# Technical Assistance for Wind Farm Vlašić Travnik-B&H

# Environmental & Social Impact Assessment

*JP Elektroprivreda BiH d.d. Sarajevo*
*Bosnia and Herzegovina (EPB&H)*

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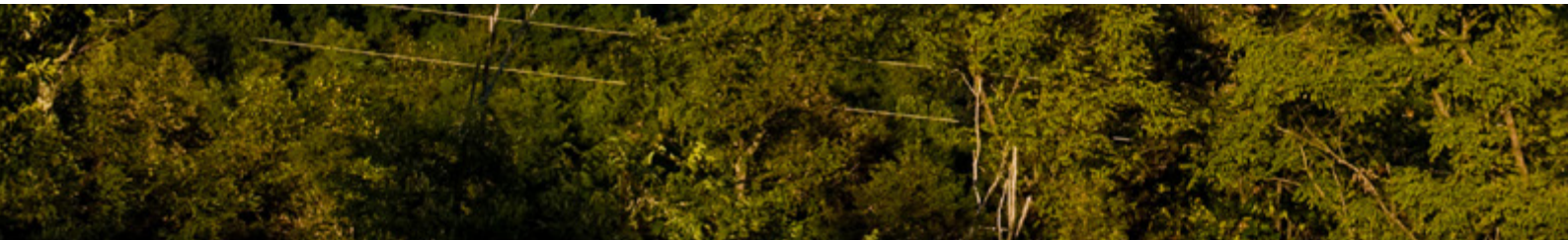


**CONTENT**

# 1. INTRODUCTION

JP Elekroprivreda BiH Sarajevo is proposing to construct a wind farm on the Vlašić mountain in Travnik Municipality. The proposed wind farm (WF Vlašić) will include 18, 2.5 MW wind turbines, access roads and associated energy infrastructure and will have a maximum generating capacity of 45 MW. The maximum height to turbine tip of each wind turbine will be 150 m; with a hub height of 93 m and 3 blades with a maximum rotor diameter of 114 m. The operational life of the wind farm is expected to be approximately 25 years.

This Environmental and Social Impact Assessment (ESIA) has been prepared in order to consider the impact of the wind farm "Vlašić" (WF Vlašić"), on all aspects of the environment.

## 1.1 „Vlašić" Wind Farm (Vlassic WF)

Observations and measurements of wind speed on Vlasic mountain have been taking place for the last two years, and it has been established that the location is suitable for a wind farm. Vlasic WF is not an integral part of the Decision of the Government of the Federation on declaring the public interest and the preparation and construction of priority power facilities in the Federation of BiH ("*Official Gazette of F BiH", no. 8/10)*. However, the Government of the Federation of BiH gave its approval for the acceptance of a grant from the European Investment Bank for the Vlašić Wind Farm in Travnik municipality.

FBiH is very specific with regard to areas with high potential for wind farm sites; most sites are located in rural areas, in the mountainous altitudes above 1,000 m a.s.l.

EP BiH wants to achieve its strategic objectives, by investment in the development of wind farms. The Vlašić Wind Farm will contribute to achieving this objective, and for this reason EP BiH launched a campaign of comprehensive measurements of wind potential on the Vlasic mountain, with the aim of building a wind farm on the site. EP BiH wants to assess the technical and economic feasibility of the Vlašić Wind Farm.

## 1.2 Project location and setting

The site of the planned Vlašić Wind Farm is about 80 km north-west from Sarajevo and 6 km north of Travnik, in Bosnia and Herzegovina. It is located in an uninhabited area about 15 km north-west of the city of Travnik, on privately owned land, primarily used for sheep grazing.

The Concession Area is the area for which the investor has received permission from the Municipality to use for the purpose of wind farm development for a defined period of time (for Vlašić Wind Farm for 30 years). The Concession Area covers an area of approximately 4.5 $km^2$ (450 ha) and is characterized by rocky and hilly terrain, mostly on a slope from southwest to northeast, with steep cliffs along the southern boundary of the concession area.

The location of Vlašić WF is shown in *Figure 1*, and the proposed turbine layout is shown in *Figure 3*, Chapter 2. A full description of the proposed project is included in Chapter 2.

