Machine building   | Measurement performed by a certified and competent laboratory       | One measurement after putting into operation Unit 8                             | Ensuring compliance with national and international standards   | EPCG              | EPCG           | EPCG                                      |
| Flora and fauna | - During the operational phase, it is necessary to constantly monitor the amount of outlet water, so            | Project Areas  | Visual observation by an expert                                     | One hydrological year (quarterly)   | The amount of outflow water that flows into   | EPCG              | EPCG           | EPCG                                      |

| Phase, item      | What parameter is to be monitored?  | Where is the parameter to be monitored? | How is the parameter to be monitored? /type of monitoring equipment | When is the parameter to be monitored? (frequency measurement continuous) | Why is the parameter to be monitored? (optional)   | Installation cost | Operation cost | Installation and Operation responsibility |
|------------------|---|---|---|---|--|-------------------|----------------|---|
|                  | <p>that there are no significant variations in the water level of the Zeta River, downstream of the dam.</p> <ul style="list-style-type: none"> <li>- Control water flow especially in months of heavy rainfall to prevent flooding.</li> </ul> |   |   |   | <p>the Zeta River</p> <p>Water flow in high water season</p>   |                   |                |   |
| Waste management | <ul style="list-style-type: none"> <li>- Type and amount of waste disposed of</li> <li>- Waste management / disposal agreements done with licensed companies</li> <li>- Waste Management Plans</li> </ul>                                       | Storage areas project and office        | Site Audit  | Quarterly   | Ensuring compliance with national and international standards, as well as EPCGs waste management plans | EPCG              | EPCG           | EPCG                                      |
| Other            | <p>Control implementation of sub-plans:</p> <ul style="list-style-type: none"> <li>- Emergency Plan</li> <li>- Waste Management Plans.</li> </ul>   | -                                       | -   | -   | -  | -                 | -              | EPCG                                      |



## 15. Environmental and Social Opportunities for Project Enhancement

The Project Developer (EPCG) and the Contractor that is selected for carrying out the construction works shall jointly work on ensuring that they preserve the current condition of the environment in the project area (at both micro locations), whereby they shall also implement activities aimed at improving the overall project area. This shall be done via the means of landscaping in the project area, i.e. arranging the area surrounding both project locations, so as to ensure that the quality of the environment is (at least) maintained on pre-project level and even improved, compared to the pre-project conditions. Such activities are going to ensure that the development opportunities are enhanced, which is not only important from the aspect of the visual improvement of the project area, but also from the aspect of sustainability and ensuring better standards and opportunities for further potential development projects in the subject area.

The general approach that should be taken by the Project Developer shall involve development and implementation of an efficient and effective Environmental and Social Management System (ESMS). ESMS shall be developed by the Project Developer, but all the relevant parties shall be involved and engaged with throughout the project lifecycle (as stipulated by PS1) in the manners stipulated by the ESMS, whereby the client (Project Developer) shall closely cooperate with the Contractor, any and all sub-contractors, workers, interested local stakeholders and any other relevant parties and stakeholders who may have an interest in the project.

## 16. Conclusions

This project includes modernisation of the existing power generation facilities, i.e. installation of the eight power generation unit at the existing machine building which has been equipped with the necessary facilities and designated location for installation of the eight unit since HPP Perucica was established. Considering the scope of works, along with the fact that HPP Perucica has been designed and operational for more than 60 years, this project is not expected to have a significant scope of negative impacts. However, it is important to note that all the abovementioned impact mitigation and prevention measures must be implemented in order to avoid and/or minimise occurrence of negative impacts.

It is however expected that HPP Perucica is going to contribute to sustainability of the power/electricity generation in Montenegro, since the eight power generation unit is going to increase the capacity of the HPP, all while providing reliability of the overall system. On another note, taking into account the wider scope of environmental and social development over time (e.g. risk of global climate change impacts), just like for any other HPP, it is necessary to constantly monitor and adapt the conditions and operation of the HPP to the national and global environmental challenges so as to avoid any potential negative impacts on the surrounding area.

## 17. Annexes

### 17.1 References and Sources of Information

1. Preliminary Design for Modernization, Revitalization and Extension of HPP Perucica – Energoprojekt, 1984
2. Book 1 – Hydro-construction part (I - open drainage system)
3. Book 1 – Hydro-construction part (II - pressure system)
4. Book 1 - Hydro construction part (III – the flow out trough/small canal)
5. Energy Development Strategy of Montenegro until 2030, Ministry of Economy, May 2014
6. Energy analysis - HPP Perucica with 8 generators
7. Study of the impact of HPP "Perucica" on the downstream course of the river Zeta, 1980
8. Modernisation and revitalisation of hydropower plant Perucica Phase I and Phase II, APPRAISAL OF ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS AND RISKS (ACTIVITY 4100), November 2013
9. Modernisation and revitalisation of hydropower plant Perucica Phase I and Phase II, STUDY ON NON-STEADY FLOW PHENOMENA IN THE UPSTREAM SYSTEM, November 2013
10. Modernisation and revitalisation of hydropower plant Perucica Phase I and Phase II, STUDY ON THE PHENOMENA OBSERVED DURING THE OPERATION, November 2013
11. Strategic Environmental Impact Assessment for Local Study of Redirection of a Part of the Zeta River Waters into Accumulations Krupac and Slano, Ministry of Sustainable Development and Tourism, Podgorica, February 2020.
12. Spatial urban Plan of municipality Niksic until 2020/2025, Podgorica, May 2015
13. Detailed urban plan OSTROG – GLAVA ZETE, 2015
14. Information on the state of the environment in Montenegro for 2020, Nature and Environmental Protection Agency, 2021
15. Information on air quality for 2021, Niksic, February 2022
16. Mapping and Typology of Landscapes in Montenegro, Ministry of Sustainable Development and Tourism, 2015
17. Assessment of the state of macrozoobenthos of the Zeta River in the area of the project "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8", Prepared by: Miloje Sundic - expert on macrozoobenthos, Podgorica June 2022
18. Assessment of the state of the invertebrate fauna (insects) in the area of the project "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8", Prepared by: Suzana Malidzan - insect expert, Podgorica June 2022
19. Assessment of the state of flora and habitats in the area of the project "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8" Prepared by: Snezana Vuksanovic - expert on flora and habitats, Podgorica June 2022
20. Assessment of the condition of the bat fauna in the area of the project "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT



- PERUĆICA - INSTALLATION OF UNIT 8", Prepared by: Ceda Ivanovic - MSc of Biological Science, Podgorica June 2022
21. Assessment of the condition of ornithofauna in the area of the project "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8", Prepared by: Andrej Vizi - bird expert, Podgorica June 2022
  22. Assessment of the situation of ichthyofauna in the area of the project "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8", Prepared by: Katarina Burzanovic - ichthyofauna expert, Podgorica June 2022
  23. Assessment of the batrachology and herpetology in the area of the project "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8", Prepared by: Natalija Cadjenovic - expert in batrachology and herpetology, Podgorica June 2022
  24. Noise level in the environment (Baseline conditions) - Niksic and Danilovgrad, Centre for Ecotoxicological Research (CETI), June 2022
  25. Physico-chemical analysis of waste water, Centre for Ecotoxicological Research (CETI), October 2021
  26. Physico-chemical analysis of waste water, Centre for Ecotoxicological Research (CETI), December 2021
  27. Physico-chemical analysis of surface water (Zeta River, Niksic), The Institute of Public Health of Montenegro - Center for health ecology, December 2021
  28. Physico-chemical analysis of surface water (entrance building Norin, Niksic), The Institute of Public Health of Montenegro - Center for health ecology, December 2021

## 17.2 Stakeholder Engagement and records of public meetings and consultations held

### - Presentation of the project to the competent national institution (NEPA)

| Meeting minutes       |   |
|-----------------------|---|
| <b>Date and time:</b> | 28 <sup>th</sup> March 2022 (13:00h)  |
| <b>Location:</b>      | EPCG, HPP Perucica  |
| <b>Purpose:</b>       | Presentation of the project to the competent national institution   |
| <b>Participants:</b>  | <ul style="list-style-type: none"> <li>• Slobodan Banović, EPCG</li> <li>• Boško Božović, EPCG</li> <li>• Jasmina Janković Mišnić, NEPA</li> <li>• Stanislava Lazarević, NEPA</li> <li>• Jelena Leković, NEPA</li> <li>• Dušan Krstić, Energoprojekt Hidroinženjering</li> <li>• Milica Daković, Energoprojekt Hidroinženjering</li> <li>• Elma Šukurica, Energoprojekt Hidroinženjering</li> </ul>   |
| <b>Discussion:</b>    | <p>The meeting was held at the premises of EPCG, HPP Perucica. The topic of the meeting was related to the general introduction into the project, presentation of the project of installation of power generation unit A8 at the HPP Perucica to the representatives of the Nature and Environment Protection Agency of Montenegro.</p> <p>Mr Slobodan Banović, as the representative of EPCG, organised the meeting with representatives of the Agency and the consultants (the consultants who have been engaged in the project for the purpose of preparation of ESIA documentation) in order to present the upcoming works already during the initial phase, and provide detailed information about the planned works which are going to be carried out during installation of power generation unit A8. In this way, he was provided with preliminary information about the need for preparation of the Environmental Impact Assessment Study, as well as the potential need for development of EIA in accordance with Montenegrin legislation.</p> <p>At the beginning of the meeting, Mr Banovic greeted the meeting participants, after which he presented the project. The project was presented via a geographic map, starting from accumulations Slano, Krupac, Vrtac, up to machine building of HPP Perucica. He explained that installation of the A8 unit was planned at the same time when the 7 previously installed units were designed. The design for construction of HPP Perucica was developed in 1958, and this project has been implemented in three phases:</p> <ul style="list-style-type: none"> <li>• The first phase included two power generation units, which have</li> </ul> |

the corresponding capacities of 38 MW and the adequate flow rate of 8.5 m<sup>3</sup>/s, and this phase was completed in 1960;

- The second phase, which included three power generation units of equal capacities and flow rate, was completed in 1962;
- The third phase, which included two power generation units, which have the corresponding capacities of 58.5 MW and the adequate flow rate of 12.75 m<sup>3</sup>/s, was completed in 1977 (outflow canal for the eight power generation unit was built during this phase).

The planned IV phase, which includes completion of the designed system, includes installation of the eight power generation unit, which is going to have the capacity of 58.5 MW and flow rate of 12.75 m<sup>3</sup>/s, whereby the objects for installation of the eight unit have been built during the previous three phases of development.

When it comes to the construction works which are going to be carried out during the IV phase, Mr Banovic stated that the works which are going to be carried out at the retention basin (potential expansion of the inflow object, which is located after the settling basin, as well as the potential adaptation of the settling basins with the purpose of improvement of water circulation).

Mr Banović stated that the overall area in which the HPP Perucica is located is owned by EPCG, as well as the entire surrounding Project area.

Additionally, spatial and planning basis for Project implementation was presented at the meeting, including: Energy Development Strategy of Montenegro, Spatial-Urbanistic Plan of Municipality Nikšić, as well as Construction Permit from 1991.

Based on all the presented information, representatives of the Agency stated that this is a project which is not going to require development of an Environmental Impact Assessment Study, as well as that in light of legal regulation, and taking into account the type and scope of works, the subject Project may be considered as adaptation of the existing facilities.

After the meeting, the project participants carried out a site visit (photos from the site are provided below).

**Photo log: 28<sup>th</sup> March 2022****Meeting at the premises of EPCG****Meeting at the premises of EPCG****Place of instalacion of unit 8****Outflow canal for unit 8****Machine building(powerhouse) of HPP Perućica**



**- Presentation of the project to the local administration unit, Municipality Niksic**

| <b>Meeting minutes</b> |   |
|------------------------|---|
| <b>Date and time:</b>  | 29 <sup>th</sup> March 2022 (13:00h)  |
| <b>Location:</b>       | Municipality Niksic   |
| <b>Purpose:</b>        | Presentation of the project to the local administration unit, Municipality Niksic   |
| <b>Participants:</b>   | <ul style="list-style-type: none"> <li>• Vladimir Vukčević, EPCG</li> <li>• Đorđije Manojlović , Municipality Nikšić</li> <li>• Vera Mirković, Municipality Nikšić</li> <li>• Milić Drago, Municipality Nikšić</li> <li>• Boro Vuković, Municipality Nikšić</li> <li>• Krtolica Vidak, Municipality Nikšić</li> <li>• Dušan Krstić, Energoprojekt Hidroinženjering</li> <li>• Milica Daković, Energoprojekt Hidroinženjering</li> <li>• Elma Šukurica, Energoprojekt Hidroinženjering</li> <li>• Marija Sindić, Energoprojekt Hidroinženjering</li> </ul>   |
| <b>Discussion:</b>     | <p>The meeting was held at the premises of the Municipality Niksic. Apart from representatives of EPCG and the Consultant, the meeting was attended by Mr Đorđije Manojlović, the secretary of the Department for Spatial Planning and Environmental Protection, and his colleagues.</p> <p>The meeting was aimed at providing the general overview of the project, i.e. presentation of the project of installation of power generation unit A8 HPP Perucica, to the representatives of Municipality Niksic.</p> <p>Mr Vukcevic, as a representative of EPCG, said that this is a continuation of the project of modernisation and upgrade of HPP Perucica. Consultants who are in charge of development of documentation in accordance with KfW regulations (German Development Bank has allocated resources for financing the project of installation of power generation unit A8) have been hired for the purpose of implementation of this project. As part of the project and the Bank's requirements, EPCG is in charge of informing the local communities and local self-government about the project, i.e. to explain the type of construction works to the local community.</p> <p>The meeting participants were informed that 7 units have been installed so far, and that implementation of the project of construction of HPP was carried out in phases (3 phases have been completed). The planned IV phase includes designing the entire system, i.e. it is planned to install the eight power generation unit during this phase. The power generation unit 8 is going to have the capacity of 58.5 MW and the flow rate of 12.75 m<sup>3</sup>/s. Through installation of the eight unit,</p> |



the installed capacity of the HPP is going to increase from the existing 307 MW to 365.5 MW, which will make the HPP Perucica become the HPP with the highest installed capacity in Montenegro.

Mr Krstic said that documentation will be prepared in accordance with KfW's methodology for the purpose of this project. The documentation will primarily present the impact of the project on the environment, people's health, as well as the social aspect of the project and its impact.

Ms Dakovic briefly discussed the documentation in question, and she stated that this documentation will be an integral part of the tender documentation. KfW bank categorised the project of installation of the power generation unit A8 as a B+ project (green project).

Ms Vera Miljkovic stated that the meeting participants had been provided with documentation related to installation of the unit A8 prior to the meeting, and that they have thus been informed about the project. She stated that they are going to cooperate with EPCG and the consultants in terms of provision of documentation which is available at the Department for Spatial Planning and Environmental Protection of the Municipality Niksic, and which can be useful during preparation of ESIA.

Documentation which is available at the Department, and which is going to be provided to EPCG is:

- 1) Information about the condition of the environment for 2021 (results for noise measurements, results for water sampling);
- 2) Biodiversity study;
- 3) Study on acoustic zones in Municipality Niksic;
- 4) Study on benefits (valorisation) of the Niksic field (finalisation of this study is expected by the end of March)

EPCG is going to send an official memo to the Department for the purpose of provision of the abovementioned documentation.

**Photo log: 29<sup>th</sup> March 2022**



Lis of participants: 29<sup>th</sup> March 2022
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**SASTANAK**  
 između predstavnika EPCG i Opštine Nikšić



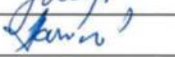
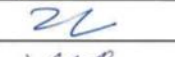
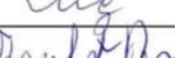
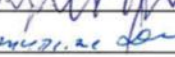
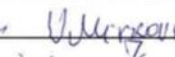
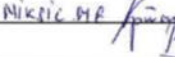
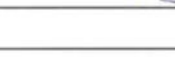

**Projekat:** Projekat rekonstrukcije i modernizacije HE „Perućica“ – ugradnja Agregata br.8  
 Upgrade of Hydro Power Plant Perucica - Installation of Unit U8

**Mjesto sastanka:** Zgrada Optine Nikšić, sala 3, I sprat

**Datum:** 29.03.2022.

**Tema:** Upoznavanje sa projektom i predstojećim aktivnostima:  
 1. Prezentacija projekta  
 2. Ekološki aspekt projekta  
 3. Društveni aspekt projekta

Sastanku su prisustvovali:

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**- Presentation of the project to the local administration unit, Municipality Danilovgrad**

| <b>Meeting minutes</b> |  |
|------------------------|--|
| <b>Date and time:</b>  | 30 <sup>th</sup> March 2022 (09:00h)   |
| <b>Location:</b>       | Municipality Danilovgrad   |
| <b>Purpose:</b>        | Presentation of the project to the local administration unit, Municipality Danilovgrad   |
| <b>Participants:</b>   | <ul style="list-style-type: none"> <li>• Vladimir Vukčević, EPCG</li> <li>• Ratko Pavićević, EPCG</li> <li>• Slobodan Banović, EPCG</li> <li>• Ilija Grgurović, Municipality Danilovgrad</li> <li>• Vasilije Otašević, Municipality Danilovgrad</li> <li>• Glorija Vukićević, Municipality Danilovgrad</li> <li>• Sandra Vuković, Municipality Danilovgrad</li> <li>• Dušan Krstić, Energoprojekt Hidroinženjering</li> <li>• Elma Šukurica, Energoprojekt Hidroinženjering</li> <li>• Marija Sindić, Energoprojekt Hidroinženjering</li> </ul>  |
| <b>Discussion:</b>     | <p>The meeting was held at the premises of Municipality Danilovgrad. Apart from representatives of EPCG and the Consultant, the meeting was also attended by Mr Ilija Grgurovic, Vide-president of Municipality Danilovgrad, and his associates.</p> <p>The meeting was aimed at providing the general overview of the project, i.e. presentation of the project of installation of power generation unit A8 HPP Perucica, to the representatives of Municipality Danilovgrad.</p> <p>Mr Banovic said that this is a continuation of the project of modernisation and upgrade of HPP Perucica. Consultants who are in charge of development of documentation in accordance with KfW regulations (German Development Bank has allocated resources for financing the project of installation of power generation unit A8) have been hired for the purpose of implementation of this project. As part of the project and the Bank's requirements, EPCG is in charge of informing the local communities and local self-government about the project, i.e. to explain the type of construction works to the local community.</p> <p>Mr Krstic said that documentation will be prepared in accordance with KfW's methodology for the purpose of this project. The documentation will primarily present the impact of the project on the environment, people's health, as well as the social aspect of the project and its impact. When it comes to the project, it is important to note that this is a continuation and finalisation of the overall idea, which was developed in</p> |

the 1950s.

Mr Banovic said that the project documentation for HPP Perucica has existed since 1952. HPP Perucica was developed in phases, and that three phases have been completed so far (the first phase included two units, the second phase included three units, the third phase includes two units). The planned IV phase includes completion of the designed system, i.e. it is planned to install the eight unit in this phase. The unit 8 is going to have the capacity of 58.5 MW and the flow rate of 12.75 m<sup>3</sup>/s. With its installation, the installed capacity of the HPP is going to increase from the existing 307 MW to 365.5 MW, and thus HPP Perucica is going to become the HPP with the highest installed capacity in Montenegro.

The machine building of HPP Perucica was built in the 1960s, which is when the space for installation of unit A8 was already built and designated.

It was stated that the new unit is going to be able to take in the water from the catchment area, whereby this water is generated during the periods of heavy rainfall, and thus increase the capacity for energy production (and enable stabilisation of the network), while, on the other hand, it is going to mitigate the possibility of occurrence of flooding. On the other hand, the new unit also represents a replacement for the previously installed units (in case a fault occurs at one of the previously installed units). Generally, constant operation of all 8 units cannot be expected throughout the year, but only during certain periods during the year which are characterised by rainfall (fall/spring).

When it comes to construction works which are planned in the IV phase, Mr Pavicevic stated that the works which are going to be carried out at the retention basin (potential expansion of the inflow object which is located after the sedimentation pool, as well as the potential adaptation of the sedimentation pools, all with the purpose of improving the water flow). He deems that the abovementioned construction works are not going to have a significant impact on the environment. Additionally, when it comes to impacts on the environment, representatives of NEPA have been introduced to the project, thus they are going to provide their official stand in terms of the need for development of the Environmental Impact Assessment in accordance with the Montenegrin requirements.

After they were introduced with the project, Mr Ilija Grgurovic (Municipality Danilovgrad) stated that he stands at disposal for any type of cooperation, as well as his associates. He assessed the project as a project with a positive impact, and stated that this project is going to help to mitigate the water levels which occur in the catchment area after heavy rainfall.

When it comes to documentation, he stated that the Municipality has certain reports and plans which are related to the environment, and he stated that they will gladly respond to EPCG's requests and provide them with the relevant documentation. Anyhow, he expressed the willingness to visit the location at which the works are going to be



carried out, if that is possible.

EPCG is going to send an official memo to the Department for the purpose of provision of the abovementioned documentation.

### Photo log: 30<sup>th</sup> March 2022



**Lis of participants: 30<sup>th</sup> March 2022**


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**SASTANAK**  
**između predstavnika EPCG i Opštine Danilovgrad**

**Projekat:** Projekat rekonstrukcije i modernizacije HE „Perućica“ – ugradnja Agregata br.8  
 Upgrade of Hydro Power Plant Perucica - Installation of Unit U8



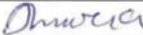

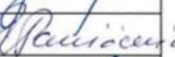

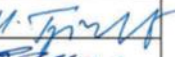



**Mjesto sastanka:** Zgrada Optine Nikšić, sala 3, I sprat

**Datum:** 30.03.2022.

**Tema:** Upoznavanje sa projektom i predstojećim aktivnostima:
 

1. Presentacija projekta
2. Ekološki aspekt projekta
3. Društveni aspekt projekta

Sastanku su prisustvovali:

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## 17.3 Supporting technical data/supporting special studies (results)

### 17.3.1 Biodiversity surveys

#### 17.3.1.1 ASSESSMENT OF THE STATE OF MACROZOOBENTHOS OF THE ZETA RIVER IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"



Prepared by: Miloje Šundić, expert on macrozoobenthos

Podgorica, June 2022



## **CONTENT**

### **ZOOBENTOS (COMMUNITY OF AQUATIC MACROINVERTEBRATES)**

1.1 Overview of the current situation with the environment

1.2 Literature review

### **2 METHODOLOGY**

### **3 RESULTS AND DISCUSSION**

### **4 ASSESSMENT OF THE SITUATION OF THE AREA**

4.1 Possible impacts (during construction / operational phase)

4.2 Proposed protection measures (during construction / operational phase)

### **5 REFERENCES**

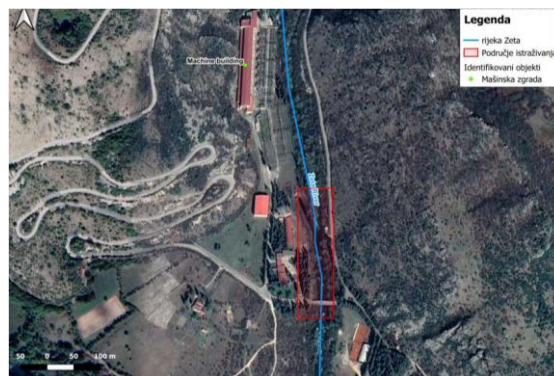
## ZOOBENTOS (COMMUNITY OF AQUATIC MACROINVERTEBRATES)

Macroinvertebrates are important factors in river communities as fundamental links in food chains between lower trophic levels (algae, detritus) and fish. Behavioral adaptations are evident especially with in aquatic insects and include regulatory behavior that controls growth. Individuals manifest it through metabolic status, harmonizing behaviors that include food collection or reproductive behavior that is responsible for the successful continuation of the lives of future generations (Wiley & Kohler, 1984). For example, behavioral drift, the deliberate entry of benthic organisms into the stream and their transport downstream is one of the most intriguing topic of interest to hydrobiologists for forty years (Waters, 1972; Muller, 1974; Brittain & Eikeland, 1988). This phenomenon can be essential for colonizing processes, searching for food or avoiding predators, all of which are related to the trophic position of the organism in the community. The composition of the macroinvertebrate community changes between the upper, middle, and lower reaches of rivers as a result of changes in the river environment (Vannote et al., 1980). The study of aquatic macroinvertebrates is one of the central topics of hydroecology. They are important links in the food chain, as well as a source of food for many species of fish. They can have a significant impact on nutrient circulation, primary production, decomposition, and translocation of matter (Wallace & Webster, 1996). Aquatic macroinvertebrate communities have characteristics that classify them as good and reliable indicators of changes in the ecological conditions that prevail and successively change in the aquatic ecosystem. Unlike the chemical parameters of water quality, which are indicators of the current state of the ecosystem, these communities with their structure show a trend of change (Tubić, 2016). A significant component of the Zeta River ecosystem is the biocenosis of animals marked as aquatic macroinvertebrates. These are organisms that, at least in one part of their life cycle, inhabit aquatic ecosystems (bottom, detritus, macrophytes, filamentous algae) and that can be affected by a mesh size > 200  $\mu\text{m}$  (Rosenberg and Resh, 1993). Aquatic macroinvertebrates include several faunal-ecological groups of organisms of different forms, of which the most common are: Insects - Ephemeroptera, Plecoptera, Trichoptera, Odonata, Coleoptera, Diptera, Heteroptera, Megaloptera and Neuroptera; Annelida - Oligochaeta, Hirudinea and Polychaeta; Mollusca - Bivalvia and Gastropoda; Platyhelminthes - Turbellaria; Crustacea - Isopoda, Mysida, Amphipoda and Decapoda, as well as some less common and abundant groups - Nematoda, Hydracarina, Collembola, Porifera. The distribution of macroinvertebrates in rivers is characterized by relatively regular changes in the qualitative composition of the community and its biomass, and the character of these changes differs from the type of river and ecological conditions in the ecosystem itself (Simić, 2002). Markovic (1998) believes that the structure of macroinvertebrates of the studied source ecosystems mostly depends on the type of substrate, water temperature and the amount of dissolved oxygen. Hydroecological research is important to us because it enables the assessment of the biodiversity of aquatic ecosystems, the compilation of a list of pollutants and various databases; with their help, it is possible to educate local communities and raise public awareness regarding the protection of such valuable resources (Živić, Marković & Ilić, 2005, Vasov, 2014). The EU Water Framework Directive (2000/60/EC) prescribes water policy frameworks, respecting the principles of sustainable development and integrated water management, with the aim of achieving a good status of all waters in the EU within 15 years. Annex B emphasizes the following biological elements as quality elements for the classification of the ecological status of rivers: composition and richness of aquatic flora, composition and richness of benthic invertebrate fauna and composition, richness and age of fish fauna. The general physico-chemical elements that accompany the biological elements are: thermal conditions, oxygen regime, salinity, nutrients and pH value. Based on biological and physico-chemical monitoring, it is possible to assign the following ecological status to surface waters: high, good, medium, weak and bad status. Analysis of



the composition of macroinvertebrate communities for biological assessment is a trend that European countries insist on (Vasov, 2014). The most common reasons for the widespread use of macrozoobenthos include: biological monitoring allows consideration of past and present state of the system (as opposed to physico-chemical, which shows only the current state) anthropogenic stress of aquatic ecosystems at all levels (Vasov, 2014). The structure and dynamics of communities and populations, as well as the abundance, richness and uniformity of species are most often studied (Todosijević, 2013). The fauna of aquatic macroinvertebrates of the Zeta River has not been sufficiently researched so far, so data on their number and distribution in this area / locality are very scarce. Longitudinal differentiation of aquatic macroinvertebrates (and other hydrobionts) is directly related to the state of hydrological conditions along the watercourse (Lindström and Traaen, 1984; Statzner et al., 1988; Davis and Barmuta, 1989; Yong, 1992), so longitudinal differentiation of macroinvertebrates is expected in qualitative and quantitative terms along the given points of the transect:

1. Locality T1 - 42°40'8.49"N,  
18°59'47.63"E
2. Locality T2 - 42°40'4.33"N,  
18°59'48.34"E



### Review of the current state of the environment

During the tour of the terrain, on the transit of the river Zeta according to the stated coordinates, the watercourse was found in hydrological and biological natural and preserved condition. The river and its trough are clean, partly overgrown with moss, with a richly developed riparian zone.

### Literature review

The literature data of this hydrological facility are mainly related to the localities of the southern course of the Zeta River, where the hydrological and bentological parameters of the river have been changed, and thus the qualitative characteristics of benthos. No literature data are available for the indicated locality, while for others they are given within the study of a wider area. Data on the leech fauna in the study area were provided by Grosser et al. (2016). Fauna of dragonflies (Odonata) (Gligorović et al., 2007, 2008, 2010; Gligorović, 2010, 2016). The fauna of water bugs in Montenegro has been insufficiently studied. Data on the Trichoptera fauna were given by Karaouzas et al. (2019), Dytiscidae (Coleoptera) were investigated in the area of Mareza (Pešić and Pavićević, 2005; Pavićević 2011), and freshwater decapod crabs Simić et al. (2008) and Rajković et al. (2012)

## METHODOLOGY

The fauna of aquatic macroinvertebrates of the Zeta River, during the month of May 2022, was collected by pulling a manual planktonic net three times by 50 cm, so that with each stroke a sample was collected from an area of 10 dm<sup>2</sup>. In this way, samples were collected from a number of different microhabitats, which resulted in a greater diversity of aquatic invertebrates. The material was collected using a manual benthic mesh with a mesh diameter of 500 µm. Sampling was performed by a combined technique of lifting material from the substrate and collecting it in a network oriented in the direction of water flow and manual collection from the substrate, semi-quantitative sampling in a defined time interval, collected from all available habitats, in proportion to their representation.

Subsamples were collected from dominant substrate types to provide a representative sample for a given part of the flow. Entomological networks and the technique of active search for invertebrates (by eye) were used to collect terrestrial fauna. 4% formaldehyde was used as a fixative to preserve the samples collected at these sites. In the field, the organisms were separated from the sediment by decantation and sieved through a benthic sieve. Under the magnification of the Zeiss Stemi 305 stereomicroscope, the organisms were extracted from parts of the medium and counted.

Determination was done up to the family level and in some cases up to the species. The keys according to the following authors were used to identify the Diptera group: Nilsson (1997), Vallenduuk & Pillot (2007) and Pillot (2009). Odonata individuals were identified using the keys of Bešovski (1994) and Nilsson (1997), the Coleoptera group was identified by the key Javorek V. (1968). Keys according to Wallace et al. Were used to identify Trichopter. (1990) and Edington and Hildrew (1995). Sampled Ephemeroptera material was identified using the keys of Belfiore (1983) and Elliott et al. (1988), while the keys to Hynes (1967) and Zwick (2004) were used to identify Plecopters.

### *Shannon Wiener Index (H')*

Using this index, we determine the diversity of the community. This index is the best for comparison because it is relatively independent of the sample size, it gives equal importance to rare species.  $H' = -\sum (pi) \times \log_{10} (pi)$  where pi represents the ratio of the number of taxon and the total number of all species (H'). The higher the value of the index, the higher the number of species in relation to the number of individuals in the community (Karadžić et al., 2009).

### *Biotic Index by Family (FBI)*

This index is used to assess the quality of surface water, based on the present families of aquatic organisms, and is calculated as follows:  $FBI = \sum x_i t_i / n$  where  $x_i$  represents the number of individuals within the taxon, and t the tolerance to pollution and n the total number of organisms in the sample. The values of this index range from 0-10 (Table 2), with higher values indicating a higher degree of organic pollution (Hauer et al., 2007).

## Research goals

One of the objectives of this study was to determine the composition and structure of the aquatic macroinvertebrate community at the study site. Special attention is paid to the groups Ephemeroptera, Plecoptera and Trichoptera. The focus of the study was also on determining the part of the overall macroinvertebrate community that makes up these three groups. One

of the goals was to determine water quality using the FBI and the diversity of the macroinvertebrate community.

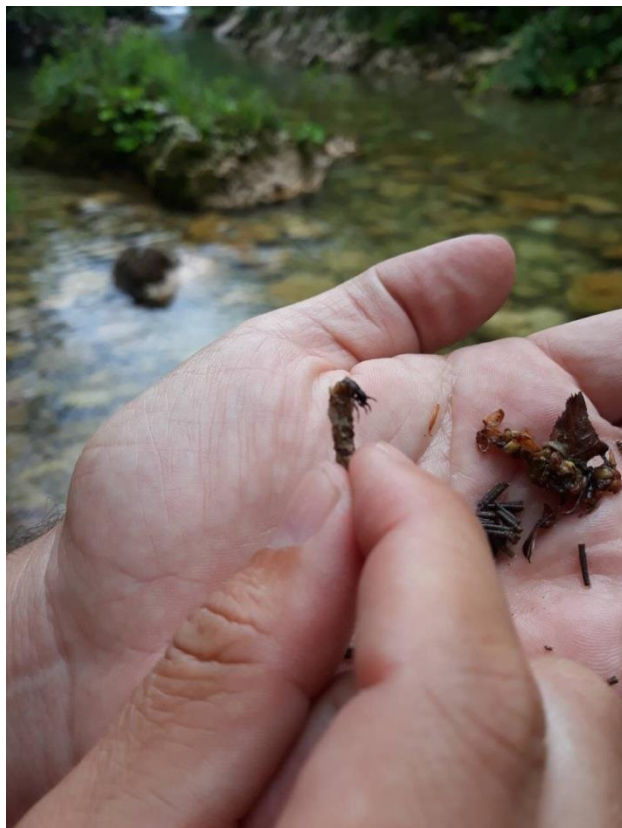
## RESULTS AND DISCUSSION

**Table 1. Qualitative composition of aquatic macroinvertebrates at the investigated localities (T1-T2) of the Zeta River (May, 2022).**

| Sampling locations/taxons   | T1 | T2 |
|-----------------------------|----|----|
| <b>TURBELLARIA</b>          |    |    |
| <i>Dugesia sp.</i>          | +  | +  |
| <b>OLIGOCHAETA</b>          |    |    |
| Naididae                    |    |    |
| <i>Nais sp.</i>             | +  | +  |
| <i>Stylaria sp.</i>         |    | +  |
| Tubificidae                 |    |    |
| <i>Limnodrilus sp.</i>      |    | +  |
| <b>HIRUDINEA</b>            |    |    |
| <i>Glossiphonia sp.</i>     |    | +  |
| <b>MOLLUSCA</b>             |    |    |
| <i>Ancylus fluviatilis</i>  | +  | +  |
| <i>Teodoxus fluviatilis</i> | +  |    |
| <i>Radomaniola curta</i>    |    | +  |
| <i>Bithynia radomani</i>    |    | +  |
| <b>CRUSTACEA</b>            |    |    |
| <i>Gammarus balcanicus</i>  |    | +  |
| <i>Asellus aquaticus</i>    | +  | +  |
| CI. INSEKTA                 |    |    |
| <b>ODONATA</b>              |    |    |
| <i>Cordulegaster sp.</i>    |    | +  |
| <b>TRICHOPTERA</b>          |    |    |
| <i>Hydropsyche sp.</i>      | +  | +  |
| <i>Limnephilus sp.</i>      |    | +  |
| <i>Leptocerus sp.</i>       |    | +  |
| <b>EPHEMEROPTERA</b>        |    |    |
| <i>Baetis sp.</i>           | +  | +  |
| <i>Ephemerella sp.</i>      |    | +  |
| <i>Heptagenia sp.</i>       |    | +  |
| <b>HEMIPTERA</b>            |    |    |
| <i>Aphelocheirus sp.</i>    |    | +  |
| <b>PLECOPTERA</b>           |    |    |
| <i>Isoperla sp.</i>         | +  | +  |
| <i>Protonemura sp.</i>      |    | +  |
| <b>DIPTERA</b>              |    |    |
| <i>Eloeophila sp.</i>       | +  | +  |

| Sampling locations/taxons | T1 | T2 |
|---------------------------|----|----|
| <i>Hexatoma sp.</i>       |    | +  |
| <i>Antocha sp.</i>        |    | +  |
| Tipulidae                 | +  | +  |
| Tabanidae                 |    | +  |
| Culicidae                 | +  | +  |
| Chironomidae              |    |    |
| <i>Orthocladius sp.</i>   | +  | +  |
| Dixidae                   |    |    |
| <i>Dixa sp.</i>           | +  | +  |
| <i>Ceratopogonidae</i>    |    | +  |
| <b>COLEOPTERA</b>         |    |    |
| Elmidae                   |    |    |
| <i>Elmis sp.</i>          |    | +  |
| <b>HETEROPTERA</b>        |    |    |
| Velidae                   |    | +  |
| Hebridae                  |    | +  |
| <b>MEGALOPTERA</b>        |    | +  |
| <b>HIDRACHNIDIA</b>       | +  | +  |

Apart from the physical and chemical conditions in the aquatic environment, hydrobionts are also adapted to the movement of water. Due to the cold and fast water in the upper reaches of the river (the area of the citadel), the rock base and the relatively constant environmental



**Figure 1. Part of the collected taxons**

conditions, they have a special set of adaptations to avoid flooding and require a large amount of oxygen. The community of aquatic macroinvertebrates consists of stenothermic organisms with dorsoventrally flattened body shape, specific attachment organs and other morpho-anatomical and physiological adaptations. In the area of the retron, where the water flow rate is lower, forms of aquatic macroinvertebrates characteristic of the middle and lower reaches occur (Grginčević et al., 1998).

During this study along the transect, a total of 35 different aquatic macroinvertebrate taxons were found, but due to the fact that some groups were not determined to the species level but only to the genus level (Hidrachnidia, Heteroptera, Ceratopogonidae) or the determination was done only to the family level. Diptera), the actual number of species is higher (Graph 1).

Most taxons belong to the group of insects (73%), which is a general characteristic of fast-flowing streams with sandy-rocky riverbeds. In terms of diversity, the orders Diptera, Trichoptera, Ephemeroptera,

Plecoptera and Coleoptera are dominate. Abundance among groups is distributed differently than the number of taxons. The Mollusca group dominates, representing 33% of the total number of sampled individuals. Significant numbers are also shown by taxons from the order Diptera - 27%, Ephemeroptera - 10%, Trichoptera - 8%, Plecoptera 7%, Crustacea (*Gammarus balcanicus*) 5%. There are fewer groups of Coleoptera - 3%, Oligochaeta - 2% and Heteroptera 1.5%, while other groups are represented by numbers of 1% and less (Graph 1).

*Gammarus balcanicus* is present only at the T2 locality while *Asellus aquaticus* is collected along the entire transect. Families that show significant abundance within the Ephemeroptera group are Ephemeridae and Baetidae. Lepidostomatidae dominate within the order Trichoptera. The group Plecoptera, which is an important representative of hilly and mountainous rivers and streams, is represented by the families Leuctridae and Perlidae. The order Diptera is the second most represented group of aquatic macroinvertebrates, within which the most important representatives are the families Culicidae, Chironomidae and Dixidae. A huge number of emerging adult mosquitoes floating above the water surface is present along the entire transect between points T1 and T2. Coleoptera is dominated by representatives of the Elmidae family. The Heteroptera group is dominated by the Velidae and Hebridae families. Amphipoda, Ephemeroptera, Plecoptera, Trichoptera and Diptera are groups that are spread throughout the transect. The most common species are Hirudine and

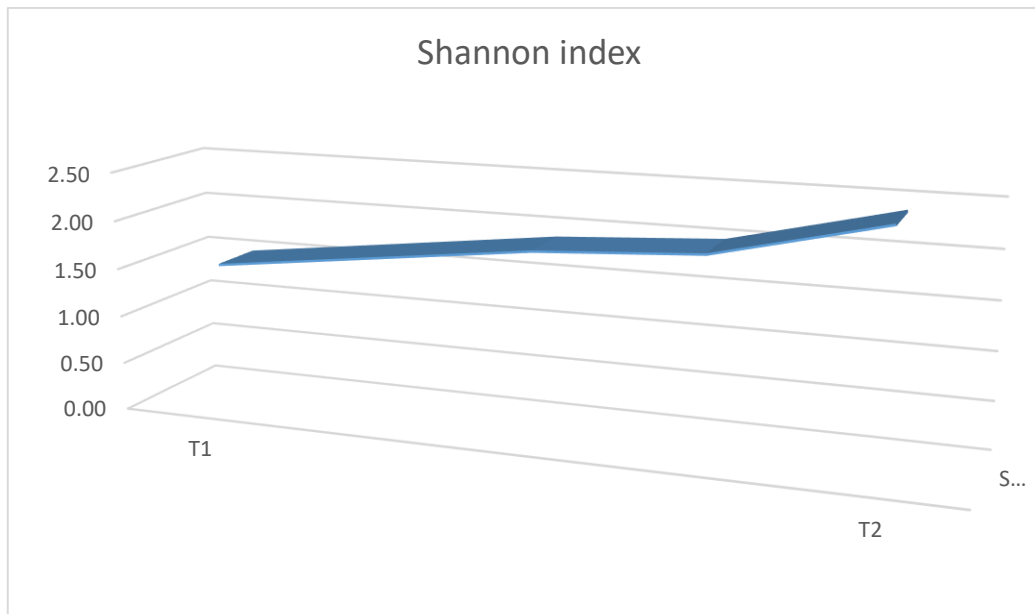


Heteroptera. Coleoptera are isolated only downstream. Along the entire T1-T2 transect of the Zeta River, dominance in total abundance belongs to the Mollusca and Diptera groups.



**Graph 1. Diversity of aquatic macroinvertebrate taxons on the transect of T1-T2 positions**

The highest community diversity (Shannon's diversity index,  $H'$ ) was found at Zeta-T2 and was 2.4, while the lowest diversity was found at T1 and 1.4 (Graph 2).



**Graph 2. Values of the Shannon index on the transect of T1-T2 positions**

The Shannon Diversity Index shows higher values at the downstream localities. The highest diversity of aquatic macroinvertebrates according to this index was recorded at the

measurement site T2 in the lowest part of the course, while the lowest diversity was found at the measurement site T1 at the most upstream sampling points. Such values were also expected given the significantly higher number of species in the downstream localities in which we find a greater diversity of substrates compared to the measured values downstream. The composition of the river flow substrate (size and heterogeneity) as well as the presence of aquatic vegetation and organic matter play a dominant role in the composition of communities (Williams and Williams, 1998).

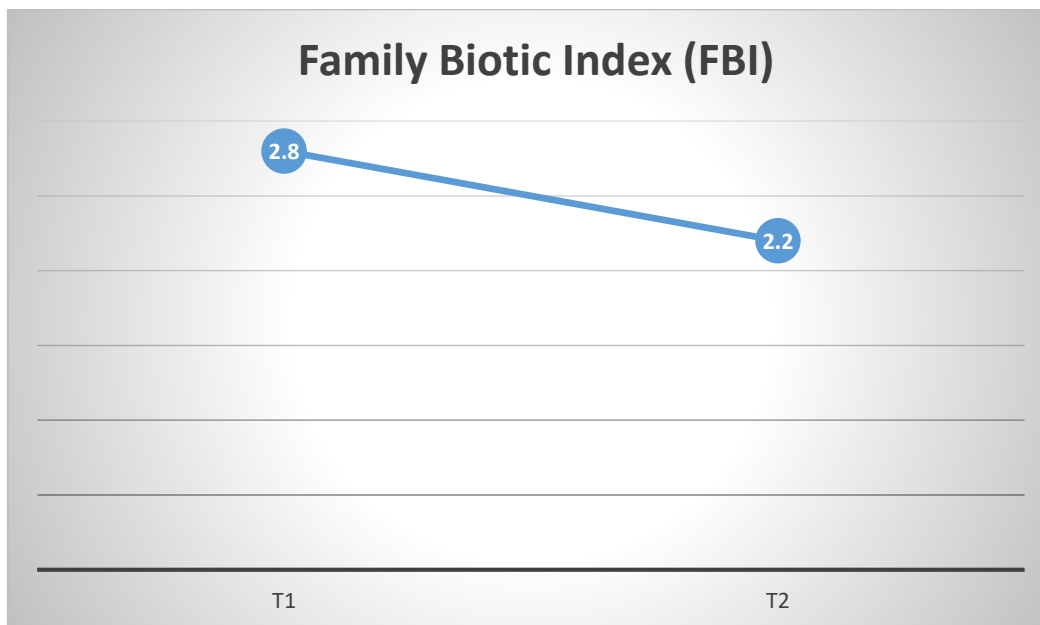
At locality T1, the order Amphipoda, together with the insect orders Ephemeroptera, Plecoptera, Trichoptera and Diptera, makes up a total of over 60% in total abundance. According to the number of isolated taxons, Mollusca and Diptera groups with 7 identified taxa dominate. Other groups are represented by one taxon out of a total of 4 isolated at this locality.

At locality 2, the most diverse group is also represented by Mollusca and Diptera with a total of 12 taxons. However, it is joined by the order Ephemeroptera, Trichoptera and Oligochaeta with 3 each, Plecoptera and Heteroptera with 2 identified taxons each, while other groups are represented by 1 taxon each. The dominance of the population of the Mollusca group at the T2 locality is joined by the Amphipoda and Diptera group and together they make up over 80% of the total number of sampled individuals at that locality.

Family Biotic Index values range from 2.80 (locality T1) to 2.20 (locality T2). The values of the index indicate that the waters at these sites belong to the 1st quality class in relation to the degree of organic pollution, i.e. oligosaprobic waters that are unloaded or slightly organically loaded (Graph 3).

**Table 2. Family Biotic Index (FBI) values for certain water qualities according to Hilsenhoff (1988)**

| Index value | Water quality |
|-------------|---------------|
| 0,00-3,75   | Excellent     |
| 3,76-4,25   | Very good     |
| 4,26-5,00   | Good          |
| 5,01-5,75   | Average       |
| 5,76-6,50   | Average bad   |
| 6,51-7,25   | Bad           |
| 7,26-10,00  | Very bad      |



**Graph 3. Values of the family biotic index at the investigated localities T1 and T2**

## Discussion

Aquatic macroinvertebrates are, in addition to organic load, directly related to hydromorphological changes in the watercourse (Cota et al., 2002). The localities in the upper parts of the watercourse had a smaller variety of substrates, and at some measuring positions the watercourse was hydromorphologically altered, which led to the disappearance of certain microhabitats. This is also one of the reasons why at the T1 site, we find fewer groups compared to the T2 site of the lower part of the stream. The dependence of the composition of aquatic macroinvertebrate communities on hydromorphological changes of watercourses (changes in the substrate structure change the benthic invertebrate community) is not included in this study due to the lack of national methodology for their assessment.

The abundance of a particular species (group) depends on the life cycle, specific behaviour, and can be increased or decreased by changing biological conditions of the habitat (Bêche et al., 2006), but the values of the diversity index must always be correlated with water quality (et al., 2000), which was also shown by this research where, according to the diversity index, the lowest values were at the site upstream. Measured values at the bottom parts of the stream also do not show a direct link between the diversity index and water quality. Therefore, the obtained values of the Shannon Diversity Index should be considered with caution and should be used as ancillary index in determining ecosystem status and always interpreted in combination with other biological index's as well as basic physicochemical indicators (Lydy et al., 2000).

**EPT index.** Three groups of insects (Ephemeroptera, Plecoptera and Trichoptera) are distinguished from the group of macroinvertebrates, which are used in methods of biological assessment of water quality as a metric trait - EPT index, which reliably separates polluted from clean sites (Wallace, Grubaugh and Whiles 1996). Most species from these three groups are sensitive to organic pollution, which makes them good and reliable indicators of water quality.

An important characteristic of Ephemeroptera is their short lifespan. They are very well adapted to the habitat, have a flattened body and extensions in places where there is a strong current of water. There are more than 300 different species in Europe and they are quite difficult to determine. During their lifetime, they are changing several times, and after the last change, they have a winged shape - subimago, which changes once again (Kerovec, 1986). A large number of Ephemeroptera have already emerged as adults, continuing their ontogenetic development along the river.

Plecopters can be easily identified and distinguished from other similar individuals. They differ in the extensions at the end of the body of which there are two, the claws on the feet, the foot built of three ankles. They usually live under rocks at the bottom of fast flowing, clean waters. After the last digestion that takes place on stones or plants, the adult is an adult (Kerovec, 1986). Also, a large number of Plecoptera have already emerged as adults.

The insect order Trichoptera is one of the most widely groups of macroinvertebrates used in river water quality assessment, along with the orders Ephemeroptera and Plecoptera (Wright et al., 2000). The most important characteristic of Trichoptera larvae is that they build 4 types of houses from available material to increase body weight to resist water current (from gravel, sand, plant material and material of animal origin - mollusk shells), depending on water flow rate (Dohet, 2002). There are also wild species. They are sensitive to different types of pollution due to poor mobility but also due to the long life cycle (Dohet, 2002).

Simple identification of these groups facilitates the application of the EPT index. The EPT index (Ephemeroptera, Plecoptera and Trichoptera as bioindicators (EPT)), used to determine water quality based on the presence and abundance of Ephemeroptera, Plecoptera and Trichoptera as bioindicators in a benthic unit sample, reliably separates contaminated from clean sites (Wallace, Grubaugh and Whiles 1996). Most species from these three groups are sensitive to organic pollution, making them reliable and useful indicators of water quality. Therefore, as the quality of the environment deteriorates, the total number of species recorded in the sample decreases. EPT indices show wealth within insect groups, i.e. their number increases with increasing water quality (Plafkin et al., 1989). Also, this index is valid for use at the family level (Plafkin et al., 1989) and is equal to the total number of families present within these three rows in the sample.