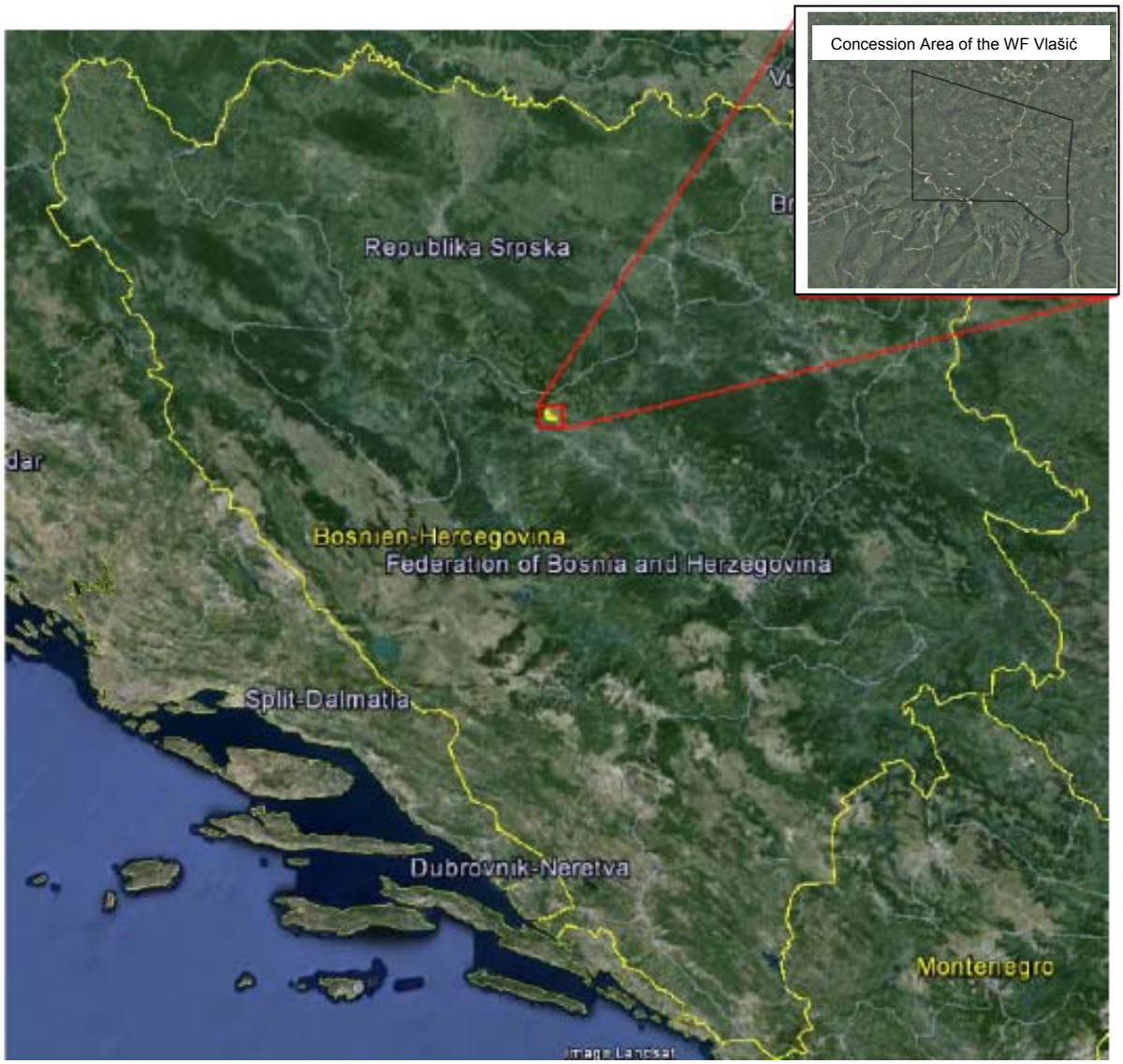



*Figure 1: Site Location*

## 1.3 Environmental and Social Impact Assessment

This ESIA has been prepared in accordance with the Terms of Reference prepared by the Investor, JP Elektroprivreda BiH, and for the needs of making the *Environmental Impact Study and social development* of the Vlašić Wind Farm, in the municipality of Travnik.

During preparation of the documentation, an analysis was made of impacts related to:

- Construction of the Wind Farm;
- Transportation of construction components to the site
- Operation of the Wind Farm

In accordance with the Terms of Reference, the assessment of impacts on fauna of birds and bats, which will be elaborated in more detail within a separate document - *Birds and Bats Baseline Conditions, Monitoring – Twelve Mounth Report*, *for Birds and Bats*, and the results will be used as the base for this ESIA.

During the preparation of the ESIA various experts have contributed according to their specialist field. This includes geology; seismology; hydrology; climatology; quality assurance of water, air and soil; biodiversity; cultural, historical and natural heritage, and landscape.

During the development of the documentation, constant communication has been maintained between the designer of the Conceptual design and the Investor , as well as suggestions and professional experience of the Investor (Department of Environmental Management) on the impact of wind farm buildings on the environment.

The methodological approach is based on an analysis of the available documentation, research of relevant data, legislation, planning and project documentation, as well as field observations

Consideration, analysis and assessments are based on the existing state (baseline) in order to identify possible impacts on the environment and the possible potential risks. Potential impacts have been assessed based on scale and magnitude in order to determine significance. Measures for prevention, mitigation and protection of the environment and landscape values have also been proposed. Based on evaluation of the impacts, a system to monitor the impact on the environment was proposed. In general, the methods used are methods of comparison and calculation for individual components of the environment.

## 1.4 The importance of renewable energy

The concept of sustainable development requires consideration of the three key aspects: economic, environmental and social. In the energy sector this means an increase in efficiency in production and consumption of energy using renewable energy sources. Renewable energy sources contribute towards as well as towards the reliability of energy supply and reducing

energy imports. Given the advantages of environmental protection, renewable energy sources are an alternative to conventional sources. It is expected that the share of renewable energy in the total energy will grow constantly in the 21st century.

The purpose of building WF "Vlašić" is the production of electricity for the needs of the Bosnian-Herzegovinian power system. Renewable energy sources such as wind power plants have very good environmental performance. Its construction reduces the consumption of fossil fuels in total energy system in BiH and thus improves the quality of the environment. *The Strategic Plan and Development Program for the Energy Sector of the Federation of Bosnia and Herzegovina (2009)* recognizes the potential of this energy source, and is expected to be achieved, through these construction projects, its primary strategic goals such as: diversification of sources of electricity, increasing the use of renewable energy sources and environmental protection. WF "Vlašić" will contribute to the total renewable energy production in the Federation of Bosnia and Herzegovina.

A major advantage of wind energy is the lack of greenhouse gas emissions. The Kyoto Protocol aims to reduce the concentrations of six greenhouse gases, among which are: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), fluorinated hydrocarbons (HFCS), perfluorinated hydrocarbons (PFC) and hexafluoride ($CF_6$). This Protocol commits industrialized countries, in the period 2008.-2012., to reduce their greenhouse gas emissions by 5,2% compared to the reference values in 1990. Bosnia and Herzegovina ratified the Kyoto Protocol on April 16, 2007, and this Protocol entered into force on 15 July, 2007.

Producing electricity from renewable energy sources significantly reduces greenhouse gas emissions, because each GWh of electricity produced from renewable energy sources has the effect of reducing emissions of 800 tons of $CO_2$, compared to the production of electricity in a thermal power plant.