## ASSESSMENT OF THE SITUATION OF THE AREA

Based on the presented results, a number of conclusions may be drawn about the diversity value of both individual groups of macro-invertebrates, as well as the whole communities that they create in River Zeta along longitudinal transects.

1. The Mollusca community dominates (in the amount of biomass) in the sample at both sites and shows a clear and significant correlation with many physico-chemical parameters in the study area. Given that this community is relatively conditioned by the amount of dissolved oxygen, as an important parameter for determining the "health" of aquatic ecosystems, we cannot use it as an indicator of the state of ecosystems.
2. The community of Ephemeroptera is the second in the presence of biomass in the studied localities and also shows correlations with the analyzed physical and chemical parameters in the studied area. Given that previous studies of the macroinvertebrate community in the Central Balkan rivers show that Ephemeroptera is one of the dominant groups of zoobenthos, the presented results confirm the hypothesis that this group is suitable for bioindicator studies, which may reduce the need to analyze the whole macroinvertebrate community.

3. The community of Trichoptera and Plecoptera monitors the previous two groups in terms of biomass. Given that this community is highly conditioned by the amount of dissolved oxygen, as an important parameter for determining the "health" of aquatic ecosystems, we can say that it can be used as a good indicator of the state of ecosystems. In unfavourable conditions, the community of Trichoptera significantly impoverishes the species (it becomes homogeneous), which is another confirmation that this community is a good bioindicator of water quality. Apart from the temperature of water and dissolved oxygen, the availability of certain microhabitats is one of the most important factors influencing the appearance and distribution of Trichoptera larvae.
4. The value of the FBI on the determined transect (localities 1-2) in the river Zeta is from 2.20 to 2.80, which classifies it as water with a very good quality, i.e. belongs to quality class I on a quarterly basis. It is necessary to determine the value of the autumn and winter periods in order to obtain the total value of the FB index (Graph 3).
5. The diversity of the Gastropoda community is not primarily conditioned by water quality (as is the case with the Ephemeroptera and Trichoptera community). Despite the fact that the Gastropod community is highly correlated and determined by a very important parameter of water quality, oxygen concentration, it is not significantly dependent on nutrient concentration. Hydrological factors such as river speed, percentage of stable substrate, as well as biotic factors such as competition have a strong influence on its structure and diversity, so the diversity of this community is extremely low in relation to values. which would be expected depending on water quality. This group achieves the greatest diversity in localities that have sufficient amounts of periphyton mass and a higher presence of macrophytes, especially if both parameters are high. It is also noticed that diversity has a general trend of increasing value downstream, which is in line with the increase in the size of the river itself, and thus with the increase in microdiversity diversity, which coincides with the claim that aquatic gastropods are strongly influenced by habitat size. Based on this, it can be concluded that this group cannot be used as a stand-alone indicator group for biodiversity, but it forms a significant part of the use of the whole community of macroinvertebrates for the purpose of studying overall diversity. The measure of community diversity of Hirudine, Oligochaeta, Hidracarina, Plathelminthes, Oligochaeta and Coleoptera cannot be used as a clear indicator of the state of the ecosystem on the presented transect, and therefore the group is not suitable for this type of bioindication. On the other hand, the change in the total number of individuals in these groups (collectively all species) is accompanied by changes in nutrient concentrations (in collective form P + N), so the consideration of these groups in this regard is applicable.
6. Based on the analysis of the macroinvertebrate community in the presented transect, it is concluded that the diversity in this period of the year depends largely on the concentration of nutrients (the lower the concentration, the higher the diversity), but also on the relationship between nutrients and mostly from the water level. Diversity also depends to a large extent on the concentration of oxygen.
7. Analyzing the overall state of diversity in the studied locations of the Zeta River, it is concluded that the total species and population diversity of macroinvertebrates is relatively low, as indicated by the Margalef index, which ranged from 1.1 to 2.2.
8. The large amount of invertebrate biomass, represented in large populations of Plecoptera, Trichoptera, Ephemeroptera and Crustacea, is an important food resource for the fish community in this part of the river.



9. During the research at the localities in question, no species was found that was placed under protection by the decree of the Republic Institute for Nature Protection (Decree on placing certain plant and animal species under protection by the decision of the Republic Institute for Nature Protection, Official Gazette of the Republic of Montenegro No. 76/06a, 2006 ).

### **Possible impacts (during construction / operational phase)**

During the construction works on this locality, depending on the size of the intervention and impact on the riverbed, turbidity or drying, significant disturbances in the trophic chains of zoobenthos, loss of biodiversity and microhabitats can occur. It should be noted that aquatic macroinvertebrates are the basic food resource for fish, so the reduction of this trophic link would endanger the fish of this locality. They have a significant impact on nutrient circulation, primary production, decomposition and translocation of matter. Aquatic macroinvertebrate communities have characteristics that classify them as good and reliable indicators of changes in the ecological conditions that prevail and successively change in the aquatic ecosystem. Unlike the chemical parameters of water quality, which are indicators of the current state of the ecosystem, these communities with their structure show a trend of change.

### **Proposed protection measures (during construction / operational phase)**

Regardless of the temporary environmental impacts, it is necessary to take all legal measures to minimize all temporary environmental impacts. This category includes all those protection measures that need to be taken within the planning and project concept, and whose application is a prerequisite for minimizing possible environmental impacts. Accident situations during the implementation of the project would be changes in the hydraulics and geometry (morphology) of the riverbed, turbidity of water, leakage of oil or lubricants from the engaged machinery due to their possible malfunction, which would lead to water pollution. In the event of such an accident, it is necessary to urgently repair and restore the location to its original condition, prepare a report and take corrective and preventive measures. If during the execution of works there is a large turbidity of water, the works must be suspended until the moment of achieving adequate water clarity. At the same time, the contractor must not release pollutants and waste materials into the water. Due to the location of the project, it is necessary to monitor the state of biodiversity at the site and its immediate surroundings. Biodiversity monitoring should be done once a year.

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**17.3.1.2 ASSESSMENT OF THE STATE OF THE INVERTEBRATE FAUNA (INSECTS) IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"**

Prepared by: Suzana Malidžan, insect expert

Podgorica, June 2022

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## CONTENT

1. INVERTEBRATE FAUNA (INSECTS)
  - 1.1 Review of the current state of the environment
  - 1.2 Literature review
2. RESEARCH METHODS
3. PRESENTATION OF RESULTS
4. ASSESSMENT OF THE SITUATION OF THE AREAENA STANJA PODRUČJA
  - 4.1 Possible impacts (during construction / operational phase)
  - 4.2 Proposed protection measures (during construction / operational phase)
5. REFERENCES
6. APPENDIX: PHOTOLOG



## INVERTEBRATE FAUNA (INSECTS)

Insects are the largest group of arthropods and the most widespread group of animals on earth with over a million described species, which is more than half of all known living organisms. The European insect fauna numbers over 100 thousand described species grouped in about 30 orders. The total number of registered species of this class (Insecta) is not known, not even approximately, primarily because many groups of insects are almost completely unexplored or there are only sporadic data. Among the groups for which there are data for Montenegro, are primarily butterflies, both diurnal (Rhopalocera) and some groups of moths (Noctuidae, Geometridae, Sphingidae, Pyralidae, Tortricoidae, etc.), followed by dragonflies (Odonata), ants (Formicidae), hay flies (Syrphidae) as well as individual families or genera of beetles (Carabidae, Scolytidae, Cicindelidae, Chrysomelidae), orthoptera (Orthoptera), and long-legged mosquitoes (Tipulidae), fruit flies (Tipulidae), fruit flies (Heteroptera), Heteroptera (Drosophilidae) Neuroptera, Cicadidae, Aphidae, etc.

Insects are rarely used as edification species or as umbrella species when it comes to selecting and protecting certain areas, and one of the reasons is insufficient level of knowledge about the role of insects in general, or individual groups, in nature. Therefore, it is necessary to continuously acquire new knowledge about the ecology of certain species, as well as their application in the evaluation and protection of certain areas. Special emphasis should be placed on rare and endangered species, highly specialized species, endemic species. Despite the important role that insects play in nature (from pollination, decomposition of materials, destruction of pests, to the role they play in the food chain and the circulation of matter and energy in nature), until recently, not enough importance was attached to their preservation.

One of the challenges we face during insect research is that it is a very numerous and diverse group, whose systematic research requires more experts dealing with different groups. On the other hand, given the different ecological characteristics (preferred habitat/microhabitat, period and mode of flight, hiding, daily dynamics and behavior), it takes a lot of time and patience to register many species. Insects are very sensitive to environmental conditions, so we will not find them in the field if the climatic conditions are unfavorable (low temperatures, wind, precipitation, clouds). Also, the appearance of many species is conditioned by vegetation. All these factors have an impact on the results of research and detection of individual species.

### Review of the current state of the environment

Insight into the available literature, we do not find published data for the subject locations (compensation basin - Slivlje/Ozrinići and the location of the machine building of HPP Perućica - Bogetići), as well as for their immediate surroundings. The data to be provided later in this chapter mainly relate to the lower half of the Zeta River Valley, downstream of the Glava Zeta site.

### Literature review

Regarding the catchment area of the river Zeta in the territory of Danilovgrad, the insect fauna was studied within the "Study of the protection of the protected natural resource of the valley of the river Zeta". It also included literature data that primarily referred to the fauna of dragonflies - Odonata (Gligorović et al., 2010; Knijf et al., 2013; Buczinski et al., 2014; Gligorović, 2016). This study does not cover the area immediately around the Perućica hydroelectric power plant, but there are several sites on the stretch from Glava Zeta,

Milojević to Viš and further downstream towards Spuž. Regarding butterfly fauna, data for the investigated area are scarce (Sobczyk and Gligorović, 2016), and Gligorović et al. (2018), provided data on the fauna of aquatic and semi-aquatic Hemiptera in springs in the Skadar Lake basin, where part of the Zeta river basin area was treated. There are also scarce data for the Trichoptera fauna for springs in the vicinity of the Zeta River (Karaouzas et al., 2019), while Pešić and Pavićević (2005) provide data on the fauna of the Dytiscidae (Coleoptera) family. Gligorović, A. (2009) provides data on the fauna of Coccinellidae (Coleoptera).

According to the "Study for the Protection of the Protected Natural Heritage of the Zeta River Valley", a total of 221 species of insects were registered in the study area, of which 70 species of diurnal butterflies (Lepidoptera), of which *Iphiclides podalirius*, *Papilio machaon*, *Zerynthia polyxena*, *Lycaena dispar*, *Euphydryas aurinia*, *Euphydryas maturna*. Then, 43 species of dragonflies (Odonata) were registered, including *Cordulegaster heros* (species from Annex II and IV of the EU Habitats Directive), as well as *Coenagrion ornatum* from Annex II of the mentioned Directive. Also, it is stated that 45 species of Coleoptera from the families Coccinellidae, Lucanidae, Scarabaeidae, Cerambycidae, Dytiscidae, Hydrophilidae, Gyrinidae have been recorded, of which the following species are of national or international importance, *Cerambycanus cerdo*, *Oryctes nasicornis*. 28 species of orthoptera (Orthoptera), 3 species of mantises (Mantodea) and 8 species of water moths (Trichoptera) were also registered.

## RESEARCH METHODS

Since insects represent the most numerous and ecologically diverse group of animals, their ecological characteristics are also very diverse, and considering the ways of collecting and scientific processing of materials. For the collection of most species, especially "good fliers", a standard entomological network is mainly used, while for the so-called method. "Mowing" uses nets with dense weaving. Also, different types of traps are used: from fragrant traps, including the Malais trap, to different photo traps for collecting certain groups of insects. In the case of Coleoptera species, odour traps were used, from which specimens were collected after 10 to 15 days, stored in 70% alcohol and determined in laboratory conditions. In certain cases, when species in the field are recorded in the juvenile stage, they are collected with organic material, most often parts of plants or their remains, and grown in special chambers.

During this year's research, the standard entomological network was primarily used to collect individual species of Lepidoptera, Diptera, Hymenoptera, Odonata and individual Coleoptera, and when it comes to river flow research, the transects along which material sampling was performed were determined. A large number of specimens, which could be determined in the field (determined to the level of the species), were then released, while one part was retained, and later determined in laboratory conditions, using a binocular stereo microscope and adequate professional literature. Standard entomological keys were used to determine the species. Some specimens, unambiguously and easily recognizable in the field, have been recorded without hunting. When it comes to rare and endangered species, they were photographed, recorded and returned to nature after registration in the field.

For the purpose of assessing the condition of the insect fauna in the subject area, two field days were conducted at the end of May and the beginning of June 2022. Rapid monitoring was performed for the purpose of creating a zero state of insect fauna in the area where the project activities are planned in order to improve the operation of the hydroelectric power plant "Perućica".

## PRESENTATION OF RESULTS

For the needs of the project task, two field days were conducted (end of May / beginning of June 2022) for the purpose of researching the insect fauna at the localities in question. For this purpose, we visited the completely narrower belt around the accumulation / retention (Slivlje), with more detailed research at several locations. Also, research was carried out in the area around the mechanical plant of HPP Perućica, but also in a couple of locations downstream from the dam. Table 1 gives the coordinates of the investigated localities.

**Table 1. Overview of researched localities**

| Locations                           | Coordinates             |
|-------------------------------------|-------------------------|
| Slivlje                             | 42.717849°N 18.995261°E |
|                                     | 42.717299°N 18.997711°E |
|                                     | 42.718256°N 18.999742°E |
|                                     | 42.720002°N 18.999071°E |
|                                     | 42.720473°N 18.996862°E |
|                                     | 42.720397°N 18.994587°E |
|                                     | 42.719556°N 18.992259°E |
|                                     | 42.718570°N 18.990855°E |
| 42.717279°N 18.994064°E             |                         |
| Bogetići (surroundings of Perućica) | 42.673261°N 18.995998°E |
|                                     | 42.672472°N 18.996387°E |
|                                     | 42.670162°N 18.996906°E |
|                                     | 42.667933°N 18.997295°E |
|                                     | 42.667484°N 18.996495°E |
| Glava Zeta                          | 42.654641°N 19.007064°E |
|                                     | 42.653678°N 19.005696°E |

Below are the species that were registered in the subject areas during the research. Most of these species are registered in both areas.

**Table 2. Overview of registered insect species in the study area**

| Group / order | Registered species   |
|---------------|--|
| Lepidoptera   | <i>Papilio machaon</i> , <i>Iphiclides podalirius</i> , <i>Zerynthia polyxena</i> , <i>Pieris brassicae</i> , <i>Pieris manni</i> , <i>Pieris napi</i> , <i>Pieris rapae</i> , <i>Anthocharis cardamines</i> , <i>Aporia crataegi</i> , <i>Colias crocea</i> , <i>Gonepteryx rhamni</i> , <i>Leptidea sinapis</i> , <i>Argynnis adippe</i> , <i>Argynnis aglaja</i> , <i>Argynnis paphia</i> , <i>Euphydryas aurinia</i> , <i>Aglais urticae</i> , <i>Issoria lathonia</i> , <i>Polygonia c-album</i> , <i>Vanessa atalanta</i> , <i>Vanessa cardui</i> , <i>Hyphodryas aurinia</i> , <i>Libythea celtis</i> , |

| Group / order | Registered species  |
|---------------|---|
|               | <i>Callophrys rubi</i> , <i>Melitaea cinxia</i> , <i>Melitaea didyma</i> , <i>Melitaea phoebe</i> , <i>Limenitis reducta</i> , <i>Melanargia galathea</i> , <i>Brintesia circe</i> , <i>Lasiommata megera</i> , <i>Maniola jurtina</i> , <i>Polyommatus icarus</i> , <i>Satyrium w-album</i> , <i>Coenonympha</i> sp., <i>Brenthis</i> sp., <i>Erebia</i> sp., <i>Pyrgus</i> sp., <i>Macroglossum stellatarum</i> , <i>Euplagia quadripunctaria</i> i <i>Saturnia pyri</i> .  |
| Coleoptera    | <i>Oryctes nasicornis</i> , <i>Coccinella septempunctata</i> , <i>Melolontha melolontha</i> , <i>Geotrupes stercorarius</i> , <i>Trichius fasciatus</i> , <i>Cetonia aurata</i> , <i>Forficula auricularia</i> , <i>Ocyopus olens</i> , <i>Meloe</i> sp., <i>Geotrupes</i> sp., <i>Cicindela</i> sp., <i>Cybister lateralimarginalis</i> , <i>Hydrophilus piceus</i> , <i>Tropinota</i> sp, <i>Ruptelia maculata</i> , <i>Carabus</i> sp., <i>Pterostichus</i> sp.  |
| Odonata       | <i>Calopteryx virgo</i> , <i>Sympetrum striolatum</i> , <i>Sympetrum meridionale</i> , <i>Gomphus vugatisimus</i> , <i>Ischnura elegans</i> , <i>Lestes barbarus</i> , <i>Coenagrion puella</i> , <i>Coenagrion</i> sp., <i>Orthetrum cancellatum</i> , <i>Anax imperator</i> , <i>Crocothemis aerithraea</i> , <i>Caliaeschna microstigma</i> , <i>Pyrrhosoma naymphula</i> .  |
| Mantodea      | <i>Mantis religiosa</i> , <i>Empusa fasciata</i> .  |
| Hymenoptera   | When it comes to Hymenoptera, presence of a large number of Western honey bees, violet carpenter bee ( <i>Xylocopa violacea</i> ) and several types of wild bees (Apidae), wasps (Vespidae), and European hornets ( <i>Vespa crabro</i> ) were identified, along with several types of bumblebees (Bombidae), as well as several species of ants (Formicidae).  |
| Diptera       | Mosquito species (Culicidae), crane flies (Tipulidae), flies (Muscidae).<br>The following hoverflies (Syrphidae) were identified: <i>Cheilosia flaviceps</i> , <i>Cheilosia ranunculi</i> , <i>Chrysotoxum cautum</i> , <i>Episyrphus balteatus</i> , <i>Eristalis tenax</i> , <i>Eristalis arbustorum</i> , <i>Eristalis similis</i> , <i>Malanostoma mellinum</i> , <i>Meliscaeva auriculis</i> , <i>Microdon devius</i> , <i>Neoascia podagrica</i> , <i>Pipizella</i> sp., <i>Helophylus trivittatus</i> , <i>Scaeva pyrastris</i> , <i>Sphaerophoria scripta</i> , <i>Syritta pipiens</i> , <i>Syrphus ribesii</i> . |
| Hemiptera     | Several types of the family species Pantatomidae were recorded  |
| Orthoptera    | <i>Anacridium aegyptum</i> , <i>Grylus campestris</i> , <i>Gryllotalpa gryllotalpa</i> , <i>Tettigonia</i> sp., (as well as several species from families Acrididae and Tettigoniidae)  |

### Species of national and international importance

Table 3. Species of national and international importance registered during this year's research

| Group / species | IUCN category | HD EU accessories | BERN accessories | CITES accessories | Protection in Montenegro |
|-----------------|---------------|-------------------|------------------|-------------------|--------------------------|
| Lepidoptera     |               |                   |                  |                   |                          |

| Group / species   | IUCN category | HD accessories | EU accessories | BERN accessories | CITES accessories | Protection in Montenegro |
|---|---------------|----------------|----------------|------------------|-------------------|--------------------------|
| Papilionidae  |               |                |                |                  |                   |                          |
| <i>Papilio machaon</i><br>Linnaeus, 1758                    | LC            |                |                |                  |                   | Yes                      |
| <i>Iphiclides podalirius</i><br>(Linnaeus, 1758)            | LC            |                |                |                  |                   | Yes                      |
| <i>Zerinthia polyxena</i><br>(Denis & Schiffermüller, 1775) | LC            | IV             |                |                  |                   |                          |
| Nymphalidae   |               |                |                |                  |                   |                          |
| <i>Euphydryas aurinia</i> (Linnaeus, 1758)                  | VU            | II i IV        |                | II               |                   |                          |
| Erebidae  |               |                |                |                  |                   |                          |
| <i>Euplagia quadripunctaria</i><br>(Poda, 1761)             | LC            | II             |                |                  |                   |                          |
| Coleoptera  |               |                |                |                  |                   |                          |
| Scarabaeidae  |               |                |                |                  |                   |                          |
| <i>Oryctes nasicornis</i><br>(Linnaeus, 1758)               | LC            |                |                |                  |                   | Yes                      |

Of the species recorded during the research, according to national legislation (Decision on protection of certain plant and animal species "Official Gazette of the Republic of Montenegro", No. 76/06), the following species are protected: *Papilio machaon*, *Iphiclides podalirius* and *Oryctes nasicornis*. Both butterfly species have been recorded in the subject areas. According to published data, the species *Lucanus cervus*, *Cerambyx cerdo* and *Saga natoliae* have also been recorded in the vicinity of Zeta Glava, and they could be expected in the wider area of the subject area. When it comes to species of international importance, *Zerinthia polyxena* (its larvae) have been recorded on plant species of the genus *Aristolochia* at several locations around the Slivlje Reservoir, and near the machine plant (Perućica) and downstream to Zeta Head. Also, at a few locations, a host plant of the species *Euplagia quadripunctaria* was recorded, whose presence at these locations was expected, while the species *Euphydryas aurinia* was recorded on herbaceous vegetation above the bank of the river Zeta near HPP "Perućica". According to published data, *Cordulegaster heros* (a species from Annexes II and IV of the EU Habitats Directive) has been recorded at several locations in the middle course of the Zeta River, which could be expected at the study site.



## ASSESSMENT OF THE SITUATION OF THE AREA

The location where the compensation pool - Slivlje / Ozrinici is located are at the foot of the hill Budoš, in the southeastern part of Nikšić field. Anthropogenic pressures are pronounced in this area. The reservoir itself is a completely artificial creation, with specific flora and fauna present both in the reservoir itself and in the existing canals. When it comes to insect fauna, these water surfaces play a significant role in the survival of those species whose life cycle is related to water, as is the case with dragonflies. Waters that enter the reservoir carry significant amounts of waste materials. This type of pollution has a negative impact on the living world in the water. The area around the reservoir consists of meadows that are partially mowed, and there are also areas under cultivars. Pesticide application is one of the possible sources of pollution for meadow ecosystems. In the immediate vicinity, except on the slopes of the hill Budoš (and Pandurica), and the slopes behind the building on the reservoir, there are no larger areas under forests. Along the river Zeta, on the stretch towards the Emperor's Bridge, there are Riparian vegetation, forests with white willow dominance, and dogwood, black poplar, chicken, blackberry, etc., through which a dirt road leads and along which the presence of waste is also evident.

The area around the machine building of HPP Perućica - Bogetići has been degraded and under anthropogenic pressure. Along the river Zeta, there is riparian vegetation with willow dominance, the presence of poplar, and in the area around the plant there are also figs, black hornbeam, walnuts, but also cypresses (planted). Currently, the greatest pressure is on organisms whose life cycle is related to water, which are sensitive to fluctuations in water levels, river flow velocity, as well as on organisms whose adults lay eggs on vegetation near water, or less mobile species that inhabit only coastal areas, and whose floods would endanger the habitat.

### Possible impacts (during construction/operational phase)

During the reconstruction of the Zeta 1 canal junction and the retention (accumulation) pool, actions are planned in order to reduce energy losses. They envisage the demolition of individual walls and the merging of swimming pools. One of the benefits is the improvement of the efficiency in the work of waste removal machines. However, the planned activities also aim to reduce vortexing, which will result in a reduction in the aeration of the system under pressure, but will also affect the aeration of the water, and thus the living world in it. Also, changes in the water level that will occur can have negative consequences for animals in the water. The very process of removing the mentioned walls will lead to the disturbance of animals in the pools (noise and vibration), but also those in the surrounding area. During the construction itself, waste (rubble) will be generated, which can be scattered in the water and in the surrounding area. These activities are impossible to perform without adequate machinery, which will not only move on access roads, and their movement and manoeuvring will have a negative impact on insects and other animals, including noise, vibration, dust, trampling of vegetation and individuals, compaction land and entrances to corridors and nests of subterranean fauna. The eventual spillage of fuel and oil from mechanization in the event of an accident can pose an additional danger to the anthofauna, but also to the living world as a whole, as well as to groundwater.

When it comes to the hydroelectric power plant "Perućica", the project task states that minor construction works will be needed in the power plant during the installation of new electrical and mechanical equipment, and that they include minor demolition, removal and drilling of concrete, removal of temporary barriers and burials. new equipment will be installed. All these works will lead to the creation of noise and vibrations that will have a negative impact on the animal world, but also to the creation of dust during the works. It remains unclear

where the concrete will be removed and which locations will be buried. The implementation of planned activities will increase the water level before the dam, and in cases of heavy water inflows, especially during prolonged rainfall, there may be overflows and possible floods, which can have negative effects on wildlife downstream, either directly - flooding preferred habitat or indirectly - changes in microclimatic conditions.

### **Proposed protection measures (during construction / operational phase)**

- It is necessary to reduce the area of influence to the minimum possible during the execution of all works, and to envisage the same in the project documentation;
- Avoid any activities outside clearly designated locations.
- The project documentation must specify the locations where it will be possible to park vehicles, and their manoeuvring, taking into account that these are the locations where the impact on flora and fauna will be minimal;
- During the execution of works, it is necessary to take care that the existing roads are used for vehicle movements and heavy machinery, and that they are not widened unless absolutely necessary. To move vehicles past existing roads, if necessary, avoid locations where rare or endangered insect species or their host plants have been registered. It is also necessary for vehicles to move at an adequate speed;
- When transporting the removed material, as well as all other types of waste, it is necessary to use protective tarpaulins, i.e. cover it so that it does not spoil, as well as in order to reduce the amount of emitted dust. In some locations, provide wetting of the substrate, in order to avoid raising dust;
- Do not use the removed concrete, the resulting rubble, excess earth, and rock to bury underground tunnels, holes and similar microhabitats that are characterized by their specific plant and animal composition. All other waste (of organic and inorganic origin) must be disposed of in accordance with the measures prescribed by the Law on Waste Management, and in no way bury or destroy natural habitats;
- If an animal's den or nest is encountered during the works, it is necessary to stop the works and consult experts in the field of biology and ecology, in order to undertake adequate activities;
- Take care that during all types of work, the noise produced, as well as the resulting vibrations, are reduced to a minimum. Also, the level of noise produced during the operational phase must be within the allowed / prescribed limits;
- When performing works on the reservoir, there must not be a drastic reduction in the water level in the reservoir and canals, as it may have a negative impact on the living world;
- Also, when performing works around the reservoir, species of plants of the genus *Aristolochia* must not be destroyed because they are plants that feed the Easter butterfly (*Zerynthia polyxena*), as well as *Eupatorium cannabinum* which feeds on the common honeysuckle (*Auplagia quadripunctata*);
- During the operational phase of the hydropower plant, constant monitoring of the amount of discharged water is necessary, in order to avoid significant variations in the water level of the Zeta River downstream of the dam. It is necessary to adopt a set of measures in accident situations and in cases of heavy rainfall that can cause rising

water levels, flooding and changes in the speed of the river, which can have negative impacts on the fauna of insects;

- It is also necessary to prepare measures in cases of other accident situations (oil discharge from oil drainage tanks, fuel spills from heavy machinery, etc.);
- It is necessary to ensure constant monitoring of activities, in order to comply with the implementation of the proposed protection measures.

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ATTACHMENT: PHOTOLOG





**Picture 1. Slivlje – accumulation (retention)**



**Picture 2. Slivlje - Zeta Canal I**



**Picture 3. Drains - waste materials (especially plastic waste accumulates in parts of the reservoir and canals, and especially around the building.**



**Picture 4. Slivlje - around the accumulation is dominated by meadow habitats, as well as areas under cultivars.**



**Picture 5. Slivlje - around the reservoir, the species *Eupatorium cannabinum* - a plant that feeds on the daytime honeysuckle (*Euplagia quadripunctaria*) has also been recorded.**



**Picture 6. Slivlje - around the accumulation there are many individuals of the genus *Aristolochia* - a plant that feeds the Easter butterfly (*Z. polyxena*).**





**Picture 7.** The area around the Perućica hydropower plant just below the dam.



**Picture 8.** In the area around the hydroelectric power plant "Perućica", along with the coastal vegetation, cypresses are present and planted.



**Picture 9.** Downstream from HPP "Perućica" the river Zeta has a slightly faster flow.



**Picture 10.** In the middle course, near the Glava Zete, the river Zeta is deeper and calmer. A large number of dragonfly species have been recorded in this area.



**Picture 11.** Old World swallowtail (*Papilio machaon*), a species protected at the national level. Recorded at a couple of investigated localities in the subject areas.



**Picture 12.** *Iphiclies podalirius*, a species protected at the national level.





**Picture 13.** *Euphydryas aurinia* - a species of international importance (from Annexes II and IV of the EU Habitats Directive).



**Picture 14.** *Zerynthia polyxena* larvae on a host plant (species of international importance) (from Annex IV of the EU Habitats Directive).



**Picture 15.** *Gonepteryx rhamni* - lemongrass. Species recorded in a larger number of area



**Picture 16.** *Aporia crataegi* - hawthorn. A common species.



**Picture 17.** *Vanessa atalanta* - Red Admiral. Quite a common species, recorded in the studied areas.



**Picture 18.** *Melanargia galathea*. Quite a common species, recorded in the studied areas.





**Picture 19. *Issoria lathonia* - mother-of-pearl.**  
Quite a common species, recorded in the studied areas.



**Picture 20. *Coccinella septempunctata* - ladybug.** One of the most recognizable beetles. Quite common with us.



**Picture 21. *Oryctes nasicornis*, female -**  
Nationally protected species.



**Picture 22. *Orthetrum cancellatum*, male -**  
Species recorded in the study areas.

**17.3.1.3 ASSESSMENT OF THE STATE OF FLORA AND HABITATS IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"**

Prepared by: Snežana Vuksanović, expert on flora and habitats

Podgorica, June 2022



## CONTENT

1. FLORA AND HABITATS
    - 1.1. Review of the current state of the environment
  2. RESEARCH METHODS
  3. REPRESENTATION OF RESULTS
    - 3.1 Location Slivlje / Ozrinići
    - 3.2 Location Glava Zeta
  4. ASSESSMENT OF THE SITUATION OF THE AREA
    - 4.1. Possible impacts (during construction / operational phase)
    - 4.2. Proposed protection measures (during construction / operational phase)
      - 4.2.1 Construction phase
      - 4.2.2 Operational phase
- ATTACHMENT: PHOTOLOG

## FLORA AND HABITATS

The subject location - Slivlje is presented by plants of lowland meadows, white willow forests and accompanying woody plants. The Slivlje retention is an artificial creation, but plant communities characteristic of the calm waters of the Zeta River have developed in it. Part of the meadows is being cultivated, so meadow communities and fields are changing in a mosaic. In the wider area, along the channel of the river Zeta 1, there are coastal (riparian) forests dominated by white willow. South of the Slivlje retention is the Pandurica hill (part of the Budoš hill) with typical mountain woodpecker forests.



*Picture 1. Slivlje*

The second subject location - Glava Zeta (machine building) with the surrounding area is characterized by cypress plantations along with other cultivars, meadow meadows, fields and coastal (riparian) forest along the river Zeta. To the west of the river is a hill with typical sub-Mediterranean vegetation dominated by thorns and stink bugs.



**Picture 2. Glava Zeta**

## Review of the current state of the environment

There are no published literature data for the subject locations (compensation basin - Slivlje / Ozrinići and the location of the machine building of HPP Perućica - Glava Zeta), as well as for the environment. The data that will be given below mainly refer to the lower half of the Zeta river valley, downstream of the Glava Zeta site. The "Study for the Protection of the Protected Natural Heritage of the Zeta River Valley" did not cover the flora and habitats of the Zeta Head, data on flora and habitats refer to the lower reaches of the Zeta (from the Zeta Waterfall downstream).

## RESEARCH METHODS

During the two-day research (May 28 and 31) at both locations (Slivlje and Glava Zeta), the present flora was listed and habitats were determined. Given many years of botanical experience, there was no need to use the determination keys common in botany (Flora Europae I-V). The Manual for the Identification of Habitat Types of Montenegro of Importance for the EU was used to determine habitat types. Figure 3 maps the habitats at the location of Slivlje and its surroundings, and Picture 4 the habitats at Glava Zeta where the machine building with its surroundings is located.

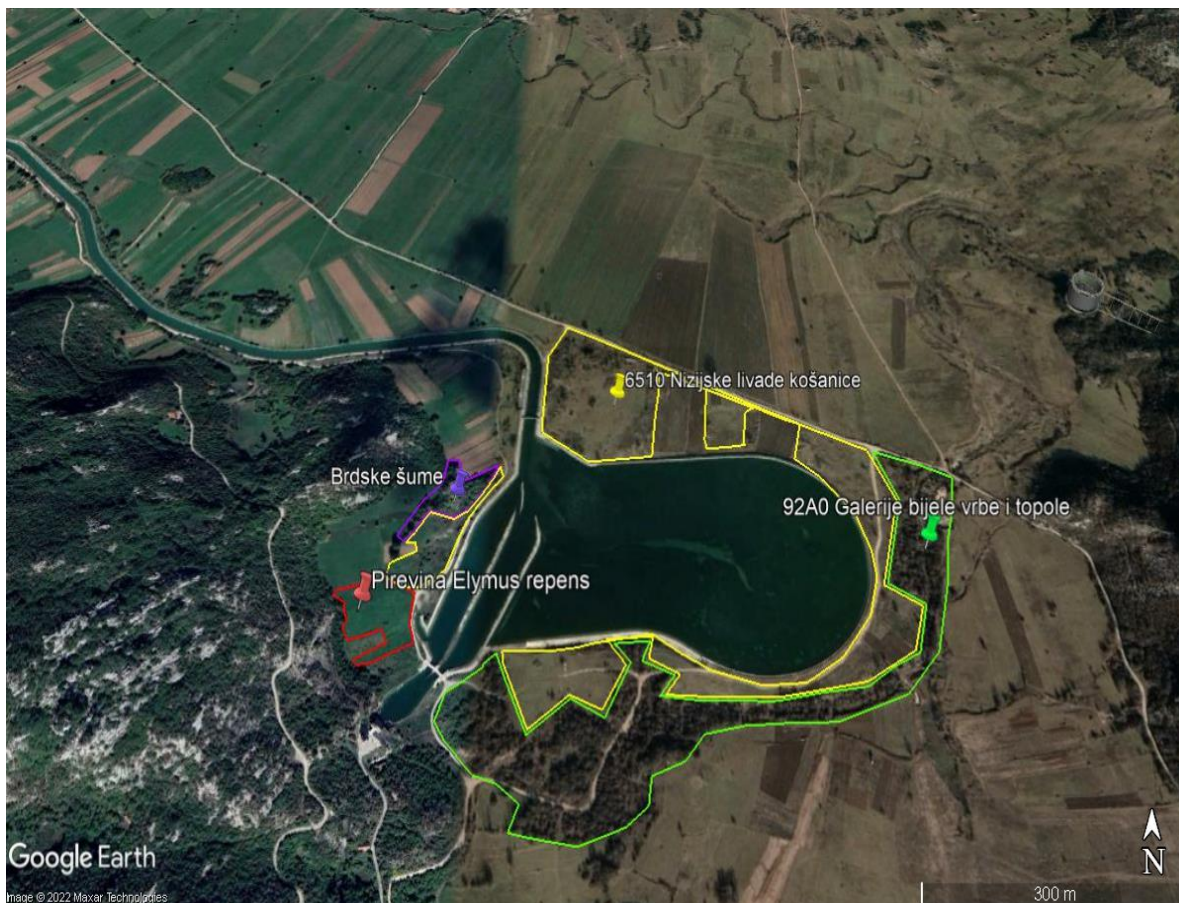
## REPRESENTATION OF RESULTS

### Location Slivlje / Ozrinići

No endemic, rare and / or protected plants have been recorded in accordance with national legislation - Decision on protection of certain plant and animal species (Official Gazette) or European legislation - Directive on the protection of natural habitats and wild flora and fauna (Habitat Directive 92/43/EEC, Annex II, IV and V) | Berne Convention (Annex II).



Two Natura 2000 habitats of low representativeness were recorded. At the Slivlje/Ozrinići site, 6510 Lowland meadows and 92A0 White Willow and Poplar Galleries were recorded. In addition to Natura habitats in the immediate vicinity of the retention, there are hilly forests of white carp *Carpinus orientalis* and neglected meadows overgrown with *Elymus repens*.



**Picture 3. Habitats - Slivlje**

Lowland meadows are widespread in Montenegro. Characteristic species recorded in this type of meadow in Slivlje are: *Trisetum flavescens*, *Festuca pratensis*, *Bromus hordaceus*, *Bromus racemosus*, *Dactylis glomerata*, *Dasypyrum villosum*, *Rhinanthus minor*, *Hordeum murinum*, *Tragopogon pratense*, *Minorus Corusolius*, *Leucanthem pratense*, *Medicago sativa* ssp. *falcata*, *Carex caryophyllea*, *Carex flacca*, *Medicago minima*, *Ranunculus bulbosus*, *Centaurea jacea*, *Silene vulgaris*, *Galium verum*, *Poa bulbosa*, *Plantago lanceolata*, *Veronica jacquinii*, *Aristolochia clematitidis*, etc. Meadows or their fragments around the retention are of low representativeness and anthropogenic influence is visible. In order to obtain reference data, good meadow meadows in the wider retention area were investigated.

Galleries of white willow and poplar stretch along the Zeta stream, which is lost in the Slivlje abyss. Dominant is the white willow *Salix alba*, followed by the willow *Salix eleagnos*, *Ulmus minor*, *Pasdrijen Cornus sanguinea*, *Euonymus europaeus*, *Rosa sempervirens*, *Ligustrum vulgare*, *Fraxinus excelsior*, common *Humulus lupulus ulmifolius*. Habitat is degraded with waste. In the southwestern part of the retention there are meadows overgrown with the weed plant *Elymus repens* and followed by *Rumex conglomeratus*. This weed inhabits wetlands but also degraded areas such as neglected fields.



The mountain vegetation is represented by thermophilic *Carpinus orientalis* forests, followed by *Fraxinus ornus*, *Quercus pubescens*, *Sambucus nigra*, and some elements of macchia such as *Phillyrea media*. White-throated woodpeckers are widespread in Montenegro. The bottom of the retention is overgrown with algae from the Chara group, and some submerged plants that grow in the waters of the Zeta River, such as *Ranunculus trichophyllus*, *Potamogeton crispus*, *Myriophyllum sp.*, *Ceratophyllum sp.*

### Location Glava Zeta

No endemic, rare and / or protected plants have been recorded in accordance with national legislation - Decision on protection of certain plant and animal species (Official Gazette) or European legislation - Directive on the protection of natural habitats and wild flora and fauna (Habitat Directive 92/43/EEC, Annex II, IV and V) I Berne Convention (Annex II).

Two Natura 2000 habitats have been recorded on Glava Zete. Along the Zeta are lined 92A0 Galleries of white willow and poplar Dry meadows or 6220 Pseudostepes with annual plants (Thero-Brachypodieta) are degraded, overgrown with plantations of *Punica granatum*. Representative meadows 6220 are located within the area of HPP Perućica and partly below the house in the southwestern part. During the research the meadows were mowed. The surrounding area where the machine building and the administrative building are located is cultivated with *Cupressus sempervirens* cypress plantations.



**Picture 4. Habitats-Glava Zete**

Along with Zeta, which reappears as an overground flow in the area of HPP Perućica on the Glava Zete, Natura 2000 habitat 92A0 of the White Willow and Poplar Gallery was recorded.



Dominated by white willow *Salix alba* and black poplar *Populus nigra*, and *Fraxinus excelsior*, *Quercus robur*, *Ficus carica*, black mulberry *Morus nigra*, pomegranate *Punica granatum*, walnut *Juglans regia*, acacia *Robinia pseudoaccacia* and climbers *Hedera helix* and *Clematis*. It has been observed that some woody species from a nearby hill inhabit somewhat elevated and drier land above the river, such as the stink bug *Pistacia terebinthus* and the dragon *Paliurus spina christii*. Apparently, this habitat type is influenced by humans due to the presence of some atypical plants such as walnuts or pomegranates. The river is clean and fast flowing so there are no typical communities in the water that occur downstream.

Habitat type 6220 Pseudostepe with annual plants (Thero-Brahypodietea) is representative only in the part of the meadow southwest of the house across from the HPP Perućica plant. It is characterized by the following plants: *Avena barbata*, *Bromus hordaceus*, *Aegilops geniculata*, *Aegilops triuncialis*, *Vulpia ligustica*, *Linum tenuifolium*, *Anthoxanthum odoratum*, *Medicago rigidula*, *Medicago minima*, *Medicago arabica*, *Plantago lanceolatum*. The pseudosteppe was mowed down.

In the immediate vicinity, pseudostepes are overgrown with orchards of *Punica granatum*, and some other woody species such as *Celtis australis*.

Downstream on the location Ilija's whirlpool, an image of a pseudostepe that was not mowed was taken, and gallery forests of white willow and poplar (92A0) with *Salix alba*, *Fraxinus angustifolia*, *Acer negundo*, *Cornus sanguinea*, *Morus alba* and to the habitat from 3260 Vodi mountain belt with watercress vegetation *Ranunculus fluitantis* and *Callitriche-Batra-chion* with *Ranunculus trichophyllus*, *Berula erecta*, *Menta aquatica*, *Veronica beccabunga* and *Iris pseudacorus*.

## ASSESSMENT OF THE SITUATION OF THE AREA

Both sites (Slivlje/ OZRINIĆI and Glava Zeta) are under strong anthropogenic influence. In the wider vicinity of the retention, there are representative meadows, and the fields alternate with them. Along the retention itself, there are neglected meadows that are not mowed and that are slowly overgrown with trees from the nearby hill Budoš-Pandurica or with trees from the gallery forests along the Zeta. The Zeta riverbed, which is lost in the Slivlje abyss in the northern part of the OZRINIĆI area, is covered with waste and garbage. Channel Zeta 1 also applies plastic and other waste that is visible on the retention gratings. Anthropogenic impact is also visible on the Glava Zeta in the vicinity of the HPP Perućica plant. Meadows, i.e. pseudostepes do not cut and are not maintained, which leads to their healing.

### Possible impacts (during construction/operational phase)

During the reconstruction of the Zeta 1 canal junction and the retention pool, the demolition of individual walls and the merging of the pool is planned. During the execution of these works, concrete waste will be generated and deposited in the surrounding area (meadows). The mechanization for the execution of works will have an impact on the surrounding meadow areas during turning and manoeuvring. Vegetation removal during works.

During the installation of new electrical and mechanical equipment in the machine building, dust will be created which will settle on the plants. During the execution of these works, waste will be generated, which, if deposited outside the plant, i.e. fenced area of HPP Perućica can have a negative impact on the surrounding habitats.

The realization of the planned activities will increase the flow of water, and a larger amount of precipitation in autumn and spring, which may cause flooding of habitats.

## Proposed protection measures (during construction / operational phase)

### Construction phase

- Minimize the area of influence when performing all works;
- Specify the locations where vehicles will be parked and their manoeuvring;
- Restrict vehicle movements and heavy machinery to existing access roads;
- Dispose of removed concrete and earth waste at locations previously agreed with the Municipalities of Nikšić and Danilovgrad and in accordance with the Law on Waste Management;
- Do not bury pits and/or other underground habitats with waste generated during the works;
- Minimize removed vegetation, taking into account whether there are bird nests in the treetops or a possible shelter for bats;
- If an animal's den or nest is encountered during the works, stop the works, and consult experts - biologists;
- When transporting excavated material, it is necessary to use protective tarpaulins to reduce the amount of dust emitted. In some locations, provide wetting of the substrate, in order to avoid raising dust.
- Take the necessary measures to prevent accidental situations, spills of fuel or oil into the river or the surrounding area, in case of an accident inform the competent institutions and stop the work;
- Ensure constant monitoring, in order to comply with the implementation of the proposed protection measures.

### Operational phase

- Control water flow especially in the months when heavy rainfall occurs to prevent flooding.

**ATTACHMENT: PHOTOLOG**



**Picture 1. Lowland meadow-Slavlje**



**Picture 2. Lowland meadows-Slavlje**



**Picture 3. Galleries of white willow and poplar-Slavlje**



**Picture 4. Galleries of white willow and poplar-Slavlje**





**Picture 5. Elymus repens and mountain vegetation in the background**



**Picture 6. Slivlje retention**



**Picture 7. Galleries of white willow and poplar-Glava Zete**



**Picture 8. Galleries of white willow and poplar-Glava Zete**



**Cypresses in the area of HPP Perućica**



**Picture 10. Pseudostepe - Ilijin vir**





**Picture 11. Galleries of white willow and poplar-Ilijin vir**



**Picture 12. Vegetation of water lilies from the lowland to the mountain belt-Ilijin vir**



**Picture 13. Waste in gallery forests-Slivlje**



**Picture 14. Plastic waste in the Slivlje retention**



**17.3.1.4 ASSESSMENT OF THE CONDITION OF THE BAT FAUNA IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"**



**Prepared by:**

Ceda Ivanovic, MSc of Biological Science

Podgorica, June 2022

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## CONTENT

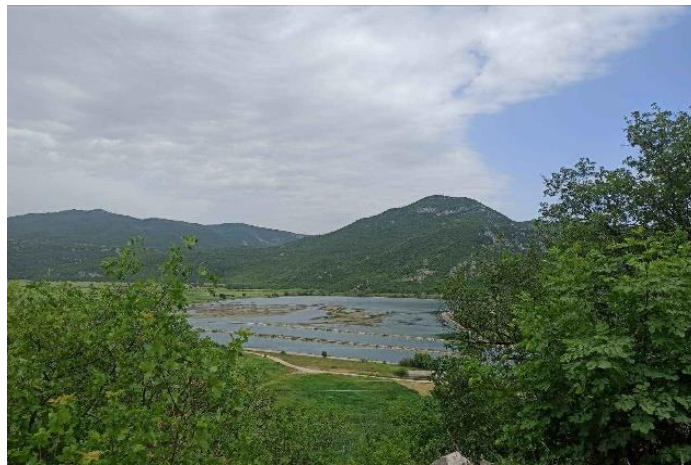
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    - 1.1 Review of the current situation on the environment okolinom
    - 1.2 Review of literature
  - 2 RESEARCH METHODS
  - 3 PRESENTATION OF RESULTS
  - 4 ASSESSMENT OF THE SITUATION OF THE AREA
    - 4.1 Possible impacts (during construction / operational phase)
    - 4.2 Proposed protection measures (during construction / operational phase)
- Photolog

## REVIEW OF THE CURRENT SITUATION WITH THE ENVIRONMENT

### Location 1

Retention basin - Slivlje/ Ozrinici is located in the southeastern part of the Niksic field, i.e. at the end flow of the Zeta River. The Zeta River originates in Gornje Polje from the Susica and Rastovac rivers. Zeta River flows south to the village of Zavrh, where it loses some of its water to the existing estavels, and the water appears in the Krupac accumulation. From here, Zeta River turns east, towards Glibavac, then further turns southeast and east to the retention basin. From this basin, water is brought to HPP "Perucica" by tunnel and pipelines.

Prior to the construction of the hydropower plant and the regulation of the Zeta riverbed, this watercourse sinks along the southern edge of the Niksic field (Budoske bare and Slivlje). From this spring, both the springs of Perucica and Obostica, the watercourse of Donja Zeta emerges, which flows into the Moraca River.



**Figure 1. Location 1 – Retention basin Slivlje/Ozrinici**

### Location 2

The machine building of HPP Perućica is located in Bogetici near the Glava Zeta, and is about 5 km away from the retention basin Slivlje.



**Figure 2. Location 2- Mechanical building of HPP Perućica**

The entire area where these two locations are located is characterized by diverse habitats: banks and forests in riverbeds, meadows under anthropogenic influence (vegetable gardens,

fields, vineyards), semi-wetlands and wetlands, grasslands and rocks, forest stands, significant underground structures, etc. which makes the whole area, and especially some parts, an exceptional habitat, ie a feeding ground for bats.

### Review of literature

The fauna of bats in the subject area is insufficiently researched, so that apart from registering the presence of certain species, very little is known about their seasonal dynamics of using shelters, habitats, hunting territories, etc. In the wider area, a total of 17 species of bats have been registered.

According to the reviewed literature in the project area, i.e. at Location 1, the presence of 6/8 species of bats was registered, as follows: *Plecotus macrobullaris*, *Myotis blythii*, *Pipistrellus pipistrellus*, *Myotis daubentonii* and/or *M. capaccinii*, *Nyctalus noctula* and *Pipistrellus kuhlii* and/or *P. nathusii*.

There are no data on recorded species for Location 2. The following is an overview of the registered species in the project area, as well as the immediate and distant surroundings.