Members of the European community, in numerous discussions and documents, have promoted a trend toward the use of renewable sources for energy purposes, as a priority task. European Parliament resolution on Electricity from renewable energy sources and the internal electricity market (SEC (1999) 470 - C5-0342/1999 - 2000/2002 (COS)) is based on:

- Working Document of the Commission (SEC(1999) 470 – C5-0342/1999);
- Agreements relating to the field of competition and the environment as revised by the Treaty of Amsterdam;
- Directive for the internal market in electricity 96/92 / EC;
- White Paper on renewable energies, COM (97) 599;
- Kyoto Protocol, adopted on 10 December 1997;

- Report of the Committee on Industry, External Trade, Research and Energy and Opinion of the Committee on Environment, Public Health and Consumer Policy (A5-0078/2000).

The constant need for increasing the production of energy is directed towards the development and research of new energy resources. Energy has become a basic requirement for material production and it is also a limiting factor for the development of a society. However, solving this important issue of today is present, among other fundamental issues and the question of environmental impact and consequences, which wind farms cause in the context of spatial planning and development of certain areas.

The construction of wind farms, in addition to the general positive impact of reducing harmful gas emissions into the atmosphere, also has a negative impact and consequences for the environment, such as:

- certain "aesthetic pollution" in the case of large wind farms, which however is limited if such a system is installed on unpopulated areas;
- possible negative impact on birds and bats;
- electromagnetic interference;
- damage to the land during construction (physical removal of land from stone flooring during construction);
- acoustic phenomena (noise and vibration created by a wind turbine operation).

As a result of potential environmental and social impacts being caused by the construction and operation of wind farms it is necessary to conduct appropriate investigations, which will objectively consider and thoroughly examine all aspects in order to find during the planning of the plant some adequate solutions which eliminate or at least sufficiently mitigate negative and increase positive effects of buildings on the environment.

## 1.5 Exploitation of Wind Energy in Bosnia and Herzegovina

The share of renewable energy sources (RES) in the world was around 10.5% in 2006, and their share of electricity production ranges from a few percent to as much as 53%. As an example of different participation of electricity production from RES, the following data are given: *Denmark (53%), Finland and the Netherlands (38%), Latvia (37.5%), Czech Republic (26.4%), Germany (20.5 %), Japan (16.7%), Turkey (17.6%), Austria (13.6%), etc*. In order to reduce $CO_2$ emissions within the EU, a target of 12% energy production by RES has been set[1]. Currently, the largest increase

[1] *Strategic Development Plan and Program of Energy Sector of F BiH, 2008.;*

among RES in the world have been wind power plants, while in Bosnia-Herzegovina, the fastest growing RES is small Hydro Power Plants (HPPs) of individual power up to 5 MW.

In the period 1999– 2001, a preliminary selection was made of potential sites for construction of wind power plants into Bosnia and Herzegovina. 12 macro-locations were preliminarily identified as suitable for the construction of wind farms, namely: Podveležje (210-260 MW); Mostar Blato (60-90 MW); Ugrovača (60-90 MW); Duvanjsko field (50-80 MW); Raško field (60-90 MW); Kocerin (20-30 MW); Udrežnje (60 - 80 MW); Dabarsko field (60-80 MW); Hutovo (20-30 MW); Popovo field (50-60 MW); Ivan Sedlo (20-30 MW); and Bjelašnica (20-50 MW).

All of these sites are located in the southern and southwestern part of Bosnia and Herzegovina (except Bjelašnica), and usually lie in the area of the FBiH. The total estimated installed capacity for these locations is 720 - 950 MW, with an annual production 1,440-1,950 GWh. A detailed study on the selection of micro-sites for wind farms has not yet been done (although it has been done for several micro locations), nor is there a so-called "Wind" map of Bosnia and Herzegovina.

In the period 2001– 2004, wind measurements were taken in some of these locations. The results obtained are promising in some of them (Podveležje, Duvanjsko field), and in the meantime, a local company was formed to build the first wind farm into the area of Mostar (Podveležje), with 100% of foreign investment. Also, Elektroprivreda HZHB plans to build wind farms on several micro-locations, which have been so far investigated.

For most of the mentioned sites for wind farms, some interested foreign investors appeared, primarily for research of potential, i.e., size of plants that would be built. Expected new facilities of wind power plants by 2010 should have been of capacity of about 120 MW, and in the period 2010 – 2020, could be expected expansion of the construction of wind farms, with a possible contribution to the capacity of approx. 700 MW.[2]

The Federation of Bosnia and Herzegovina has a significant potential for distributed generation of electricity, especially in small hydropower plants, wind power plants and biomass cogeneration systems. Generally, this type of production has positive effects on the power system, because it represents production from RES.

Ultimately, the assessment of potential sites for wind farms in BiH has resulted in a list of 27[3] sites in the southern part of Bosnia and Herzegovina, in the zone of about 50 km along the Croatian border, which by all observed, represent the largest wind potential in Bosnia and Herzegovina. The total potential of the observed locations from the standpoint of the availability of space is estimated at about 900 MW. It should be noted that for some of the locations, the

*2 Strategic Development Plan and Program of Energy Sector of F BiH, 2008.*

3 *The study of the energy sector in Bosnia and Herzegovina, Module 12– Consumption management, energy conservation and renewable energy sources, 2008.*

assessment includes consideration of the conditions and possibilities for connecting possible wind power plants to power infrastructure, which in those locations can lead to significant reduction in the total carrying capacity. The total technical potential for wind energy use in Bosnia and Herzegovina is significantly higher and is estimated at app. 2,000 MW, while care should be taken that the mentioned result arises from the analyzes of available space for wind farms in Bosnia-Herzegovina, not taking into account certain limitations (connection to the grid, environment protection, etc.).

For a detailed analysis of the potential of wind energy in Bosnia and Herzegovina, as the basis of structuring of wind energy policy, setting tariffs for the purchase, etc., would be useful to design and implement an integrated project, which would include the following activities:

- systematic description of wind climatology in Bosnia and Herzegovina, including wind measurement program;
- a thorough examination and selection of potential sites for construction of wind farms;
- evaluation of potential sites, using some appropriate multi-criteria methods, and identification of elements for evaluation (criteria);
- analysis of the costs and benefits of wind energy use in Bosnia and Herzegovina, in order to determine the avoided costs and methodologically establish economically justified share of wind power plants in the structure of future electricity demand in Bosnia and Herzegovina.