**Table 1. Species of registered bats in the area (Presetnik et al, 2014, EPA., 2019)**

| No. | Species  | Locality  |
|-----|--|---|
| 1.  | <i>Hypsugo savii</i>                           | The whole area (overflight)   |
| 2.  | <i>Rhinolophus ferummequinum</i>               | CN24: Loc. 116; CN34: Loc. 134; – CN41: Loc. 141; –<br>General locations: <b>Loc. 193.</b><br>In overflight above the whole area  |
| 3.  | <i>Rhinolophus hipposideros</i>                | – CN33: Loc. 124; – CN24: Loc. 116; – CN31: Loc. 118;<br>– CN32: Loc. 120; – CN33: Loc. 124; – CN34: Loc. 134;<br>– CN41: Loc. 141; – Loc. 142; General locations: <b>Loc. 193.</b><br>In overflight above the whole area |
| 4.  | <i>Rhinolophus euryale</i>                     | CN24: Loc. 116; – General locations: <b>Loc. 193</b>  |
| 5.  | <i>Plecotus macrobullaris</i>                  | -CN24: Loc. 117; – CN33; <b>Loc. 133.</b> General locations:<br><b>Loc.133: underground fortification above Slivlje 42.7219, 19.0082 / 645 meters above sea level</b>   |
| 6.  | <i>Myotis myotis and/or Myotis blythii</i>     | CN24: Loc. 116; CN33: <b>Loc. 133.</b><br><b>Loc.133: underground fortification above Slivlje 42.7219, 19.0082 / 645 meters above sea level</b>   |
| 7.  | <i>Myotis nattereri</i>                        | CN24: Loc. 116; – General locations: <b>Loc. 193</b>  |
| 8.  | <i>Myotis mystacinus</i>                       | CN41: Loc. 147  |
| 9.  | <i>Myotis capaccinii</i>                       | CN24: Loc. 11; – CN34: Loc. 135; CN41: Loc. 144;<br>General locations: <b>Loc. 193.</b><br>The whole area (overflight)  |
| 10. | <i>Myotis daubentonii and/or M. capaccinii</i> | <b>CN33: Loc. 123- on the water accumulation of the hydropower plant (Ozrinici) 42.7202, 18.9986 / 600 meters above sea level</b>   |
| 11. | <i>Pipistrellus pipistrellus</i>               | – CN33- <b>Loc. 123; - Loc. 129;</b> – CN34- Loc. 136;<br>General locations: <b>Loc. 193.</b>   |

| No. | Species                                       | Locality  |
|-----|---|---|
|     |   | <p>- on the water accumulation of the hydropower plant (Slivlje/Ozrinici) 42.7202, 18.9986 / 600 meters above sea level - Loc.123</p> <p>- east part of the water accumulation (Slivlje / Ozrinici) 42.7204, 19.0011 / 615 meters above sea level - Loc.129</p>   |
| 12. | <i>Pipistrellus pygmaeus</i>                  | - CN33: Loc. 121; - Loc. 122; - CN23: Loc. 115; - CN34: Loc. 135; - Loc. 136; General locations: <b>Loc. 193.</b>   |
| 13. | <i>Pipistrellus kuhlii</i>                    | - CN31: Loc. 119; - CN33: Loc. 122; - Loc. 125; - Loc. 126; - Loc. 130; - CN34: Loc. 135; - CN41: Loc. 143; - Loc. 144; - Loc. 145; - Loc. 146. General locations: <b>Loc. 193.</b>   |
| 14. | <i>Pipistrellus kuhlii and/or P. nathusii</i> | <p>- CN23: Loc. 115; - CN24: Loc. 117; - CN33: Loc. 121; - <b>Loc. 123</b>; - Loc. 125; - <b>Loc. 127</b>; - Loc. 128; - Loc. 130; - Loc. 131; - Loc. 132; - CN34: Loc. 136.</p> <p>- <b>Loc. 123: on the water accumulation of the hydropower plant (Ozrinici) 42.7202, 18.9986 / 600 meters above sea level</b></p> <p>- <b>Loc. 127: Near the underground fortification above Slivlje (Niksic) [42.7219, 19.0082 / 645 meters above sea level]</b></p> |
| 15. | <i>Pipistrellus nathusii</i>                  | - CN33: Loc. 121; General locations: <b>Loc. 193.</b>   |
| 16. | <i>Nyctalus noctula</i>                       | <p>- CN23: Loc. 115; CN33: <b>Loc. 127</b>; Loc. 130; - CN34: Loc. 136 General locations: <b>Loc. 193.</b></p> <p>- <b>Loc.127: Near the underground fortification above Slivlje (Niksic) 42.7219, 19.0082 / 645 meters above sea level</b></p>   |
| 17. | <i>Eptesicus serotinus</i>                    | - CN23: Loc. 114  |



### Legend

Data schedule: UTM square: Nr. location: location description (larger settlement nearby)  
[latitude in ° N, longitude in ° E / altitude in meters

– CN23: Loc. 114: blind branch of the river Zeta, 5 km southeast of Orlina (Niksic) [42.7456, 18.8719 / 660]; – Loc. 115: Krupac Lake /dam (Niksic) [42.7928, 18.8999 / 615].

– CN24: Loc. 116: Fairy Cave (Niksic) [42.8123, 18.9007 / 650]; – Loc. 117: near the Fairy Cave (Niksic) [42.8123, 18.9007 / 670].

– CN31: Loc. 118: road Danilovgrad – Podgorica, 1.3 km northwest of Frutak (Danilovgrad) [42.5832, 19.0487 / 115]; – Loc. 119: road Danilovgrad – Podgorica, 1.4 km southwest of Kujava (Danilovgrad) [42.5952, 19.0404 / 145].

– CN32: Loc. 120: road Danilovgrad – Podgorica, 800 m west, northwest of Zagorak (Danilovgrad) [42.6175, 19.0218 / 200].

– CN33: Loc. 121: fortress Bedem (Niksic) [42.7740, 18.9426 / 640]; – Loc. 122: near street lamps near the fortress Bedem (Niksic) [42.7736, 18.9437 / 640]; – **Loc. 123: on the water accumulation of the hydropower plant (Ozrinici)** [42.7202, 18.9986 / 600]; – Loc. 124: Petrovic's house next to the Niksic mill (Niksic) [42.7783, 18.9377 / 630]; – Loc. 125: near the castle of King Nicholas (Niksic) [42.7695, 18.9513 / 630]; – Loc. 126: near the railway station (Niksic) [42.7707, 18.9448 / 650]; – **Loc. 127: near underground fortification Slivlje (Niksic)** [42.7219, 19.0082 / 645]; – Loc. 128: main boulevard (Niksic) [42.7733, 18.9442 / 645]; – **Loc. 129: trail east of the water accumulation of the hydropower plant (Ozrinici)** [42.7204, 19.0011 / 615]; – Loc. 130: Street VI Crnogorske Brigade (Niksic) [42.7745, 18.9567 / 640]; – Loc. 131: on the street near the fortress Bedem (Niksic) [42.7750, 18.9448 / 640]; – Loc. 132: Karadjordjeva Street (Niksic) [42.7748, 18.9524 / 650]; – **Loc. 133: underground fortification Slivlje (Niksic) [42.7219, 19.0082 / 645].**

– CN34: Loc. 134: Vidrovan cave (Vidrovan) [42.8584, 18.9368 / 670]; – Loc. 135: Vidrovan River, on a small bridge, Vidrovan (Niksic) [42.8537, 18.9397 / 651]; – Loc. 136: Vidrovan stream (Vidrovan) [42.8581, 18.9396 / 660].

CN41: Loc. 141: Gukos cave (Slap) [42.6005, 19.0680/50]; – Loc. 142: road Danilovgrad – Podgorica, 1.3 km south from Curilac (Danilovgrad) [42.5277, 19.1175/50]; — Loc. 143: road Danilovgrad – Podgorica, 200 m east, northeast of Orja Luka (Danilovgrad) [42.5644, 19.0828/50]; – Loc. 144: road Danilovgrad – Podgorica, 500 m south of Frutak (Danilovgrad) [42.5733, 19.0661/95]; – Loc. 145: road Danilovgrad – Podgorica, 700 m southeast of Frutak (Danilovgrad) [42.5734, 19.0619/95]; – Loc. 146: Danilovgrad – Podgorica road, 950 m northwest of Orja Luka (Danilovgrad) [42.5700, 19.0722/60]; – Loc. 147: road Danilovgrad-Podgorica, on the roundabout [42.5456, 19.1031/49].

General locations: – **Loc. 193: Niksic field and surroundings.**

## RESEARCH METHODS

The research was conducted by the following methods:

- Habitat map analysis (Corine, Natura 2000), Google Earth;
- Review of the literature in order to determine the presence of certain species of bats in the subject area;
- Search and inspection of potential shelters (abandoned houses, tree hollows, etc.) with the aim of finding bats;

- Bat recording of the Pettersson D500X Ultrasound Detector/Recorder Mk I, with visual detection, using transects;
- Analysis of bat echolocation signals using literature and Bat Sound Pro 4 software.

## PRESENTATION OF RESULTS

### Registered species

The research of the bat fauna at the Location 1 – retention basin Slivlje / Ozrinici was performed on 28/29 May 2022. At Location 1, the presence of 8/9 species of bats was determined.



**Figure 3. Location 1 – transects**

The research of the bat fauna at the Location 2 - machine building of the HPP “Perućica” was performed during May 31<sup>st</sup> and June 1<sup>st</sup> 2022, and 8/9 species of bats were registered at the location.



**Figure 4. Location 2 - transects**

**Table 2. List of identified species in the subject areas with protection status**

| No. | Species                                      | Location                 | Protection status (IUCN / Habitats Directive) |
|-----|--|--------------------------|---|
| 1.  | <i>Hypsugo savii</i>                         | Location 1<br>Location 2 | LC/ Annex IV                                  |
| 2.  | <i>Nyctalus noctula</i>                      | Location 1<br>Location 2 | LC/Annex IV                                   |
| 3.  | <i>Nyctalus leisleri/Eptesicus serotinus</i> | Location 1               | LC/ Annex IV/ LC/ Annex IV                    |
| 4.  | <i>Eptesicus serotinus</i>                   | Location 1<br>Location 2 | LC/ Annex IV                                  |
| 5.  | <i>Barbastella barbastellus</i>              | Location 1<br>Location 2 | NT/ Annex II and IV                           |
| 6.  | <i>Myotis emarginatus</i>                    | Location 2               | LC/ Annex IV                                  |
| 7.  | <i>Myotis daubentonii</i>                    | Location 1<br>Location 2 | LC/ Annex IV                                  |
| 8.  | <i>Miniopterus schreibresii</i>              | Location 1               | NT/Annex II and IV                            |
| 9.  | <i>Pipistrelus kuhlii</i>                    | Location 1               | LC/Annex IV                                   |
| 10. | <i>Pipistrellus kuhlii/nathusii</i>          | Location 2               | LC/Annex IV                                   |
| 11. | <i>Pipistrellus pipistrellus</i>             | Location 2               | LC/Annex IV                                   |
| 12. | <i>Tadarida teniotis</i>                     | Location 1<br>Location 2 | LC/ Annex IV                                  |

The presence of a total of 12 species of bats was registered at both investigated locations.

### Shelters

Near Location 1, two suitable bat shelters were found: a roadside cave (42.43 43.9N 18.5749.8E) and an abandoned house (42.4325.2N 18.5846.1 E). In the cave were not found bats (Figure 5), although it has all the conditions for a shelter for bats, but since it is next to the road and close to houses, the question is whether bats use it as a shelter for harassment. In the abandoned house were found older guano remains (Figure 6), but no bats, indicating that bats use this location as a winter shelter.





**Figure 5. Cave**



**Figure 6. Abandoned house**



**Figure 7. Guano**

At the subject location we found two potential shelters for bats, a tunnel through the hill, across from the machine building of HPP Perućica (42 ° 40'20.43 "N 18 ° 59'47.20" E) and cave - indentation in the rock near the dam of HPP Perućica (42 ° 40 "27 .78" N 18 ° 59'47.46 "E).



**Figure 8. Tunnel**



**Figure 9. Tunnel and indentation in the rock**

### **ASSESSMENT OF THE AREA CONDITION**

Overall, both Location 1 and Location 2 are located in areas that are extremely important for the bat fauna, both in terms of habitat diversity for different species and as a rich feeding and shelter for bats.

The daily and seasonal activities of bats are related to the presence of sufficient food, water sources, shelter from the wind and optimal night temperature. Water areas are important hunting habitats with a significant concentration of insects, especially if they retain water throughout the year because then they provide them with a constant source of water.

Bats use both locations extensively as permanent habitat, shelter, hunting grounds, and all other life cycles (breeding, hibernation, migration corridors, etc.).

Both locations are of great importance for the bat fauna in terms of all the above factors.

Location 1 and Location 2 (especially Location 2) are located near the area of the Park of Nature "River Zeta" which includes the basin of the river Zeta and the river Matica, i.e. part of the territory of the municipalities of Danilovgrad and Podgorica. The main values of the park are aquatic ecosystems, namely the Zeta River with its tributaries, springs on the left and right side of the Zeta River, the Moromis wetland and the remains of lowland forests.

The wider area of the Zeta River Basin has been recognized by BirdLife and IUCN as an area of importance for biodiversity conservation (KBA). Also, in 2019, this area was presented as SPA "Bjelopavlička ravnica", i.e. Specially Protected Area under the Birds Directive. In this way, the area of the Bjelopavlička plain became a potential part of the European ecological network NATURA 2000.

All this shows how important this ecosystem as a whole is for flora and fauna.



### **Possible impacts (during construction/operational phase)**

The impacts of a hydropower plant on habitat types and types protected by EU Nature Directives vary considerably from location to location. Impacts can occur at any stage of the operating cycle of a hydropower plant, from construction to reconstruction or decommissioning, as well as in day-to-day operation and management. They can cause the loss, decay and fragmentation of natural habitats and populations of species whose survival depends on those habitats. The importance of loss depends on the magnitude of the impact, as well as on the rarity and vulnerability of affected habitats and species (EU, 2018).

Impacts can also be caused by connected infrastructure such as access roads, pipelines or power lines intended to connect the hydropower plant to the electricity grid. With the loss, decay or fragmentation of affected habitats, these structures can cause death or significant disturbance to terrestrial species. These impacts can be extremely important if hydropower and related infrastructure are located along migration routes, in narrow valleys with cliffs used by birds of prey, as well as bats or near wetlands and other water bodies important to bats (EU, 2018).

Impacts in the construction, reconstruction and operation of hydropower facilities occur due to: changes in the morphology of rivers and river habitats, obstacles to migration and expansion of protected species, disruption of sediment dynamics, change regimes in environmentally friendly flow, changes in flow regime due to the work hydropower plant, changes in seasonal flooding, changes in the chemical composition and temperature of water, injury and killing of individual animals, displacement and disturbance, impacts on terrestrial species and habitats, and finally cumulative impacts (EU, 2018).

In order to objectively assess impacts, field research must cover at least one full season and the whole area that may be affected by the project, in order to take into account, the fact that environmental conditions can vary significantly depending on the seasons i.e., record habitat use during other, more important, periods of the year (e.g., migration or breeding season, etc.).

Considering that the project locations are about the reconstruction of the existing HPP, i.e., smaller requirements, the following opinion is issued.

The conducted research could assume the following:

- Retention basin Slivlje/Ozrinici is a very important site for bats registered in the area;
- Due to the reconstruction of the overflow threshold, due to the influence of noise from working machines and other vehicles, there may be harassment of bats, i.e. until their temporary avoidance of this location, i.e., going to another source of permanent water with an appropriate amount of prey in the vicinity, which may cause a decrease in their number at this location during the works;
- After the completion of works and the restoration of "peace", bats should return to the site and be present during the operational phase, as they have been so far;
- Location 2 - machine building of HPP Perućica and its surroundings are also an exceptional area for bat fauna;
- During the works, due to noise and vibration, bats may be disturbed, which may also lead to a decrease in their number on the location;

### **Proposal of protection measures (during construction/operational phase)**

If habitats are disturbed or lost (during the construction, reconstruction or operation of HPPs) and thus the ecological functions for bats, it is necessary to plan compensatory measures to compensate for this in the immediate vicinity. Compensation can be most effectively implemented by declaring legal protection and active measures to improve the state of ecosystems in the immediate environment (*Paunovic, M., Karapandza, B., Ivanovic S., 2011*).

In order to give concrete protection measures, as already mentioned, all aspects of the use of a certain area by bats must be considered.

In the case of the mentioned reconstruction, it is advisable to remove as little vegetation as possible around the project locations, to maintain the retention basin and other water surfaces in the optimal regime (enough water). There are no other special measures.

What is important to note is that one must take into account the numerous impacts caused by HPPs, both in construction and in reconstruction and operation. Consideration of all impacts and taking into account the EU recommendations and guidelines when it comes to such projects, especially if the sites are located in / or near areas that are already recognized as areas of importance (Nature Park, potential areas of the Natura network 2000) must comply at all times with the provisions of Article 6 (2) of the Habitats Directive.

In particular, Article 6, Paragraph 2 *“Prescribes the obligation that the condition of the site must not deteriorate in relation to the situation in which it was when it was first determined by the Natura 2000 site” (EU, 2018)*.

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APPENDIX: Location 1



**Habitats**



**Overview of shelters**



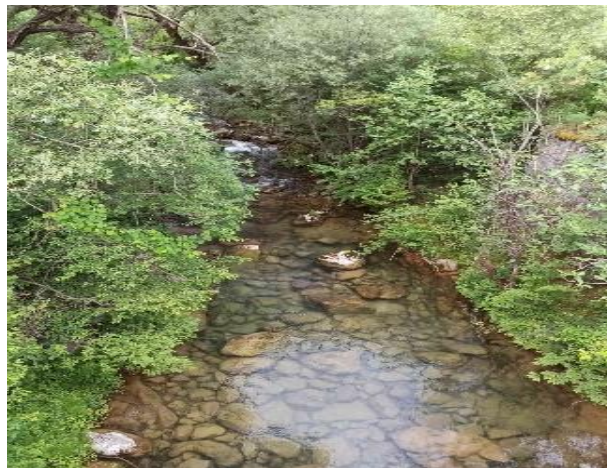
**Field work**



APPENDIX: Location 2



### Habitats



### Shelter





**Field work**



**17.3.1.5 ASSESSMENT OF THE CONDITION OF ORNITHOFAUNA IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"**

Prepared by: Andrej Vizi, bird expert

Podgorica, June 2022



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## CONTENT

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  - 2 RESEARCH METHODS
  - 3 PRESENTATION OF RESULTS
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    - 4.1 Possible impacts (during construction / operational phase)
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- Photolog

## ORNITHOFAUNA (BIRDS)

### Review of the current situation on the environment

The description of the subject area in the project task identifies the zone of possible impact of the reconstruction of HPP Perućica infrastructure on the immediate vicinity of the retention pool "Slivlje" in the extreme southeast of Nikšić field, together with the floodplain (Budoške bare) and northern slopes of Budoš, and the immediate vicinity Glava Zete.

The area around Slivlje belongs to the category of agricultural and grassy habitats (Tucker & Evans, 1997), with wetlands that turn into terrestrial wetlands depending on hydrological conditions. Stands of moist willow and ash forests are also present here. On the south side, this area is limited by the slopes of Budoš with characteristic vegetation of degraded deciduous forest on karst relief. This is a very anthropomorphic habitat, especially in terms of the water regime of Zeta, which is mostly controlled and used for the needs of HPP Perućica. However, depending on the hydrological conditions, part of the water overflows, which maintains the wetland character of the surrounding habitats, which is a significant resource for water birds, which contributes to the anthropogenic maintenance of fish stocks. Therefore, there are significant capacities in this part of the subject area in the form of different habitat types and partially controlled resources for different bird species.

At the location of Glava Zete, i.e. the hydroelectric power plant, the habitats have been significantly modified for the needs of the production process. The Glava Zete site is located in the immediate vicinity of the Zeta Nature Park. The study of the protection of this area identified the Zeta Valley as a significant migratory corridor in Montenegro, but the upper course from HPP Perućica was excluded from protection and no significant bird populations were found (EPA, 2019).



**Picture 1. Overview of the protected area of the Nature Park "Zeta"**

## Review of literature

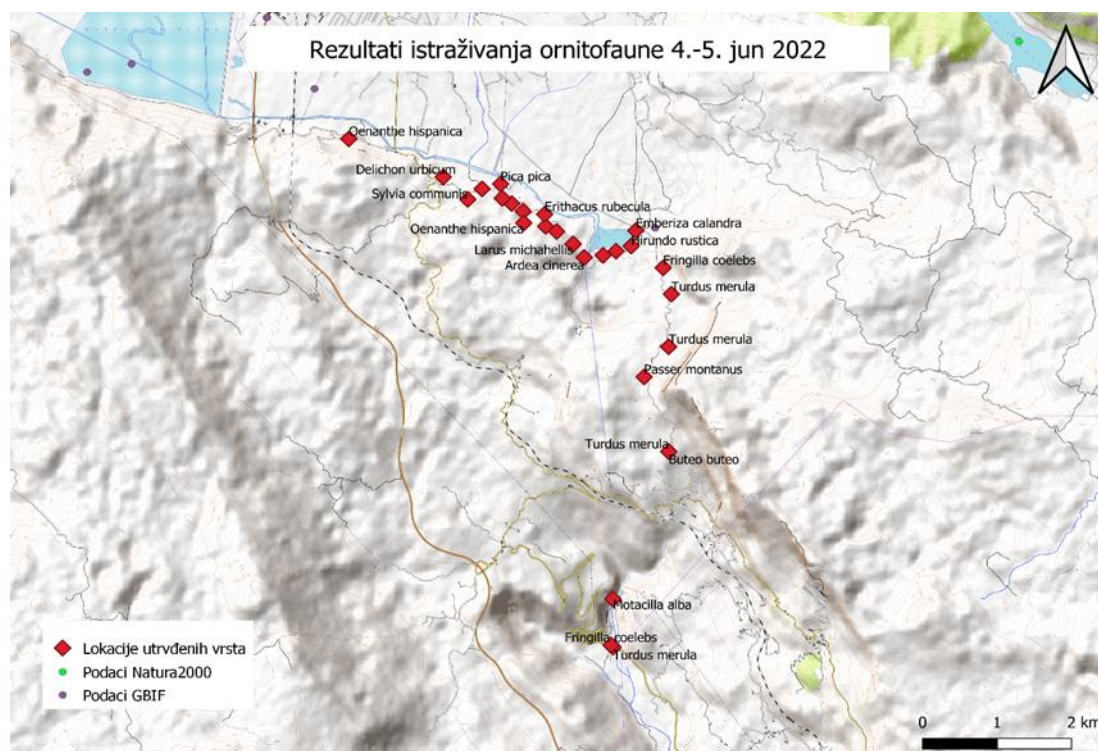
There are just few published ornithological data and literature with a focus on the subject area of the Nikšić field and the upper course of the Zeta river. However, a large amount of data is available from other sources: the Water Bird Winter Monitoring Program, which includes the Nikšić Reservoirs, author's bird impact studies, ringed bird data at nearby sites, and current research to evaluate Natura 2000 sites. Also, literature sources were used to define the characteristic habitat types in the subject area for individual bird species. Cabinet collection of ornithological data also included online sources, i.e. available databases on biodiversity in the area. The GBIF data set (DOI10.15468 / dl.96j32f) was used to form the list of birds present during the year, while the provisions of relevant documents were used for the national and international status of endangerment and protection: Bird Directives (2009/147 / EC), Solutions on protection of certain plant and animal species (Official Gazette of the Republic of Montenegro No. 76/06), the Convention on Migratory Species, the IUCN list of globally endangered species, as well as the national red list of endangered birds.

## RESEARCH METHODS

Research methods for the purposes of this study included cabinet research and field research. As part of the cabinet work, relevant literature data on birds from the wider area of the Nikšić field and the Glava Zete locality were collected. For the purposes of ornithological evaluation, a list of birds found in this area throughout the year was formed and field research methods were defined during this study, primarily with the aim of detecting nesting sites characteristic of the habitats: agricultural and grasslands, terrestrial wetlands degraded sub-Mediterranean deciduous forests. The field research was conducted in the form of a line transect, which was selected to cover all habitats. In addition, observations were made from height points in order to detect predators and water birds in the retention basin and along the Zeta canal. The research was conducted in daylight conditions, in the morning. 12x50 binoculars were used for visual identification of the species, and sound identification with the help of play-back technique was applied. Data on bird species, numbers and locations were collected using a dedicated smartphone app.

## PRESENTATION OF RESULTS

By analyzing literature data and working in the field 4-5. June 2022, 110 bird species were found in the area of Slivlje and Glava Zete. According to the global IUCN classification, four species have an unfavorable protection status; according to the Birds Directive, 22 species are listed in Annex I 11 species have a negative trend in Montenegro (declining), while 20 species are on the latest list of endangered species in Montenegro (EPA, 2022). During the field work in June 2022, 29 species were found in the field.



Picture 2. Locations of observed birds in June 2022.

The overall overview of ornithofauna with endangered and protected status is given in Table 1. Species found during field work 4-5. June 2022 are marked in color.