Certainly, in parallel with these activities, for significant wind power industry development in Bosnia and Herzegovina, it should be necessary to establish an institutional and legal framework at national, entity and local levels.

When it comes to the infrastructure required for the connection of electric power facilities based on renewable energy to the distribution network, this primarily means underdevelopment of distribution network of Power System, to which the connection of such systems is performed. This is a common issue for all the systems for the production of electricity based on renewable energy sources. Also, there are individual infrastructure problems, which are specific for each RES, which could be dealt with planning primarily at the local level, but also with the support of senior government authorities (eg. in the biomass it is the "openness" of forest areas for its collection, in wind farms, it is road infrastructure, etc.).

Challenges and constraints when it comes to the construction of wind farms in BiH/FBiH, can be viewed from the aspect of the problems, which appear, recommendations for overcoming these problems, as well as technical, market and regulatory measures to reduce the risk of building wind farms.

The main problems for the integration of wind power plants into the power system are:

- increased losses in the transmission network due to overload, circuits and transfer of energy over long distances;
- increased consumption of reactive power due to transfer of energy over long distances and increased load factor of lines;
- wind power plants are also sensitive to very small and short-lived "decline" of voltage;
- there is substantial economic impact of wind farms on conventional production.

Since this is the early stage of development of wind farms in Bosnia and Herzegovina[4], the focus will be placed on projects of larger wind farms, which on the one hand make up the bulk of projects, and on the other hand have better economic viability and opportunities for implementation. Smaller projects have a relatively limited impact on the implementation of the program of wind farms in Bosnia and Herzegovina, and their implementation should be considered in the second phase of development, having implemented a number of major projects, i.e., having arranged the whole management system of the renewable energy sources, and having established the technical and infrastructure assumptions. It is estimated that wind power plants of lower capacity (less than 10 MW) can have up to 20 percent of share, in the total installed capacity of all wind power plants.

According to available data, currently about 20 wind power projects of larger capacity are at some stage of implementation in BiH. By the analysis of available basic documents and maps, however, it was found that opportunities, in terms of available space, are much higher.

Currently, in the FBiH[5], there are still no built wind power plants, which are owned by JP EP. From large projects related to the installation of wind turbines, it can be said that the project documentation for wind power plants (WPP) Mesihovina in the municipality of Tomislav Grad and WPP Velika Vlajna in the municipality of Mostar, owned by EP HZHB, is under construction.

[4] *The study of the energy sector in Bosnia and Herzegovina, Module 12– Consumption management, energy conservation and renewable energy sources, 2008.*

[5] *Public Enterprise "Elektroprivreda of Bosnia and Herzegovina"*

# 2. TECHNICAL DESCRIPTION OF THE PROJECT

## 2.1 Site Description

*Location*

The proposed project site is located on the Vlašić plateau in the Municipality of Travnik, approximately 80 km northwest of Sarajevo and 6km north of Travnik, in Bosnia and Herzegovina (Figure 1, Chapter 1). The proposed project site is known as the Concession Area.

*Topography and Land Use*

The proposed Vlašić WF site, as shown in *Figure 1*, covers approximately 450 ha. The site predominantly consists of small land parcels of private land primarily used for the grazing of sheep. Wind monitoring at the site during three years has confirmed that mean wind speeds are greater than 6.55 m/s at Vlašić III met-mast with 63.41 m height (there are an aditional two met-masts – Vlašić I with 10 height and Vlašić II with 30 m height).

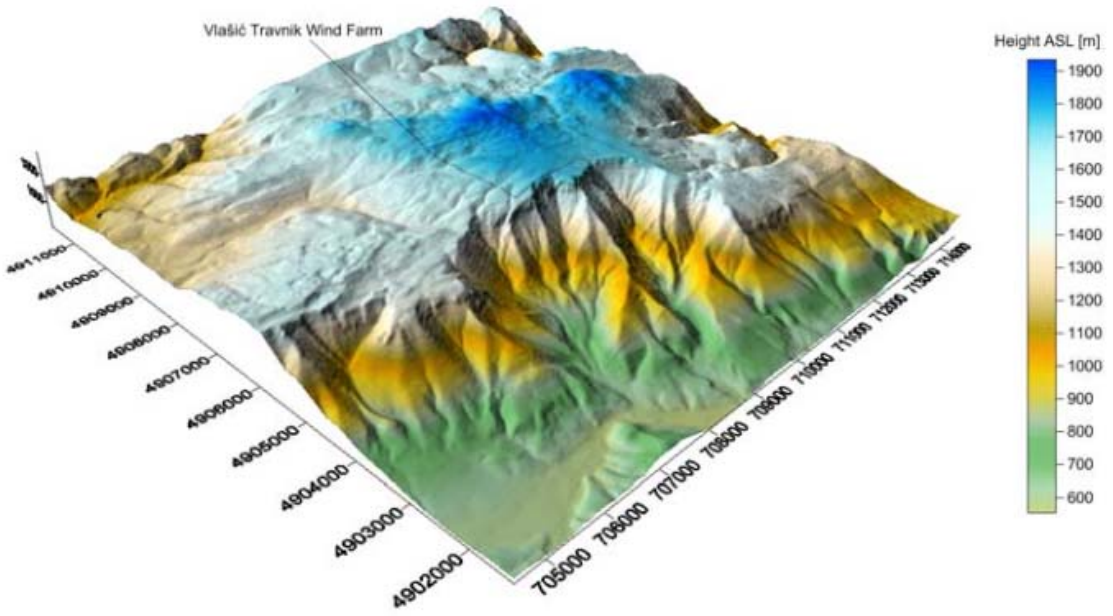



*Figure 2: 3D surface map of the Vlašić Wind Farm site and its surroundings*

## 2.2 The Proposed Development

The proposed development is for construction and operation of a wind farm (WF Vlasic) of 18 three-bladed horizontal axis wind turbines. For the purpose of the ESIA the turbine model of Alternative 1[6] has been assessed and the maximum dimensions of the turbines will include a turbine rotor diameter of 114 m, a hub height of 93 m and a maximum height to turbine tip of 150 m. WF Vlasic would have associated electricity transformers, underground cabling, access tracks, crane hardstanding, control building and substations compound, a permanent communication mast located within the substations compound and temporary communication mast and a free-standing wind monitoring met mast. During construction and commissioning, there would be a number of temporary works including construction of site facilities, storage areas, rotor assembly pads, access track turning heads, and welfare facilities. These project components are described in this chapter.