Table 1. The overall overview of ornithofauna with endangered and protected status

| Bird species in the vicinity of the area | Domestic name  | Protection Decision, Republic of Montenegro | Convention on Migratory Species | EU Directive (2009/147 / EC) | IUCN Global endangered status | IUCN status of Montenegro |
|--|----------------|---|---------------------------------|------------------------------|-------------------------------|---------------------------|
| <i>Accipiter gentilis</i>                | Hawk hen       | RCG   | II                              | I*                           |                               | VU                        |
| <i>Accipiter nisus</i>                   | Eurasian       | RCG   | II                              | I*                           |                               | LC                        |
| <i>Acrocephalus arundinaceus</i>         | Big reed       | RCG   | II                              |                              |                               | LC                        |
| <i>Actitis hypoleucos</i>                | Common         | RCG   | II                              |                              |                               | VU                        |
| <i>Aegithalos caudatus</i>               | A long         | RCG   |                                 |                              |                               | LC                        |
| <i>Alauda arvensis</i>                   | Eurasian       | RCG   |                                 | II/2                         |                               | LC                        |
| <i>Alcedo atthis</i>                     | Aquarius       | RCG   |                                 | I                            |                               | VU                        |
| <i>Anas crecca</i>                       | Duck           |   | II                              | II/1, III/2                  |                               |                           |
| <i>Anas platyrhynchos</i>                | Deaf duck      |   | II                              | II/1, III/2                  |                               | LC                        |
| <i>Anas ouerauedula</i>                  | Duck umbilical |   | II                              | II/1                         |                               |                           |
| <i>Anser fabalis</i>                     | Guska          |   | II                              | II/1                         |                               |                           |
| <i>Anthus pratensis</i>                  | Meadow         | RCG   |                                 |                              | NT                            |                           |
| <i>Anthus spinoletta</i>                 | Mountain       | RCG   |                                 |                              |                               | LC                        |
| <i>Ardea alba</i>                        | Great White    | RCG   | II*                             | I                            |                               |                           |
| <i>Ardea cinerea</i>                     | Gray heron     | RCG   |                                 |                              |                               | VU                        |
| <i>Athene noctua</i>                     | Ordinary       | RCG   |                                 |                              |                               | LC                        |
| <i>Aythya ferina</i>                     | Red-headed     |   | II                              | II/1, III/2                  | VU                            |                           |
| <i>Aythya fuligula</i>                   | Cubic float    |   | II                              | II/1, III/2                  |                               | DD                        |
| <i>Aythya nyroca</i>                     | Float Brunette | RCG   | I, II                           | I                            | NT                            | EN                        |



| Bird species in the vicinity of the area | Domestic name   | Protection Decision, Republic of Montenegro | Convention on Migratory Species | EU Directive (2009/147 / EC) | IUCN Global endangered status | IUCN status of Montenegro |
|--|-----------------|---|---------------------------------|------------------------------|-------------------------------|---------------------------|
| <i>Bucephala clangula</i>                | Float hole      |   | II                              | II/2                         |                               |                           |
| <i>Buteo buteo</i>                       | Common          | RCG   | II                              |                              |                               | LC                        |
| <i>Carduelis carduelis</i>               | Goldfinch       | RCG   |                                 |                              |                               | LC                        |
| <i>Carduelis chloris</i>                 | European        | RCG   |                                 |                              |                               | LC                        |
| <i>Charadrius alexandrinus</i>           | Sea urchin      | RCG   | II                              | I                            |                               | CR                        |
| <i>Cinclus cinclus</i>                   | Water piece     | RCG   |                                 |                              |                               | LC                        |
| <i>Circaetus gallicus</i>                | Eagle snake     | RCG   | II                              | I                            |                               | VU                        |
| <i>Circus aeruginosus</i>                | Western         | RCG   | II                              | I                            |                               | VU                        |
| <i>Circus cyaneus</i>                    | Hen harrier     | RCG   | II                              | I                            |                               |                           |
| <i>Coccothraustes</i>                    | Hawfinch        | RCG   |                                 |                              |                               | LC                        |
| <i>Columba livia</i>                     | Cave pigeon     |   |                                 | II/1                         |                               | LC                        |
| <i>Corvus corax</i>                      | Raven           | RCG   |                                 |                              |                               | LC                        |
| <i>Corvus cornix</i>                     | Gray crow       |   |                                 | II/2                         |                               | LC                        |
| <i>Cuculus canorus</i>                   | Common          | RCG   |                                 |                              |                               | LC                        |
| <i>Delichon urbica</i>                   | City swallow    | RCG   |                                 |                              |                               | LC                        |
| <i>Dendrocopos maior</i>                 | Big colorful    | RCG   |                                 | I*                           |                               | LC                        |
| <i>Dendrocopos medius</i>                | Medium          | RCG   |                                 | I                            |                               | LC                        |
| <i>Dendrocopos syriacus</i>              | Village         | RCG   |                                 | I                            |                               | LC                        |
| <i>Dryocopus martius</i>                 | Black           | RCG   |                                 | I                            |                               | LC                        |
| <i>Egretta garzetta</i>                  | Little White    | RCG   |                                 | I                            |                               | VU                        |
| <i>Emberiza cia</i>                      | Rocky bunting   | RCG   |                                 |                              |                               | LC                        |
| <i>Emberiza cirulus</i>                  | Black-throated  | RCG   |                                 |                              |                               | LC                        |
| <i>Emberiza citrinella</i>               | Yellow          | RCG   |                                 |                              |                               | LC                        |
| <i>Emberiza melanocephala</i>            | Black-headed    | RCG   |                                 |                              |                               | LC                        |
| <i>Erithacus rubecula</i>                | The robin       | RCG   | II                              |                              |                               | LC                        |
| <i>Falco subbuteo</i>                    | Swallow         | RCG   | II                              |                              |                               | VU                        |
| <i>Falco tinnunculus</i>                 | Falcon          | RCG   | II                              |                              |                               | LC                        |
| <i>Ficedula albicollis</i>               | White-necked    | RCG   | II                              | I                            |                               | DD                        |
| <i>Fringilla coelebs</i>                 | Common          | RCG   |                                 | I*                           |                               | LC                        |
| <i>Fulica atra</i>                       | Eurasian coot   |   | II*                             | II/1, III/2                  |                               | LC                        |
| <i>Gallinago gallinago</i>               | Swamp snipe     |   | II                              | II/1, III/2                  |                               |                           |
| <i>Gallinula chloropus</i>               | Bar popcorn     | RCG   |                                 | II/2                         |                               | LC                        |
| <i>Garrulus glandarius</i>               | Old fren        |   |                                 | II/2                         |                               | LC                        |
| <i>Gavia arctica</i>                     | Black-throated  | RCG   | II*                             |                              |                               |                           |
| <i>Grus grus</i>                         | Heate           | RCG   | II                              | I                            |                               |                           |
| <i>Hirundo daurica</i>                   | Long            | RCG   |                                 |                              |                               | LC                        |
| <i>Jynx torquilla</i>                    | Snakehead       | RCG   |                                 |                              |                               | LC                        |
| <i>Lanius collurio</i>                   | Russian         | RCG   |                                 | I                            |                               | LC                        |
| <i>Lanius excubitor</i>                  | Big magpie      | RCG   |                                 |                              |                               |                           |
| <i>Lanius minor</i>                      | Gray magpie     | RCG   |                                 | I                            |                               | NT                        |
| <i>Lanius senator</i>                    | Red-headed      | RCG   |                                 |                              |                               | LC                        |
| <i>Larus michahellis</i>                 | Yellow-legged   | RCG   |                                 | II/2                         |                               | LC                        |
| <i>Larus ridibundus</i>                  | An ordinary     | RCG   |                                 | II/2                         |                               | CR                        |
| <i>Mergus mergamser</i>                  | Great diver     | RCG   | II                              | II/2                         |                               | VU                        |
| <i>Mergus alpestris</i>                  | The             | RCG   | II                              |                              |                               | LC                        |
| <i>Motacilla alba</i>                    | White           | RCG   |                                 |                              |                               | LC                        |
| <i>Motacilla cinerea</i>                 | Mountain        | RCG   |                                 |                              |                               | LC                        |
| <i>Motacilla flava</i>                   | Yellow wagtail  | RCG   |                                 |                              |                               | LC                        |
| <i>Muscicapa striata</i>                 | Gray            | RCG   | II                              |                              |                               | LC                        |
| <i>Netta rufina</i>                      | Float transport | RCG   | I                               | II/1                         |                               |                           |
| <i>Oenanthe hispanica</i>                | Mediterranean   | RCG   | II                              |                              |                               | LC                        |
| <i>Oenanthe oenanthe</i>                 | An ordinary     | RCG   | II                              |                              |                               | LC                        |
| <i>Oriolus oriolus</i>                   | Eurasian        | RCG   |                                 |                              |                               | LC                        |
| <i>Parus caeruleus</i>                   | Eurasian blue   | RCG   |                                 |                              |                               | LC                        |

| Bird species in the vicinity of the area | Domestic name  | Protection Decision, Republic of Montenegro | Convention on Migratory Species | EU Directive (2009/147 / EC) | IUCN Global endangered status | IUCN status of Montenegro |
|--|----------------|---|---------------------------------|------------------------------|-------------------------------|---------------------------|
| <i>Parus major</i>                       | Great tit      | RCG   |                                 |                              |                               | LC                        |
| <i>Passer domesticus</i>                 | House          | RCG   |                                 |                              |                               | LC                        |
| <i>Passer hispaniolensis</i>             | Spanish        | RCG   |                                 |                              |                               | LC                        |
| <i>Passer montanus</i>                   | Polish         | RCG   |                                 |                              |                               | LC                        |
| <i>Pernis apivorus</i>                   | Osicar         | RCG   | II                              | I                            |                               | NT                        |
| <i>Phalacrocorax carbo</i>               | Great          | RCG   |                                 |                              |                               | NT                        |
| <i>Phoenicurus ochruros</i>              | Mountain       | RCG   | II                              |                              |                               | LC                        |
| <i>Phylloscopus collybita</i>            | A simple       | RCG   | II                              |                              |                               | LC                        |
| <i>Phylloscopus sibilatrix</i>           | Forest whistle | RCG   | II                              |                              |                               | LC                        |
| <i>Pica pica</i>                         | Magpie         |   |                                 | II/2                         |                               |                           |
| <i>Picus viridis</i>                     | Green          | RCG   |                                 |                              |                               | LC                        |
| <i>Plegadis falcinellus</i>              | Skewer         | RCG   | II                              | I                            |                               | NT                        |
| <i>Podiceps cristatus</i>                | Great crested  | RCG   |                                 |                              |                               | NT                        |
| <i>Podiceps nigricollis</i>              | Black-         | RCG   |                                 |                              |                               | VU                        |
| <i>Regulus ignicapillus</i>              | Firehead king  | RCG   | II                              |                              |                               | LC                        |
| <i>Regulus regulus</i>                   | The king       | RCG   | II                              |                              |                               | LC                        |
| <i>Saxicola rubetra</i>                  | An ordinary    | RCG   | II                              |                              |                               | LC                        |
| <i>Saxicola torquata</i>                 | Black-headed   | RCG   | II                              |                              |                               | NT                        |
| <i>Serinus serinus</i>                   | European       | RCG   |                                 |                              |                               | LC                        |
| <i>Sitta europaea</i>                    | Eurasian       | RCG   |                                 |                              |                               | LC                        |
| <i>Streptopelia decaocto</i>             | Dove           |   |                                 | II/2                         |                               | LC                        |
| <i>Sturnus vulgaris</i>                  | Starling       | RCG   |                                 | II/2                         |                               | LC                        |
| <i>Sylvia atricapilla</i>                | Black-headed   | RCG   | II                              |                              |                               | LC                        |
| <i>Sylvia cantillans</i>                 | Red-throated   | RCG   | II                              |                              |                               | LC                        |
| <i>Sylvia communis</i>                   | An ordinary    | RCG   | II                              |                              |                               | LC                        |
| <i>Sylvia curruca</i>                    | Shrubbery      | RCG   | II                              |                              |                               | LC                        |
| <i>Tachybaptus ruficollis</i>            | Little grebe   | RCG   |                                 |                              |                               | LC                        |
| <i>Tachymarptis melba</i>                | Big chip       | RCG   |                                 |                              |                               | LC                        |
| <i>Tadorna tadorna</i>                   | Ruddy          | RCG   | II                              |                              |                               | CR                        |
| <i>Tringa ochropus</i>                   | Green          | RCG   | II                              |                              |                               |                           |
| <i>Troglodytes troglodytes</i>           | Eurasian wren  | RCG   |                                 | I*                           |                               | LC                        |
| <i>Turdus iliacus</i>                    | Red-winged     | RCG   | II                              | II/2                         | NT                            |                           |
| <i>Turdus merula</i>                     | An ordinary    | RCG   | II                              | II/2                         |                               | LC                        |
| <i>Turdus philomelos</i>                 | Thrush singer  | RCG   | II                              | II/2                         |                               | LC                        |
| <i>Turdus pilaris</i>                    | Blackbird      | RCG   | II                              | II/2                         |                               | EN                        |
| <i>Turdus viscivorus</i>                 | Thrush         | RCG   | II                              | II/2                         |                               | LC                        |
| <i>Upupa epops</i>                       | Eurasian       | RCG   |                                 |                              |                               | LC                        |

Of the species that have an unfavorable endangered status according to domestic and international legislation, water and wetland birds are present in the subject area, e.g. Gray Heron (*Ardea cinerea*), Crane (*Grus grus*), Honeysuckle (*Alcedo atthis*) and Skewer (*Plegadis falcinellus*), as well as birds of open habitat (*Gray Magpie*, *Lanius minor*) and predators: Hawk (*Accipiter gentilis*) and Eagle (*Circaetus gallicus*). The highest concentrations are shown by gulls (*Larus ridibundus*, *Larus michahellis*), which feed opportunistically on anthropogenic habitats, as well as cormorants (*Phalacrocorax carbo*), which also adapt to the current availability of fish. In June 2020, a significant nesting population of the great bunting (*Emberiza calandra*) was found on the grassy areas in the immediate vicinity of Slivlje, which is estimated at about 30 pairs.

## ASSESSMENT OF THE SITUATION OF THE AREA

The subject area of the southern Nikšić field and the Glava Zete was anthropogenically modified in the middle of the last century with the aim of exploiting hydrological capacities. Such a large intervention resulted in a significant change in the natural features of the original ecosystem, however, due to the incomplete efficiency of the system, part of the area retained the original character of wetlands. On the other hand, authentic agriculture with its effects on ornithofauna is mostly abandoned. Unfortunately, there are no comparable data on the composition of the state of bird populations in the Nikšić field before immersion. The current state of the ornithofauna is conditioned by the volatile resources of the semi-natural habitat, which changes in accordance with the hydrological state, interventions on the fish stock and the needs of electricity production. Nevertheless, this area has retained a rich ornithofauna due to habitat diversity and favorable geographical position. Significant populations of migratory waterbirds regularly appear on the accumulation lakes, while the characteristic terrestrial species have adapted to the new conditions and resources. Anthropogenic impacts of the Perućica HPP infrastructure have not changed for decades. Changes in water levels and their environmental effects are still largely due to natural factors. In these conditions, there was a certain habituation, i.e. adaptation of ornithofauna, especially species that have a wider ecological valence, however, the development of their populations is limited by unstable ecological factors. The described reconstruction of the Slivlje pool, which implies changes in order to more efficient water management, is therefore not interpreted as a significant negative effect on the ornithofauna.

### Possible impacts (during construction/operational phase)

Based on the description of the reconstruction given in the project task, the impact on the ornithofauna is limited to the immediate surroundings of the retention pool. Construction works imply a certain degree of negative effects in the form of disturbance and loss of habitat for birds that nest in the immediate vicinity, primarily on grassy soil and neighbouring forest vegetation. Considering that this is a semi-natural habitat with a seasonal character, where regular mowing and traffic take place, it is estimated that these impacts will be minimal. Only in the case of occupying new areas of natural habitat for the needs of construction of facilities and access roads is the effect of irreversible loss of habitat and its fragmentation possible. When it comes to the reconstruction of the Slivlje pool, changes in the composition of aquatic communities on a concrete base are expected, and thus a disturbance in the trophic chain that includes ichthyophage birds, which may be contributed by the new water regime (faster retention emptying). It is expected that these changes will not have significant harmful effects, because the observed water birds use this locality on an optional basis, in accordance with the currently available resources.

The installation of a new generator in the machine hall will not have significant effects on the ornithofauna. At this location, mostly synanthropic species have been found that tolerate the presence of humans. The location of the plant itself is not problematic due to the presence of a migratory corridor in the Zeta Valley, because it is located in a deep canyon outside the overflight zone.

Proposed protection measures (during construction / operational phase)

Protection measures during construction are reduced to recommendations for minimizing the effects of loss and fragmentation of natural grassland habitat during construction works on the reconstruction of the Slivlje retention pool. It is optimal to perform the works in the period outside the reproductive season, i.e. in the period I-IV and VIII-XII, in order to eliminate the

disturbance of nesting birds. Existing access roads and degraded areas should be used for earthworks for the disposal of materials and construction waste, and the occupation of additional areas should be avoided.

In case the works are performed at the beginning of the reproductive season in April, it is recommended to preventively remove vegetation on the necessary areas, in order to avoid destroying the started nests. At the Glava Zete site, construction waste should also be avoided on the banks or in the Zeta riverbed in order to preserve existing natural communities.



ATTACHMENT: PHOTO LOG



**Picture 1. The great bunting (*Emberiza calandra*) is a numerous nesting bird in the grassy areas of the Nikšić field**



**Picture 2. Mediterranean gull (*Larus michahellis*) feeds opportunistically in the pool "Slivlje"**





**Picture 3. Agricultural and grassland habitats are a significant type of habitat in the Nikšić field**



**Picture 4. Retention pool from the observation point**





**Picture 5. Northern wheatear (*Oenanthe oenanthe*) on the retaining wall above the engine room of HPP "Perućica"**



**Picture 6. Anthropomorphic habitat at the location of HPP "Perućica"**



**17.3.1.6 ASSESSMENT OF THE SITUATION OF ICHTHYOFAUNA IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"**

Prepared by: Katarina Burzanović, ichthyofauna expert

Podgorica, June 2022

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## CONTENT

- 1 ICHTHIOFAUNA (FISH)
    - 1.1 Review of the current situation on the environment
    - 1.2 Literature review (rough)
  - 2 RESEARCH METHODS
  - 3 PRESENTATION OF RESULTS
  - 4 ASSESSMENT OF THE SITUATION OF THE AREA
    - 4.1 Possible impacts (during construction / operational phase)
    - 4.2 Proposed protection measures (during construction / operational phase)
  - 5 CONCLUSION
  - 6 REFERENCES
- ATTACHMENT: PHOTOLOG

## ICHTHYOFAUNA (FISH)

The project area includes the upper reaches of the Zeta River. The ichthyofauna of the upper course consists mainly of salmonids: *Salmo zetensis*-endemic of the Zeta river, *Salmo marmoratus*, *Salmo farioides* and several species of cyprinids (Marić, 2019).

### Review of the current situation on the environment

The surveyed area includes 200m from the upper flow of Zeta River, from the confluence of River Zeta and Perucica (photo 1) up to catchment for HPP Perucica (photo 2). When it comes to river zoning, this area belongs to the so-called salmonid region. This region is characterised by the strongest water currents, low temperature (10-12°) which is characterised by low variations, high oxygen concentration, and the surface is mostly comprised of rocks and big stones, and rarely from big round stones. The subject area belongs to the area of strict fishing ban, because natural trout hatcheries are located a couple hundred meters upstream (photo 3).

### Literature review (general overview)

The paper uses literature data with the primary source "Fauna of freshwater fish (Osteichthyes) of Montenegro" and "Hydrobiology". Other sources of information are listed in the chapter "Literature".

## RESEARCH METHODS

Field research of fish in the impact zone of the project "improving energy efficiency and upgrading the system of HPP Perućica" was conducted on June 2 and 3, 2022. The field research was conducted with an electric generator in the presence of the president of SRK Nikšić, Vujica Lalić and fish keeper Željko Vukotić. There were no restrictions that accompanied the research. On that stretch of 200 meters, only the coastal trout, *Salmo faroides*, was registered (Figure 4), which is very numerous on that stretch. They state that the *Anguilla Anguilla* can also be registered in this area, especially around the small dam.

## PRESENTATION OF RESULTS

The following table provides an overview of expected species, based on literature data (Marić, 2019), as well as an overview of identified species.

**Table 1. List of assumed and determined species**

| Ordinal number | Species name (Latin name)                 | Endemism | Degree of endangerment (IUCN) | Identified species |
|----------------|---|----------|-------------------------------|--------------------|
| 1.             | <i>Salmo faroides</i> Karaman, S., 1937   |          | Not evaluated                 |                    |
| 2.             | <i>Salmo marmoratus</i> Cuvier, 1829      |          | LC                            |                    |
| 3.             | <i>Salmo zetensis</i> Hadžišće, 1962      | Yes      | EN                            | Yes                |
| 4.             | <i>Anguilla anguilla</i> (Linnaeus, 1758) |          | CR                            |                    |

### – *Salmo zetensis*

Conservation status: Kottelat & Freyhof (2007) for *S. zetensis* according to **EN**. In Montenegro is critically endangered (**CR**) and measures must be taken urgently to recover the population. The species is protected by the Law on Freshwater Fisheries and is on the list of endangered species, the Law on Freshwater Fisheries has the highest degree of protection. It is on the list of the Red Book in Montenegro.

### – *Anguilla anguilla*

In Montenegro it is **EN**, according to Kottelat & Freyhof (2007) **CR**. The eel also enters the upper stream, because it is a predator and feeds on other fish, smaller aquatic animals, eggs, crabs, larvae and earthworms.

## ASSESSMENT OF THE SITUATION OF THE AREA

### Possible impacts (during construction / operational phase)

The terms of reference state that the project will be realized through the realization of two tasks:

- Within the first task, the reconstruction of the existing drainage channel of the A8 unit, the reconstruction of the composition pool and the rehabilitation of the water level are planned;
- Task 2 includes the installation of mechanical and hydromechanical equipment, installation of electrical equipment, appropriate construction work on the installation of mechanical and electrical equipment. It is stated that all construction works related to the installation of the A8 unit were completed during the construction of the power plant, in the first phase of construction. Minor construction works are planned in the power plant itself during the installation of new electrical and mechanical equipment. All these works include minor demolition, removal and drilling of concrete, concreting and installation of new concrete. These construction works should include the



rehabilitation of concrete and concrete surfaces of the bus channel. Finally, the final craft work will be done, including the floors and the painting of the walls and facades.

When performing construction works, there is always the possibility of influencing the water flow, if they are performed near or within the riverbed.

Construction work, depending on the type, can cause changes in the riverbed itself, if it is riverbed excavation. This type of work changes the morphology of the riverbed bottom and then we have a strong impact on all aquatic organisms.

As the mentioned types of construction works will not be performed in this project task, it is unnecessary to state potential impacts. All types of work are performed inside the machine building, i.e. outside the riverbed, at a significant distance.

Potentially, due to concreting, physical turbidity could occur, but even this is unlikely given the distance from the watercourse.

**There is no degradation of the flood zone.** The flood zone provides shelter and is the central area where fish from the main river flow migrate during the flood wave. It enables the maintenance of biomass and the diversity of the entire fish settlement related to seasonal cycles (periods of high and low waters).

**In the event of an accident** (spillage of harmful chemicals into the environment, e.g. petroleum products) under each transformer there are collection pits that do not allow spillage into the riverbed.

Since this part is inhabited by trout species, which do not have tolerance to changes in water quality (pollution), they require clear and clean water rich in oxygen. From the description of the project task, I do not find the possibility of a potential impact on ichthyofauna.

### **Proposed protection measures (during construction/operational phase)**

Separate protection measures for endangered species

- *Anguilla anguilla* (CR)

It has the status of a critically endangered species. Eels are catadromous migrants and reproduction is exclusively related to the sea. In autumn, when the water level rises and the currents increase, an unstoppable urge leads them to the sea, often through underground streams and caves, often crawling over wet meadows and mud. It is mostly active at night, and feeds on various aquatic invertebrates, fish and frog larvae (Morović, 1976). It lives along the bottom, in various cracks or under rocks. It is a widespread species that inhabits most European watercourses that flow into the Atlantic Ocean, North, Baltic and Mediterranean Seas.

- *Salmo zetensis*

It has the status of an endangered species and is the only legally protected species in Montenegro, distributed in the Zeta River and its tributaries. Spawning in winter is usually December-January. It goes to spawn in the upper reaches of the river Rijeka.

The potential impact of the project on these species would be reflected through habitat degradation and contamination. The works should be performed when the water level is minimal, during the summer period.

Prevent the possibility of accidental pollution of watercourses (spillage of oil, lubricants or petroleum products into watercourses) Existing collection pits are a good protection against such accidental situations.

In the case of wastewater, prevent spillage by special drainage channels, and treat wastewater via sedimentation tanks and separators.

**Proposal:** to monitor fish biodiversity after the completion of reconstruction in the Upper Zeta area.

## Conclusion

After visiting the terrain and analyzing the project task, in the presence of the executive director of HPP Perućica, I am of the opinion that the mentioned reconstruction has almost no impact on the fish stock. This is due to the fact that the works are not performed in the vicinity or the riverbed itself, as well as due to the nature of the works. These are minor construction works and concreting of smaller volume, replacement and installation of electrical and other equipment inside the machine building.

HPP Perućica implements all environmental protection measures on a daily basis and can serve as a good example of ecological attitude towards the environment. In the immediate vicinity there is a spawning ground for soft trout, well guarded and locked (Picture 3) where large pieces of fish can be seen with the naked eye, which speaks volumes about the degree of protection and how good the ecological conditions in this area are.

**From all the above, I am of the opinion that the reconstruction of HPP Perućica does not have a negative impact on the environment, i.e. the fish stock of the zone of potential impact, and I give my consent to this type of project.**

## Literature

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**17.3.1.7 ASSESSMENT OF THE BATRACHOLOGY AND HERPETOLOGY IN THE AREA OF THE PROJECT "PROMOTION OF ENERGY EFFICIENCY AND UPGRADE OF HYDRO POWER PLANT PERUĆICA - INSTALLATION OF UNIT 8"**

Prepared by: Natalija Čadjenović, expert in batrachology and herpetology

Podgorica, June 2022



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## CONTENT

- 1 OVERVIEW OF THE CURRENT SITUATION WITH THE ENVIRONMENT
    - 1.1 Literature review
  - 2 RESEARCH METHODS
  - 3 PRESENTATION OF RESULTS
    - 3.1 Reptiles
    - 3.2 Amphibians
  - 4 ASSESSMENT OF THE SITUATION OF THE AREA
    - 4.1 Possible impacts during construction
    - 4.2 Proposed protection measures or remedial measures
- ATTACHMENT: PHOTOLOG

## OVERVIEW OF THE CURRENT SITUATION WITH THE ENVIRONMENT

The object of this study are amphibians and reptiles, two different groups of vertebrates, which inhabit terrestrial, semi-aquatic and aquatic habitats. The investigated area is characterized by a large number of occasional and permanent water surfaces, so that such a space provides conditions for a pronounced diversity of amphibians and reptiles.

Due to the large oscillation of water during the year in the study area there are a large number of occasional water surfaces that are the most important part of the habitat for amphibians.

### Literature review

Preparations for the research included a review of literature data for amphibians and reptiles in the wider subject area and their location on a map. Batraho and the herpetofauna of the researched area have not been the subject of scientific studies, so the diversity of amphibian and reptile fauna of this region can be seen on the basis of literature data related to the Zeta River Valley (Zeta River Valley of Nature - a protected natural asset - the natural monument "Gornjepoljski vir" in the municipality of Nikšić. The inspection of the route performed at the end of May inspected the terrain on which the research will be performed. Special emphasis is placed on natural and semi-natural zones of wet and aquatic habitats important for the existence of amphibians and reptiles.

## RESEARCH METHODS

The survey of amphibians and reptiles was conducted at the end of May for two field days (May 28 and 31). Determining the presence of expected species of amphibians and reptiles in favorable habitats in the subject area was carried out by the method of visual transect and the method of search with the help of mereds, based on standard methods for assessing the diversity of batracho and herpetofauna. Meredov search was conducted only in some cases for the purpose of species determination. After determination, the individuals were immediately returned to the habitat. During the field visit, the following data were collected: date, time, geographical coordinates, altitude, number of observed individuals, their age category, threats present. Standard herpetological literature was used to identify the species (Arnold & Ovenden 2002, Speybroeck et al., 2016;).

## PRESENTATION OF RESULTS

The importance of this area for batracho and herpetofauna is reflected in the number of recorded species, for a relatively short period of research. A total of 11 species of amphibians and reptiles were registered in the study area. This is certainly due to the biogeographical position of this area dominated by temperate - continental climate with a strong Mediterranean influence but also a great diversity of habitats, suitable for forms of reptiles that inhabit dry rock habitats, field edges, overgrown embankments and roadsides, and wetlands. smaller and larger ponds and rivers important for amphibians, but also reptiles that prefer this type of habitat (eg *Natrix natrix*, *Natrix tessellata*).

### Reptiles

During the research conducted in two field days, the presence of 8 species of reptiles in the impact zone of the project was determined. Of the potential species, *Vipera ammodytes*, *Pseudopus apodus*, *Podarcis melisellensis* have not been recorded. Karst lizard (*Podarcis melisellensis*) and Balkan spruce (*Hierophis gemonensis*) are endemic to the Balkan Peninsula. The forest turtle (*Testudo hermanni*) and the striped turtle (*Elaphe*

quatuorlineata) have the status of almost endangered species (NT) and are listed in Annex II of the Habitats Directive. The forest turtle is also on the CITES list.

**Table 1. Reptile species**

| Species  | National legislation | Endemism           | CITES | IUCN | BERN | Habitats | Note                              |
|--|----------------------|--------------------|-------|------|------|----------|-----------------------------------|
| <b>Chelonia</b>                                      |                      |                    |       |      |      |          |                                   |
| <b>Testudinidae</b>                                  |                      |                    |       |      |      |          |                                   |
| <i>Testudo hermanni</i><br>(Forest Turtle)           | protected species    | –                  | (II)  | NT   | II   | II,IV    |                                   |
| <b>Sauria</b>  |                      |                    |       |      |      |          |                                   |
| <b>Lacertidae</b>                                    |                      |                    |       |      |      |          |                                   |
| <i>Podarcis muralis</i><br>(Wall lizard)             | protected species    | –                  |       | LC   | II   | IV       |                                   |
| <i>Lacerta viridis</i>                               | protected species    | –                  |       | LC   | II   | IV       |                                   |
| <b>Ophidia</b>                                       |                      |                    |       |      |      |          |                                   |
| <b>Colubridae</b>                                    |                      |                    |       |      |      |          |                                   |
| <i>Natrix natrix</i><br>(Grass snake)                | protected species    | –                  |       | LC   | III  | –*       | * IV individual island subspecies |
| <i>Natrix tessellata</i><br>(Dice snake)             | protected species    | –                  |       | LC   | II   | IV       |                                   |
| <i>Hierophis gemonensis</i><br>*( Balkan whip snake) | protected species    | Endemic of Balkans |       | LC   |      | –        | * as <i>Coluber gemonensis</i>    |
| <i>Elaphe quatuorlineata</i><br>(Four-lined snake)   | protected species    |                    |       | NT   | II   | II, IV   |                                   |
| <i>Dolichophis caspius</i><br>(Caspian whipsnake)    | protected species    |                    |       | LC   | II   | IV       |                                   |

Status of protection of detected reptile species (National legislation: "Decision on protection of certain plant and animal species" Official Gazette 76/06; IUCN (International Union for Conservation of Nature) red list; NT - almost endangered taxon; LC - least worrying last concern); VU-not critically endangered but threatened with extinction in the future; II, IV - species is in the appendix or annex; BERN (Bern Convention on the Conservation of European Wildlife and Natural Habitats) - (II, strictly protected animal species ; III, protected animal species); Habitats Directive - Council of European Communities (1992): Council Directive 92/43 / EEC of 21 May 1992 on the conservation of natural habitats and of wildlife and flora Habitats Directive - 92/43 / EEC )

## Amphibians

During the research conducted on the basis of two field days, the presence of 3 species of amphibians in the impact zone of the project was determined (Table 2). All detected species are protected by national legislation. Registered species are not considered endangered taxa according to the IUCN categorization. From potential species can be expected *Hyla arborea*, *Salamandra salamandra*, *Rana dalmatina*. These species have not been confirmed in the study area, which may be a reflection of the very short time of field research during extremely warm days, when the possibility of detecting amphibians is lower due to their reduced activity.

**Table 2. Amphibian species found**

| Species  | National legislation | Endemism | CITES | IUCN | BERN | Habitats | Note                      |
|--|----------------------|----------|-------|------|------|----------|---------------------------|
| <b>Anura</b>                                     |                      |          |       |      |      |          |                           |
| <b>Bufonidae</b>                                 |                      |          |       |      |      |          |                           |
| <i>Bufo bufo</i><br>(Brown toad)                 | protected species    | –        | –     | LC   | III  | –        |                           |
| <i>Bufo viridis</i><br>(Green toad)              | protected species    | –        | –     | LC   | II   | IV       | *as <i>Bufo viridis</i>   |
| <b>Ranidae</b>                                   |                      |          |       |      |      |          |                           |
| <i>Pelophylax ridibundus</i><br>(Big Green Frog) | * protected species  | –        | –     | LC   | III  | V        | *as <i>Rana ridibunda</i> |

Status of protection of detected reptile species (National legislation: "Decision on protection of certain plant and animal species" Official Gazette 76/06; IUCN (International Union for Conservation of Nature) red list; NT - almost endangered taxon; LC - least worrying last concern); VU-not critically endangered but threatened with extinction in the future; II, IV - species is in the appendix or annex; BERN (Bern Convention on the Conservation of European Wildlife and Natural Habitats) - (II, strictly protected animal species ; III, protected animal species); Habitats Directive - Council of European Communities (1992): Council Directive 92/43 / EEC of 21 May 1992 on the conservation of natural habitats and of wildlife and flora Habitats Directive - 92/43 /EEC )

**Table 3. Presence of reptile species on certain transects**

| Species name   | Coordinates  |
|--|--|
| <i>Testudo hermanni</i><br>(Forest Turtle)           | 42°40'5.62"N 18°59'41.25"E                                   |
| <i>Podarcis muralis</i><br>(Wall lizard)             | 42°40'10.57"N 18°59'48.95"E                                  |
| <i>Lacerta viridis</i><br>(European green lizard)    | 42°40'22.09" N 18°59'42.31"E<br>42°43'14.31" N 18°59'35.40"E |
| <i>Hierophis gemonensis</i><br>*( Balkan whip snake) | 42°43'12.87"N 18°59'36.14"E                                  |
| <i>Elaphe quatuorelineata</i><br>(Four-lined snake)  | 42°43'13.34"N 18°59'46.05"E                                  |



|  |                             |
|--|-----------------------------|
| <i>Dolichophis caspius</i> (Caspian whipsnake) | 42°40'03.58"N 18°59'44.98"E |
| <i>Natrix natrix</i><br>(Grass snake)          | 42°43'13.13"N 18°59'55.69"E |
| <i>Natrix tessellata</i><br>(Dice snake)       | 42°43'12.88"N 18°59'41.08"E |

**Table 4. Presence of reptile species on certain transects**

| Species name                                     | Coordinates  |
|--|--|
| <i>Bufo bufo</i><br>(Brown toad)                 | 42°43'03.36"N 18°59'38.88"E                                |
| <i>Bufotes viridis</i><br>(Green toad)           | 42°43'15.01"N 18°59'38.04"E                                |
| <i>Pelophylax ridibundus</i><br>(Big Green Frog) | 42°43'09.03"N 18°59'51.32"E<br>42°43'14.16"N 18°59'39.70"E |

## ASSESSMENT OF THE SITUATION OF THE AREA

The research area is quite well preserved. The diversity of batracho and herpetofauna is exposed to stronger / weaker human influences. Since these are vulnerable groups, any negative impact leaves great consequences on their survival. The most common reasons for the endangerment of amphibians and reptiles are fragmentation and loss of natural habitats.

In some places, the influence of urbanization has been noticed, which leads to the removal of vegetation, leveling of the terrain and soil compaction, which can reduce the place for hibernation of amphibians and reptiles, as well as reduce the number of prey (various terrestrial invertebrates). Large amounts of garbage that have a negative impact on the entire environment have been registered, and a particularly negative effect is reflected on amphibians for whom aquatic habitats are the main reproductive centers.

### Possible impacts during construction

When performing works as a reaction to noise and vibration, individuals may move outside the boundaries of the area of activity. Increased mortality of adults and juveniles when crossing the road during the works can be expected for land turtles (*Testudo hermanni*), whose dispersion is due to the selection of new habitats (juveniles), and / or portage for food, shelter and egg-laying sites (adult individuals) occurs during the day. Also, during the works in the researched area, the mortality of certain species is expected when crossing the road (*Bufo bufo*, *Testudo hermanni*, *Lacerta viridis*). The works can lead to water turbidity, which can have a negative impact on the reproductive phase of amphibians.

### Proposed protection measures or remedial measures

- Strictly limit the movement of heavy machinery to the most necessary manipulative surface, using already existing roads to avoid further fragmentation and degradation of habitats and to reduce soil compaction to a minimum;
- Continue and improve the monitoring program (regular monitoring of protected and endemic species);

- Prevent forest exploitation in the wider area. Increased exploitation of wood, allows increased penetration of light which is negatively reflected on the leaf litter which provides optimal conditions (humidity and temperature) for incubation of eggs of snakes present;
- Regularly assess the number of populations and population trends;
- The stated data to represent the basis for further actions in the protection of habitats and populations of species;
- Works should be performed outside the reproductive period, avoid the period from March to July.

**ATTACHMENT: PHOTO LOG**

**FAUNA OF BATRACHOLOGY AND HERPETOLOGY IN THE SUBJECT AREA**

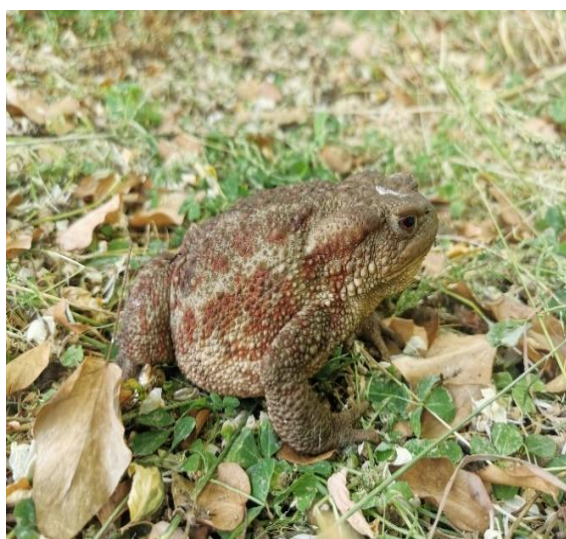
**Picture 1. *Elaphe quatuorelineata***



**Picture 2. *Testudo hermanni***



**Picture 3. *Hierophis gemonensis***



**Picture 4. *Bufo bufo***



**HABITATS IN THE SUBJECT AREA**



**Picture 5 Preserved habitat for amphibians**



**Picture 6. Amphibian reproductive center**





Picture 1. Map of the research area

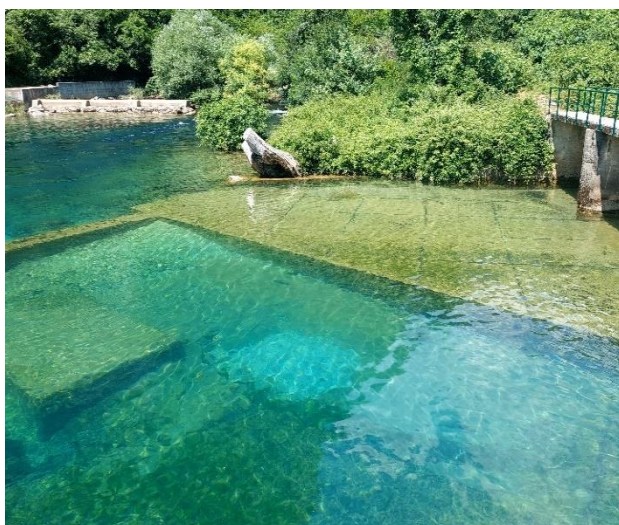


Picture 2. Research area



Picture 3. Research area





**Picture 4. Research area**



**Picture 5. Trout**

## 17.3.2 Noise surveys

**TEST REPORT**

|  |  |
|--|--|
| Type of test                                       | <b>Noise level in the environment (Baseline conditions) - Nikšić and Danilovgrad</b>   |
| Number of reports                                  | 00-1182/1/B  |
| Date of issue of the report                        | 06 June 2022   |
| <b>INFORMATION ABOUT THE APPLICANT</b>             |  |
| Request number and date                            | CETI no. 00-1182 od 20 May 2022  |
| Address / Tel./Fax                                 | St. Jola Piletića 24 - Podgorica; +382 20 227 501; +382 20 227 502   |
| <b>SAMPLE DATA</b>                                 |  |
| Sampling date                                      | 01 June and 02 June 2022   |
| Sampling plan/method                               | ISO 1996-1: 2018 "Acoustics - Description, measurement and evaluation of environmental noise" - Part 1: Basic values and evaluation procedures; ISO 1996-2: 2018 "Acoustics - Description, measurement and evaluation of environmental noise" - Part 2: Determination of sound pressure levels |
| Test required                                      | Equivalent noise level   |
| Additions, deviations or omissions from the method | No   |
| <b>RULE OF DECISION MAKING</b>                     |  |
| Binary system (ILAC-G8: 09/2019)                   |  |
| Measurement performed                              | Ranko Zekić, graduate physicist.; Benard Berišaj, graduate physicist.  |
| Attachments  | 1. Measurement graphs; 2. Equipment  |

**V.D. DIRECTOR OF THE LAB SECTOR. DIAGNOSIS  
AND RADIATION PROTECTION**

**Dr. Nikola Svrkota, B.Sc.**

Dr. Nikola Svrkota, B.Sc.

Statement:

1. Test results refer to the test sample only.
2. The test report may be reproduced solely as a whole.
3. It is not allowed to display the name "Center for Ecotoxicological Research Podgorica" d.o.o. in the text of the declaration or for advertising purposes, without the consent of the Center.



## **CONTENT**

1. GENERAL INFORMATION
  2. RESULTS OF THE TEST
  3. MEASURING UNCERTAINTY
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## RADIATION PROTECTION AND NOISE MEASUREMENT UNIT

### RESULTS OF THE ANALYSIS

#### GENERAL INFORMATION

Based on the request no. 00-1182, on 01 June and 02 June 2022, an examination of the noise level in the environment was performed in order to determine the zero state of the noise level for the project "Improvement of energy efficiency and upgrade of HPP Perućica - installation of unit 8".

Noise level testing was performed with a phonometer "2250 - Bruel & Kjaer" which was calibrated with a calibrator "4231 Bruel & Kjaer" which meets the international standards IEC 61672-1: 2002 class 1, IEC 651 and 804 Type 1. The measurement methodology was applied in accordance with ISO 1996-1: 2018 and ISO 1996-2: 2018 "Acoustics - description, measurement and evaluation of environmental noise" - Part 1 and 2.

In accordance with the request, measurements of day, evening and night noise levels in the environment were realized at 2 measuring positions, according to the nearest residential buildings where it was estimated that the noise level could be the highest. The first measuring position is located at the Slivlje / Ozrinići site in the immediate vicinity of the compensation basin, while the second position is at the Bogetići / Glava Zeta site near the Perućica HPP machine building. The layout of all measuring positions with their geographical coordinates is given in Figures 1 and 2 and the presentation of noise level measurements in Figures 3-4.



**Figure 1. Station of measuring position 2 (42.716200, 18.990771) at Slivlje / Ozrinići**



**Figure 2. Station of measuring position 2 (42.668377, 18.994499) at the location Bogetići / Glava Zeta**

Table 1.1 provides data on the calibration of the instrument before and after the end of the measurement, the frequency weighting used, the dynamic characteristics of the measuring instrument, the position of the microphone, the operating mode and the position of the noise source.

**Table 1.1 Calibration for device B&K 2250**

| Date of calibration | Sensitivity [mV / Pa] | Deviation [dB] | Frequency weighting | Dynamic characteristic | Position of microphone |
|---------------------|-----------------------|----------------|---------------------|------------------------|------------------------|
| 01.06.2022.         | 44.12                 | -0.13          | A                   | FAST                   | 1.5m (Free field)      |
| 01.06.2022.         | 44.32                 | 0.04           | A                   | FAST                   | 1.5m (Free field)      |
| 02.06.2022.         | 44.23                 | 0.03           | A                   | FAST                   | 1.5m (Free field)      |



**Figure 3. Measurement of noise levels at position 1**





**Figure 4. Measurement of noise levels at position 2**

## TEST RESULTS

At the selected measuring positions, noise level tests were performed in the daytime, evening and night period in order to determine the zero state at these localities. There were no specific noise sources during the measurement, so the measured noise levels represent the background (residual) noise level at these measuring positions. The results of all noise level measurements are given in Tables 2.1 - 2.6

**Table 2.1 Measured daily indicators of residual noise level at measuring position 1. (Compensation Pool)**

| Date         | Elapsed time | LAeq [dB]   | LCpeak [dB] | LAFmax [dB] | LAFmin [dB] | LAE[dB] |
|--------------|--------------|-------------|-------------|-------------|-------------|---------|
| 01 June 2022 | 00:10:00     | <b>38.1</b> | 79.1        | 52.7        | 26.3        | 65.0    |
| 01 June 2022 | 00:10:00     | <b>37.0</b> | 75.8        | 61.4        | 25.0        | 64.8    |
| 01 June 2022 | 00:10:00     | <b>38.6</b> | 77.5        | 61.3        | 25.6        | 66.4    |

**Table 2.2 Measured evening indicators of residual noise level at measuring position 1. (Compensation Pool)**

| Date         | Elapsed time | LAeq [dB]   | LCpeak [dB] | LAFmax [dB] | LAFmin [dB] | LAE[dB] |
|--------------|--------------|-------------|-------------|-------------|-------------|---------|
| 01 June 2022 | 00:10:00     | <b>39.2</b> | 74.8        | 54.5        | 25.2        | 67.0    |
| 01 June 2022 | 00:10:00     | <b>36.8</b> | 81.5        | 58.0        | 25.4        | 64.5    |
| 01 June 2022 | 00:10:00     | <b>37.1</b> | 78.5        | 58.3        | 23.4        | 64.8    |



**Table 2.3 Measured night indicators of residual noise level at measuring position 1. (Compensation Pool)**

| Date         | Elapsed time | LAeq [dB]   | LCpeak [dB] | LAFmax [dB] | LAFmin [dB] | LAE[dB] |
|--------------|--------------|-------------|-------------|-------------|-------------|---------|
| 02 June 2022 | 00:10:00     | <b>37.5</b> | 86.7        | 59.7        | 27.5        | 65.2    |
| 02 June 2022 | 00:10:00     | <b>34.7</b> | 74.2        | 56.0        | 29.4        | 62.5    |
| 02 June 2022 | 00:10:00     | <b>34.3</b> | 74.7        | 54.9        | 29.8        | 62.1    |

**Table 2.4 Measured daily indicators of residual noise level at measuring position 2. (Machine building)**

| Date         | Elapsed time | LAeq [dB]   | LCpeak [dB] | LAFmax [dB] | LAFmin [dB] | LAE[dB] |
|--------------|--------------|-------------|-------------|-------------|-------------|---------|
| 01 June 2022 | 00:10:00     | <b>43.7</b> | 93.1        | 66.7        | 37.2        | 71.4    |
| 01 June 2022 | 00:10:00     | <b>42.7</b> | 79.7        | 57.7        | 36.9        | 70.5    |
| 01 June 2022 | 00:10:00     | <b>44.9</b> | 85.8        | 60.8        | 40.1        | 72.7    |

**Table 2.5 Measured evening indicators of residual noise level at measuring position 2. (Machine building)**

| Date         | Elapsed time | LAeq [dB]   | LCpeak [dB] | LAFmax [dB] | LAFmin [dB] | LAE[dB] |
|--------------|--------------|-------------|-------------|-------------|-------------|---------|
| 01 June 2022 | 00:10:00     | <b>41.0</b> | 82.0        | 55.5        | 38.1        | 68.8    |
| 01 June 2022 | 00:10:00     | <b>40.6</b> | 79.5        | 53.3        | 38.2        | 68.4    |
| 01 June 2022 | 00:10:00     | <b>40.4</b> | 82.1        | 58.0        | 37.9        | 68.2    |

**Table 2.6 Measured night indicators of residual noise level at measuring position 2. (Machine building)**

| Date         | Elapsed time | LAeq [dB]   | LCpeak [dB] | LAFmax [dB] | LAFmin [dB] | LAE[dB] |
|--------------|--------------|-------------|-------------|-------------|-------------|---------|
| 01 June 2022 | 00:10:00     | <b>40.3</b> | 87.1        | 61.5        | 38.2        | 68.1    |
| 01 June 2022 | 00:10:00     | <b>40.3</b> | 87.0        | 62.8        | 37.7        | 68.1    |
| 01 June 2022 | 00:10:00     | <b>40.2</b> | 75.9        | 52.0        | 38.5        | 67.9    |

In Table 2.7. meteorological parameters measured during the noise level test are presented: temperature T, relative humidity of the air, air flow rate V and pressure P.

**Table 2.7. Measured meteorological parameters measured during noise level measurement**

| T [°C] | RH [%] | V [km/h] | P [mb] |
|--------|--------|----------|--------|
| 30     | 55     | 4.2      | 1014   |
| 18     | 76     | 3.6      | 1015   |

## MEASUREMENT UNCERTAINTY

The estimation of measurement uncertainty in determining the sound pressure level is defined by the MEST ISO 1996-2:2018 standard (Chapter 4). The sound pressure level depends on the noise source, the measurement interval, the weather conditions, the distance from the noise source, the measurement method and the class of instruments used.