A detailed plan of the site showing the proposed site layout is shown in *Figure 3*.

[6] *The turbine alternative has been chosen following feasibility of 12 options that were considered.*

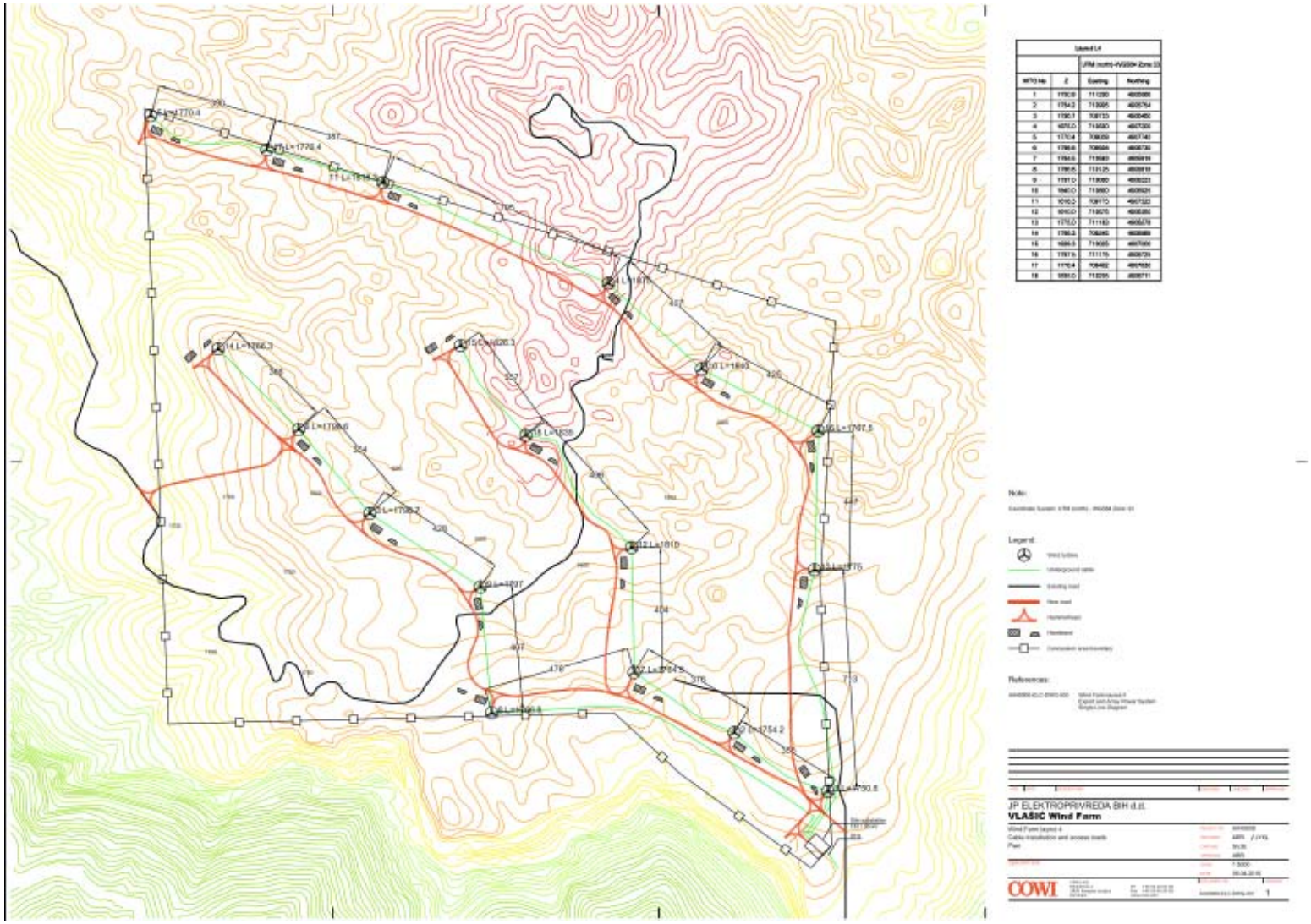



*Figure 3: Proposed site layout*

The layout of the wind farm has taken into account the micro-siting of each turbine in order to provide flexibility for its exact location. Wind monitoring masts, access tracks, crane hardstandings, control building, sub-station compound, temporary construction compound and other infrastructure would be determined by the contractor.

*Land Take*

Permanent land take from a wind farm development is relatively small. The wind turbines have to be spaced apart, so as not to interfere aerodynamically with one another (array losses). The actual permanent land take is limited to the area of the towers themselves and the gravel path around them, their associated transformers on plinths, the access tracks leading to them, the crane hardstandings, the permanent wind monitoring mast, control building, electricity transformers, and the substation.

At each wind turbine location, the completed foundation is overburdened with soil approximately 1m deep, leaving only the concrete or steel plinth to which the steel tower is attached. The plinth is approximately 20.7 m in diameter. Additionally, there is an external high voltage (HV) enclosure housing a transformer and switchgear, approximately 3 m x 6 m in area and 3 m in height, on a concrete plinth 4 m x 7 m, for each tower. Each turbine and HV enclosure, would use approximately 364.37 $m^2$ of land; this would amount to 0.66 ha of land.