Total measurement uncertainty, when determining the equivalent noise level, is determined as extended uncertainty, ie. standard uncertainty multiplied by the coverage factor  $k = 2$  which provides a 95% confidence level.

$$L_{Aeq \text{ Actual}} = L_{Aeq \text{ Measurement}} \pm 2 \cdot u_A$$

where  $L_{Aeq \text{ Actual}}$  - Actual value of equivalent noise level;  $L_{Aeq \text{ Measurement}}$  - The measured value of the equivalent noise level a  $2 \cdot u_A$  is the value of the extended measurement uncertainty.

Considering the defined factors that affect the measurement uncertainty, it is calculated as:

$$u_A = \sqrt{(C_L' \cdot U_L')^2 + (C_{sou} \cdot U_{sou})^2 + (C_{met} \cdot U_{met})^2 + (C_{loc} \cdot U_{loc})^2 + (C_{res} \cdot U_{res})^2}$$

where:

- $C_L'$ : Coefficient of sensitivity of the measured noise level which includes residual noise
- $U_L'(U_{slm})$ : Measurement uncertainty of the measured noise level (measurement uncertainty of the measuring chain)
- $C_{sou}$ : Sensitivity coefficient for variation of noise source operating mode
- $U_{sou}$ : Measurement uncertainty due to variation of noise source operation mode
- $C_{met}$ : Coefficient of sensitivity for variation of meteorological conditions
- $U_{met}$ : Measurement uncertainty due to variation of meteorological conditions
- $C_{loc}$ : Sensitivity coefficient for the location of the measuring instrument
- $U_{loc}$ : Measurement uncertainty for the location of the measuring instrument
- $C_{res}$ : Sensitivity coefficient for the measured residual noise level
- $U_{res}$ : Measurement uncertainty for the measured residual noise level

In this case, for a given series of measurements at a given measuring position, the formula for calculating the total combined measurement safety is reduced to:

$$u_A = \sqrt{(C_L' \cdot U_{slm})^2 + (C_{komb} \cdot U_{komb})^2 + (C_{res} \cdot U_{res})^2}$$

where  $U_L' = U_{slm} = 0.5 \text{ db}$  (for class 1 instruments),  $U_{loc} = 0$  (for the position of the microphone in the free field),  $U_k = \sqrt{\sum (L_i - L_k)^2 / (N_k - 1)}$  is the combined measurement uncertainty of source and meteorological conditions,  $U_{res} = \sigma_{st.dev.}$  a  $C_{sou} = C_{met} = C_{kom} = 1$ ,  $C_L' = 1 / (1 - 10^{-0.1(L' - L_{res})})$  i  $C_{res} = (10^{-0.1(L' - L_{res})}) / (1 - 10^{-0.1(L' - L_{res})})$ .

Since in this case it is a question of examining the level of residual noise in the environment (zero state), it is treated as basic (specific) noise without the contribution of other sources, so the previous formula for measurement uncertainty is reduced to:

$$u_A = \sqrt{(U_{\text{slm}})^2 + (U_{\text{met}})^2}$$

where  $U_{\text{slm}} = 0.5$  dB (for instrument class 1),  $U_{\text{met}} = 2.0$  dB. The measured uncertainty of the noise level was measured  $u_A = 2.1$  dB, while the extended measurement uncertainty was  $2 \cdot u_A = 2 \cdot 2.1 = 4.2$  dB.

## OVERVIEW AND ANALYSIS OF THE OBTAINED RESULTS

Secretariat for Spatial Planning and Environment of the Municipality of Nikšić, on 13 May 2013 passed the "Decision on the determination of acoustic zones on the territory of the municipality of Nikšić" (decision number: 07-353-215) which performed the acoustic zoning of the territory of this municipality. Also, the Municipal Assembly of Danilovgrad passed the "Decision on the determination of acoustic zones in the municipality of Danilovgrad" (decision number: 03-030-104/1 of 12 April 2016; "Official Gazette of Montenegro - Municipal Regulations", No. 19/2016 from 28 April 2016) which performed the acoustic zoning of the territory of the municipality of Danilovgrad.

The first measuring position at which the noise level in the environment was examined in order to determine the zero noise level for the project "Improvement of energy efficiency and upgrade of HPP Perućica - installation of unit 8" belongs to the Municipality of Nikšić and the second measuring position belongs to the Municipality of Danilovgrad. The obtained values of noise levels at these measuring positions were compared with the limit values of noise levels for residential, mixed-use zone and zone under strong influence of traffic, in accordance with the above Decision, Decision and "Rulebook on noise limits in the environment, the manner of determining noise indicators and acoustic zones and methods of assessing the harmful effects of noise ("Official Gazette of Montenegro", No. 060/11).

Table 4.1 shows the mean values of the series of measured equivalent levels of background (residual) noise for day, evening and night period ( $L_{\text{day}}$ ,  $L_{\text{evg}}$  i  $L_{\text{night}}$ ) at measuring positions 1 and 2 as well as the corresponding noise level limit values for the specified acoustic zones.

**Table 4.1 Measured values of daily noise level indicators at all measuring positions**

| Measuring location | Time period | Value of the residual noise level<br>$L_{\text{day}} / L_{\text{evg}} / L_{\text{night}}$ (dB) | Limit noise level values<br>$L_{\text{day}} / L_{\text{evg}} / L_{\text{night}}$ (dB) |                |  |
|--------------------|-------------|--|---|----------------|--|
|                    |             |  | Residential zone  | Mixed-use zone | Zone under the strong influence of traffic noise |
| 1                  | Day         | 38   | 55  | 60             | 60   |
|                    | Evening     | 38   | 55  | 60             | 60   |
|                    | Night       | 36   | 45  | 50             | 55   |
| 2                  | Day         | 44   | 55  | 60             | 60   |
|                    | Evening     | 41   | 55  | 60             | 60   |
|                    | Night       | 40   | 45  | 50             | 55   |

## CONCLUSION

Analysis of the results of measuring the noise level in the environment in order to determine the zero noise level for the project "Improvement of energy efficiency and upgrade of HPP Perućica - installation of unit 8", shows that at the tested measuring positions day, evening and night noise indicators prescribed for a residential zone, mixed-use zone, zone under the strong influence of traffic noise and are in accordance with the "Decision on determining acoustic zones in the municipality of Nikšić" (decision number: 07-353-215 of 13 May 2013), "Decision on determination of acoustic zones on the territory of the municipality of Danilovgrad" (decision number: 03-030-104/1 of 12 April 2016) and the "Rulebook on limit values of noise in the environment, the method of determining noise indicators and acoustic zones and methods of assessing harmful effects noise (" Official Gazette of Montenegro", No. 060/11).

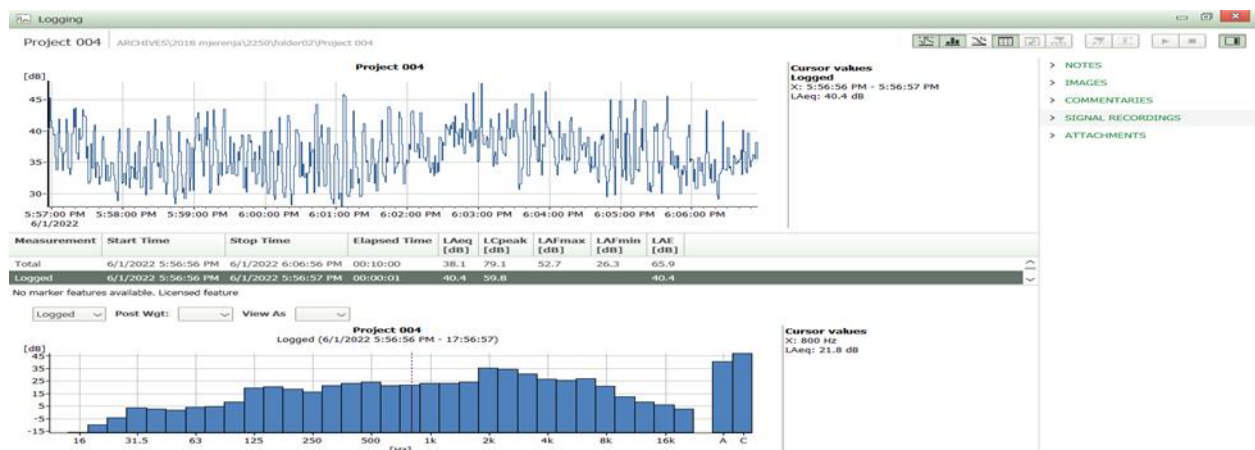
Edited by:

**HEAD OF RADIATION PROTECTION AND  
NOISE MEASUREMENT UNIT**

Benard Berišaj, graduate phys.

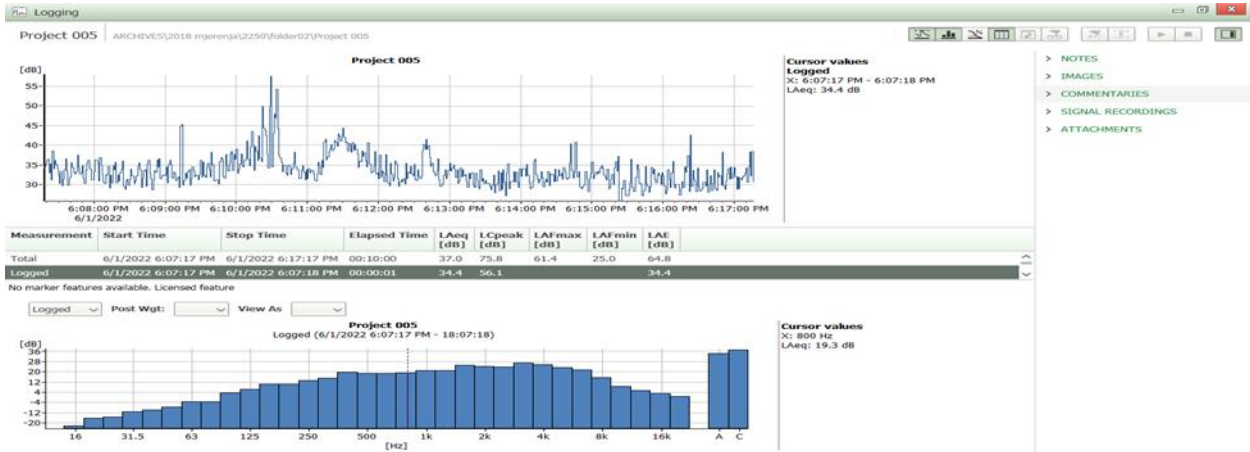
PhD Nikola Svrkota, graduate phys.

## ANNEX 1. Measurement graphs



**Graph 1. Measurement of daily noise level No. 1 at position 1**





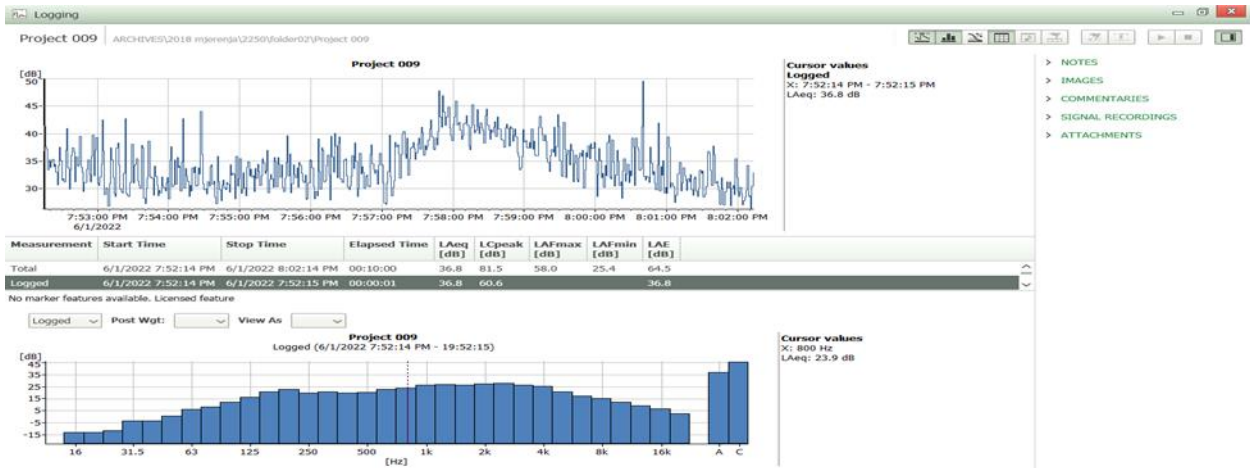
**Graph 2. Measurement of daily noise level No. 2 at position 1**



**Graph 3. Measurement of daily noise level No. 3 at position 1**



**Graph 4. Measurement of evening noise level No. 1 at position 1**



**Graph 5. Measurement of evening noise level No. 2 at position 1**



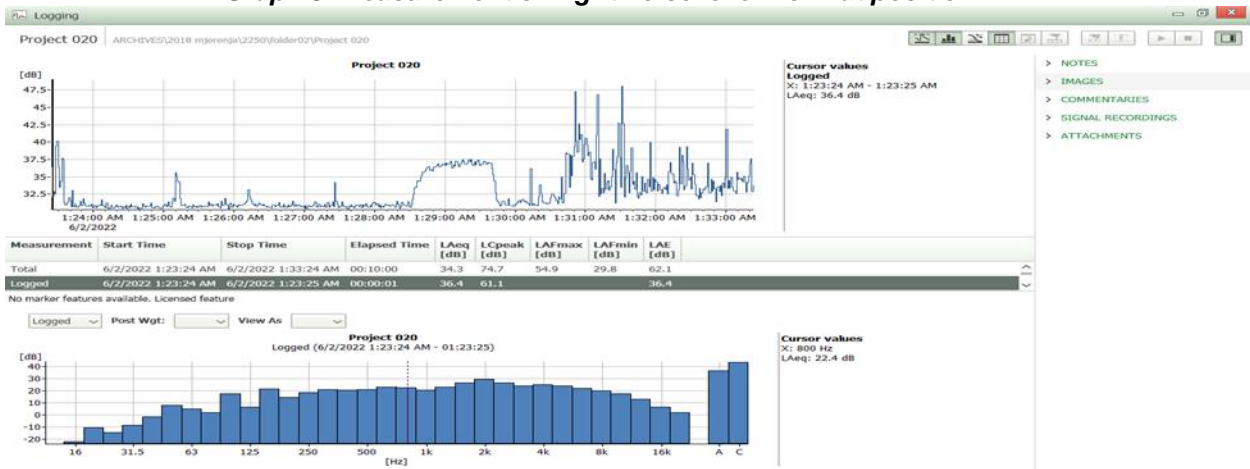
**Graph 6. Measurement of evening noise level No. 3 at position 1**



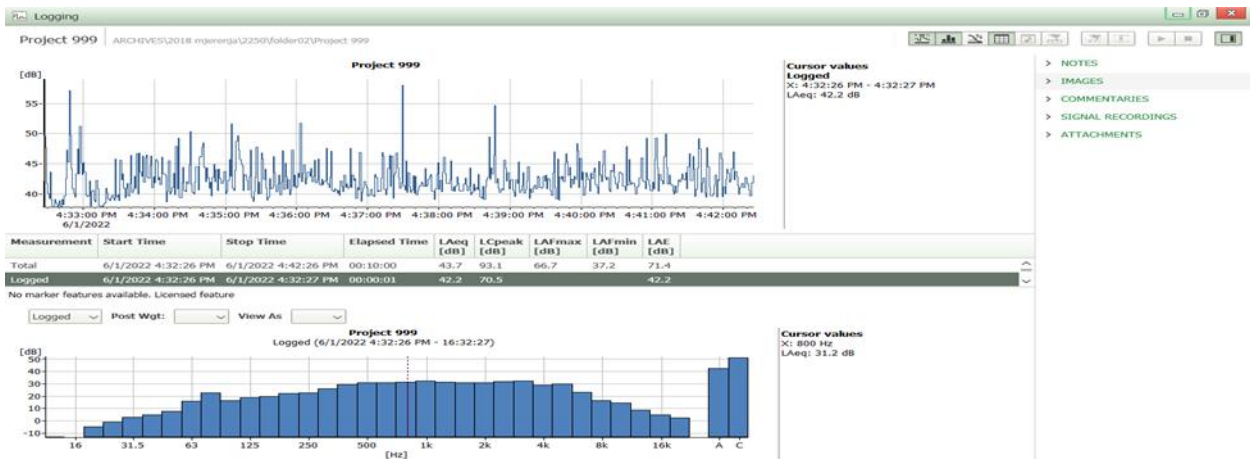
**Graph 7. Measurement of night noise level No. 1 at position 1**



**Graph 8. Measurement of night noise level No. 2 at position 1**



**Graph 9. Measurement of night noise level No. 3 at position 1**

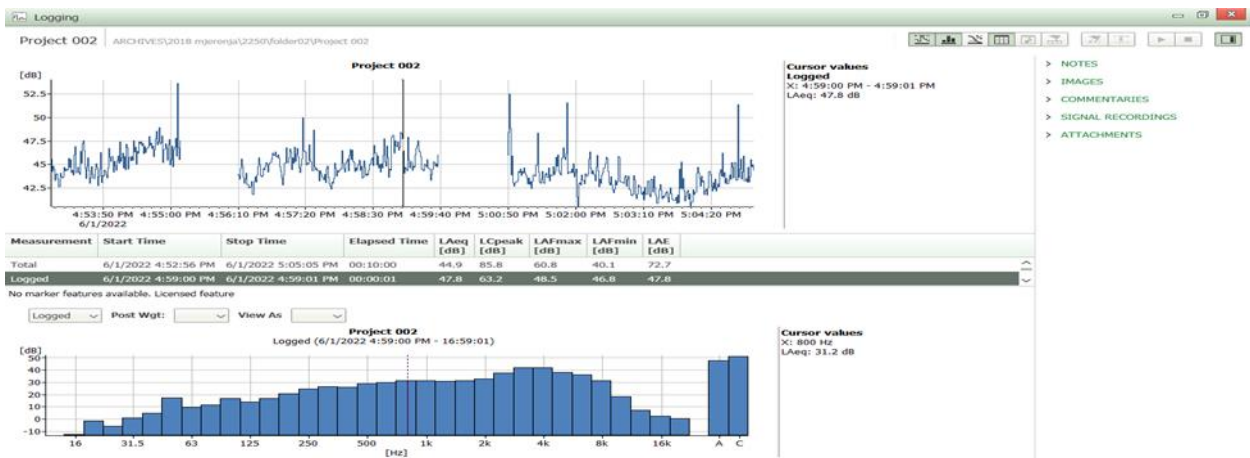


**Graph 10. Measurement of daily noise level No. 1 at position 2**





Graph 11. Measurement of daily noise level No. 2 at position 2

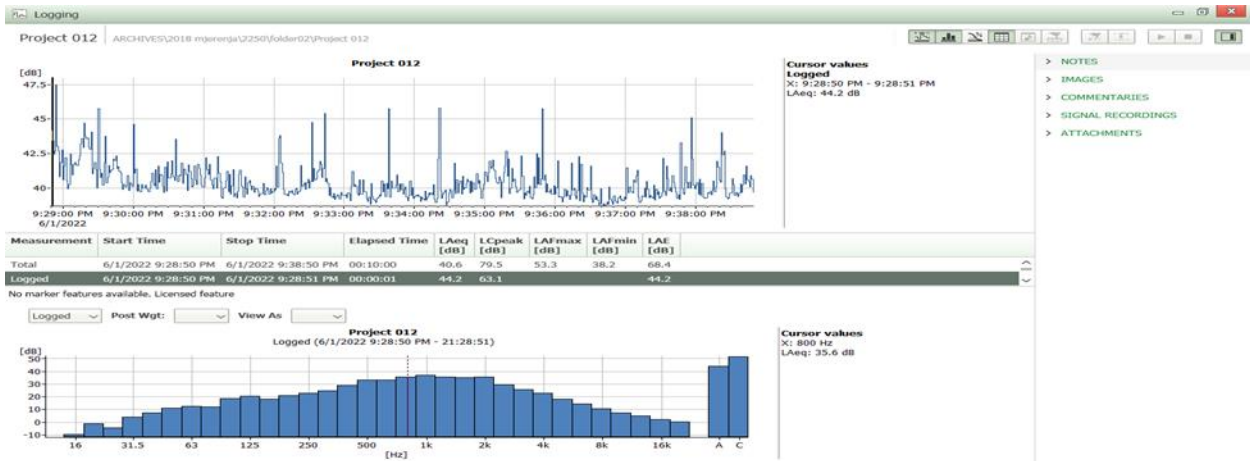


Graph 12. Measurement of daily noise level No. 3 at position 2

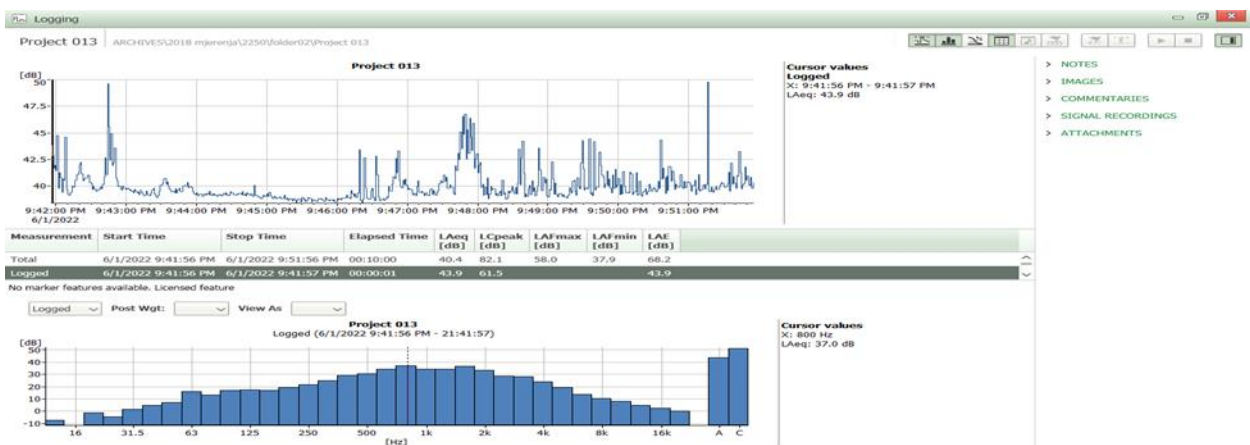


Graph 13. Measurement of evening noise level No. 1 at position 2





Graph 14. Measurement of evening noise level No. 2 at position 2



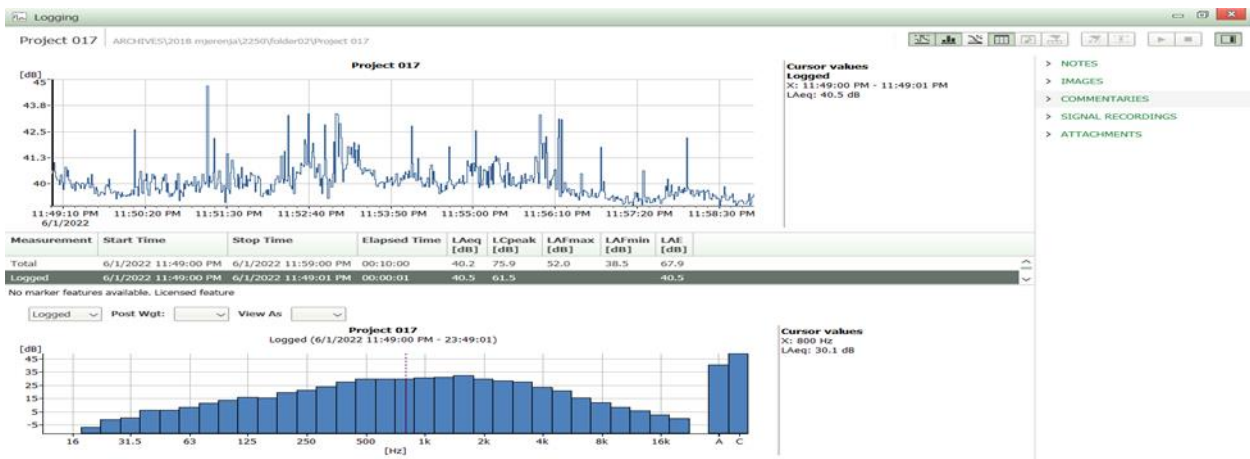
Graph 15. Measurement of evening noise level No. 3 at position 2



Graph 16. Measurement of night noise level No. 1 at position 2



**Graph 17. Measurement of night noise level No. 2 at position 2**



**Graph 18. Measurement of night noise level No. 3 at position 2**

**ANNEX 2. Noise level testing equipment:**

- Bruel & Kjaer sound level analyzer type 2250
- Bruel & Kjaer microphone type 4189
- Acoustic calibrator Bruel & Kjaer type 4231
- Octave and third filter Bruel & Kjaer 2250 -Frequency analyzer