There is one site entrance. The access tracks will be typically 4.5 – 5.5 m wide on straight sections, with widening on bends and at passing places. A detailed description of the transport road is given in *Section 2.4: Traffic, transport and access*.

The total length of access track accross the site would be approximately 12,904 m, which translates to an estimated land take of 6.97 ha (12,904 m length of track x 4.5 m track width x 1.2 m for general widening and site entrance). In addition, shoulders each side of the track would be required, these would be approximately 1m wide and would be reinstated after construction.

Other permanent (for the length of the project), land take consists of:

- a substation compound (54 m x 62 m, 0.33 ha), which includes 1 m wide gravel path on all sides and 5 m gravel path at the front separating it from the control rooms;
- control buidling adjacent to the substation compound (27.25 m x 8.84 m, 0.02 ha), with a 3 m wide concrete loading area along their lengths and 1 m gravel path around three sides of the building, 0.01ha in total;
- hardstandings at each turbine location for assembling the cranes and for the cranes to stand on. The specific layout of the hardstanding areas varies for different turbine manufacturers. The typical rectangular design would require a total permanent area of 1,450 $m^2$ per turbine of harstandings for main and auxillary cranes, totalling 2.61 ha for all 18 turbines; and

- 36 $m^2$ is required for the permanent wind monitoring (met) mast (0.004 ha).

The total permanent land take from new access tracks, hardstandings, met mast, substation and compound and turbines would be up to approximately 10.6 ha, or approximately 2.4% of the total project area. Off-site road widening works would be an additional 1.2 ha (approximate), taking the total permanent land take for the project to 11.8 ha.

There would be temporary land take for the construction compound which would require an area of up to approximately 80 m x 70 m (0.56 ha), with a passing place in front of the compound to allow for temporary parking.

There would be some temporary area of hardstanding at the foundation of each turbines. It allows for working areas for the assembly of crane (assembly of crane booms; turbine rotors) and for the turbine parts to be laid down prior to erection. These areas would amount to 0.034 ha for each turbine, totalling 0.61 ha for the project. An example of turbine at hardstanding is shown in *Figure 4*.

*Figure 4: Turbine at hardstanding*

The build-up of the hardstanding depends on the same factors as for the roads, however, with different bearing capacities. For this initial stage, the depth of build up is assumed identical to

the roads. In some areas, the depth of the bottom layer might be required to be deeper than indicated, while in other areas less depth will be requested, due to differences in applied load.

Sufficient drainage along the hardstanding shall be included to ensure they are functional in all weather conditions. In the conceptual design, the hardstanding will be sloping towards the edges of the areas, and the edges of the hardstanding will be placed as minimum 100 mm above existing ground level.

Temporary track shoulders during the construction phase would be about 1 m on either side of the 12,904 m length of tracks, totalling 2.58 ha.

During the turbine foundation construction, a circle of about 20.7m diametar would be excavated; this temporary land take (minus the permanent land take of the turbine and transformer plinths) would be 288.75m$^2$, totalling 0.52 ha for the project.

Total temporary land take on site that is required during the construction period, but not needed during operation would amount of 6.87 ha. Tables 1 and 2 below summarise the land take areas for the project.

*Table 1: Permanent land take for the duration of the project*

| Element | Ground Dimensions | Total Area (ha) for Project |
|---|---|---|
| Wind turbines x18 | 20.7 m diameter | 0.66 |
| External Turbine Transformer | 7 m x 4 m | |
| Acces Track | 12,904 m x 4.5 m x 1.2 m | 6.97 |
| Substation Compound | 54 m x 62 m | 0.33 |
| Control building | 27.25 m x 8.84 m | 0.02 |
| Crane hardstandings | 1,450 m$^2$ | 2.9 |
| Met mast | 36 m$^2$ | 0.004 |
| Off-site widening works | N/A | 0.87 |
| **Total** | **N/A** | **11.8** |

*Table 2: Temporary land take for the 19 months construction period*

| Element | Ground Dimensions | Total Area (ha) for Project |
|---|---|---|
| Construction Compound | 80 m x 70 m | 1.24 |
| Crane hardstanding | 340 m2 | |
| Laydown areas | 61 m$^2$ | 0.122 |
| Track shoulders | 12,904 m x 2 m | 2.58 |
| Turbine foundation areas | 1,466 m$^2$ | 2.93 |
| **Total** | **N/A** | **6.87** |

*The Wind Turbines*

The main components of wind turbines are shown in *Figure 5*.


*Figure 5: The main components of a wind turbine*

The key dimensions of the turbine are shown in *Table 3*. These represent maximum dimensions.

*Table 3: Dimensions of the main components of a wind turbine*

| Component | Comment | Dimensions |
|---|---|---|
| Rotor | Rotor hub, 3 rotor blades and the pitch system comprise the rotor | • Maximum blade length is 56 m;<br>• Rotor sweep is 10.207 $m^2$;<br>• Maximum hub 4.65 m x 5.31 m x 3.97 m (L x W x H);<br>• Maximum rotor dia 114 m |
| Nacelle | With drive train, generator and yaw system | 3 sections, largest load is external shell dimensions 4m x 4.3 m x 12.7 m |
| Tower | Tubular tower comprising 4sections | • 13.95m x 4.3 m dia;<br>• 18.25m x 4.03 m dia;<br>• 24.15m x 4.02 m dia;<br>• 32.15m x 4.02 m dia;<br>• Hub height 93 m |
| Medium-voltage transformer (MV transformer) and medium-voltage swichgear (MV swichgear), | | |
| Foundation | In ground foundation set in place by mass reinforced concrete | Approximately 20.7 m diameter x 3.05 m thick |

The wind turbine industry evolves quickly. Designs continue to improve technically and economically. The most suitable turbine model for a particular location can change with time and therefore a final choice of the most suitable machine for WF Vlašić would be chosen shortly before the time of construction, within the overall tip height limit of 150 m.

This Environmental and Social Impact Assessment (ESIA) Study has been based on the turbine model Alternative 1. Exact tower and rotor dimensions vary a little between manufacturers, but suitable turbines in the nominal 2.4 MW upwards range are produced by companies such as Nordex, Enercon and Gamesa.

The locations of the proposed turbines are shown in *Figure 3*. Public enterprise Elektroprivreda of Bosnia and Herzegovina (JP EP BiH) request a 50 m micro-siting (deviation from turbine position shown) for turbines and associated infrastructure. This would allow for possible variations in ground conditions across the site which would only become apparent as trial pits are dug at the start of construction.

In addition, a 50m micro-siting flexibility in turbine positioning would help to mitigate unforeseen environmental constraints, e.g. avoidance of archaeological features that were not apparent from existing records. Equally, it is proposed that access tracks and other site infrastructure are able to be micro-sited by up to 50 m to fit the turbines and to avoid sensitive sub-surface features.

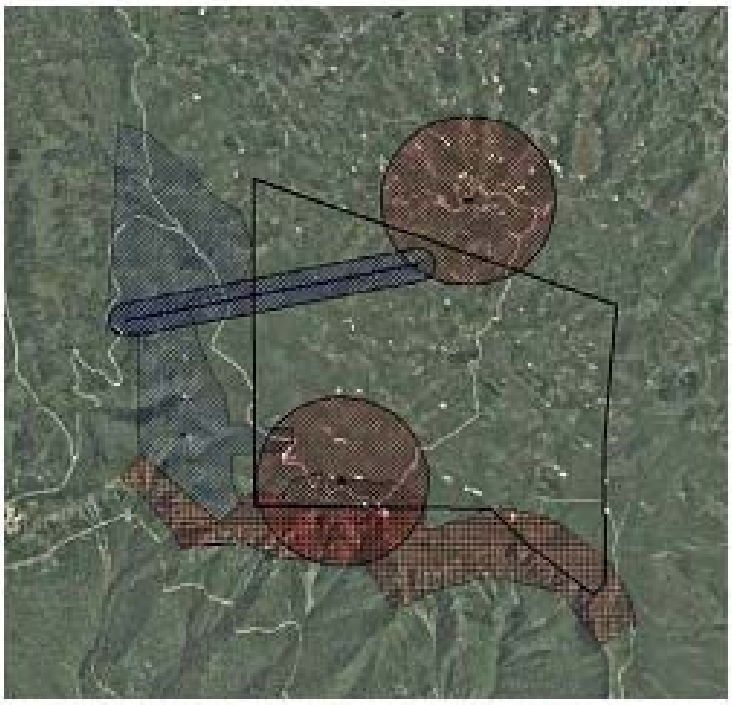


*Figure 6: Site concession area (thick black lines) and restriction areas (hatched)*

During the design of the proposed WF Vlasic, several environmental constraints have been identified and restriction zones around these constraints have been integrated into the design in

order to avoid these areas. The restriction areas illustrated in *Figure 6* result from the following identified constraints:

- DiagCross blue Hatching: overhead power line that feeds electricity to the radio TV station. The Consultant has not been informed on possible requirements for a buffer area around the power line, but has, based on experience, applied a 100 m buffer zone;
- DiagCross round buffer area north: a 500 m safety buffer zone around the radio-TV station and related buildings has been applied. This buffer zone is also based on the Consultant's experience, as no specific requirements have been identified in this regard;
- DiagCross round buffer area south: a 500 m safety buffer zone around the mountain lodge has been applied. Again this zone is applied based on the Consultant's experience, as no specific requirements have been identified;
- Cross Hatching red area in the south: cliff and steep slopes; birds and bats restriction areas („buffer zone").

The micro siting is to take into consideration the following:

- minimising any impact from other turbines;
- minimising earthworks;
- access;
- ground conditions;
- minimising the impact on the ecology of the site;
- minimising intrusion into areas of vegetation; and
- minimising the visual impacts.

The formation of turbine pads will require the excavation of material to form a level and sound operating surface. A conservative estimate with an average cut of 2 m will be required, with cuts up to 10 m on steep slopes. The turbine pads will need a pavement of similar standard to the internal roads.

It is common to have a high voltage transformer enclosure for some models located alongside the base of each turbine. The transformer's function is to raise the generation voltage to the higher transmission level that is needed to transport the electricity to the grid. Switchgear is required by utility to comply with regulations.

Some models of turbine are now integrating the turbine transformers within the tower or nacelle assemblies, thus obviating the need for the external transformer, but this is by no means a universal design trend. Therefore, assessment of impacts have considered external transformers to cover both designs.

A significant amount of research has been undertaken in relation to turbine colour and finish. A pale grey colour with a semi-matt finish is generally agreed to be the most appropriate.

The wind farm would be served by a central computer system located in the substation control buildings, which would monitor the performance and behaviour of each turbine. The central computer system would also be in control of the infra red lighting to be placed on each corner of the turbine layout, as requested by the Ministry of Defence.

Monitoring has shown that there are very few hours during the year with wind speeds above the turbine cut-out wind speeds and therefore, the high wind losses will be low. The cut-out wind speed for Alternative 1 turbines is 25 m/s, the re-start wind speed is 2 m/s below the cut-out wind speed. High wind loss has been estimated based on the simple cut-out / re-start wind speed strategy (the cut-out/re-start wind speeds in m/s) and for 18 turbines (25/23), it is 0.015%

*Electrical Connection*

The electrical systems would consist of the one-site electrical conncection system, the on-site sub-station and a predicted overhead 110 kV connection. Subject to technical assessment and surveys, the proposed connection corridor is shown in *Technical Assistance for Wind Farm Vlašić, Travnik – BiH, Grid Connection Study.*

At this stage, the grid route corridor remains indicative and therefore the potential impacts of the route within this study are considered at a high level. Detailed environmental impacts of the grid connection would be assessed as part of the grid connection planning application.

Assuming the use of currently available models, each wind turbine would generate electricity at 690 V, 50 Hz and would have its own transformer located adjacent to, or within the base of the tower to step up the voltage to the one-site distribution voltage of 30kV. Each turbine would be connected by a length of underground cable and each group of turbines would be connected to the sub-station via similar underground cables. All medium voltage cables on the site would be buried underground, below ploughing depth.

The substation compound would normally contain power quality improvement equipment, the communication mast, up to two auxiliary transformers, and possibly a spare turbine transformer. The one-site substation (WPP Vlašić 30/110 ± 3.75% kV) is proposed to be located on the southeast corner of the wind farm.

*The One-Site Sub-Station and Control Building*

Access to the Sub-station would be from an access road on the southwest corner of the wind farm. The sub-station compound would normally contain power quality improvement equipment, up to two auxiliary transformers, and possibly a spare turbine transformer. The substation has one control building with two parts; one for EP BiH equipment, and one for the Distribution Network Operator (DNO) equipment and would accommodate metering equipment, switchgears, the central computer system and electrical control panels. A spare parts store room, mini workshop area, toilet and wash basin would also be located in the control building. The building would be

visited periodically by maintenance personnel. There is no requirement for any other permanent buildings on the site.

The substation consists of a 34 m x 46 m (1,564 $m^2$, 0.156 ha) 110kV switchyard and a 14 m x 27.25 m (381.5 $m^2$; 0.04 ha) substation building. The platform for the switchyard will be cut into the existing site to reduce the visual impact. Substation building and 110kV switchyard levels will be stepped to minimise earthworks.

Indoor storage is proposed to be in containers, as this is a cost effective solution. However, it should be checked whether this fulfils the requirements to the specific Wind Turbine Generator (WTG). The containers are placed next to the substation. The outdoor storage area includes storage space for blades and other large wind farm components. A parking area for the service crane is also located in this area. Depending on the WTG manufacturer chosen, different requirements apply to the availability of outdoor storage areas and site compounds.

The external perimeter of the compound will be fenced and the surfacing will generally consist of a granular hardstanding with concrete plinths to support heavy items of plant such as transformers. All equipment containing oil within the compound will be bunded to contain any spillage.

A permanent control building approximately 27.25 m long x 8.84 m wide will be included within the substation compound, together with a water storage tank, on-site waste water treatment facilities and car parking for up to 20 vehicles.

The proposed on-site waste water treatment system involves two stages of treatment – the first stage in a tank or treatment system, and the second when the effluent is dispersed to land.

Rain water would be collected from the roof of the control building via horizontal gutters, and drained into a storage tank located within the toilet area. An overflow from the tank would drain to the outside of the building into a rain water soak-away.

The storage tank would supply:

- Raw/untreated water to the toilet ;
- Rain water via a UV filter to the hand basin.

Should an extended period of no rainfall occur, water would be transported to the site in small tanks as required.

Following an assessment of foul treatment options by reviewing *Pollution Prevention Guidelines 4*, it has been determined that both the toilet, wash basin and sink should drain to small package treatment plants located adjacent to the control building, which would be constructed and located in accordance with the relevant regularions of the *Law on Construction of F BiH* and the *Ministry of the Environment and Tourism*prior to construction. There is no mains sewer within 1km of the substation making connection to the mains impractical. A septic tank and soakaway would be unsuitable because of the larger area needed for the soakaway.

*Wind Monitoring Mast*

Initially data from two of three existing met masts were used: Vlašić II (30m) and Vlašić III (60m). At later stage in the measurement campaign, Vlašić III (60m) collapsed and was replaced by an 80m mast at the same position. The third mast is Vlašić I (10 m). Additional masts on site, other than those used for the wind study, may be introduced only in the event of a power curve verification and if relevant a site calibration (only temporary masts), or if the Client decides to make further measurements in the extended Concession area. As such additional permanent masts are not included in the project.

*Wind Farm Site Internal Access Tracks*

The development of the internal access track layout has been an iterative process. There are a number of design constraints for the site including landscape, ecology, topography, geology and public road access that were taken into account when selecting the layout.

During the design development several site visits were undertaken to optimise the layout and to minimise the extent of earth works and associated adverse environmental impacts. During these site visits each proposed route was walked or driven using GPS tracking to confirm its viability. The overall design philosophy for the internal wind farm access roads has been to follow existing farm tracks and tops of ridges where ever possible. This minimises the volume of excavation and extent of cuts and fills, and reduces the visual impacts. Cut and fill batter height and cut batter stability are addressed in the Geotechnical Report.

The internal access roads are assumed to be unpaved, i.e. compacted gravel/crushed stone roads, and shall ensure safe transport conditions during construction of the site, transport and installation of WTG components, the service of the WTGs duringthe operational phase, and finally during the decommissioning of the wind farm. However, depending on the slope of the road asphalt may be needed on some areas. This will be assessed for the detailed design in accordance with the requirements of the WTG manufacturer.

The layout of the internal site roads are based on the cable route layouts, and is shown in *Figure 3*.

There is one proposed access point for the southeast side. The principal objectives in determining the access points from public roads were to:

- minimise disruption to other road users on the public roads;
- select locations where a safe and efficient intersections can be constructed; and
- minimise haul distances within the wind farm site.

Traffic using the internal site roads will comprise:

- road legal vehicles, such as trucks, utilities and cars;

- abnormal load vehicles such as tractor/trailer combinations for transporting the tower and nacelle units (over-width and over-weight) and blades (over-length);
- construction vehicles such as dump trucks and excavators; and
- tracked crane used for tower assembly.

Thus, site access roads are designed to use maximum, where possible, existing roads on the site, following site borders and to be harmonized in such manner to minimize occupation of land for grazing use, where possible, and to minimize disruption of the environment and land occupation. The tracks are proposed for access to the various locations of turbines and will be a total length of approximately 12,904 m and a width of approximately 4.5 m.

Some further standard requirements to the roads could be:

- maximum cross fall gradient of 2%;
- maximum gradient of 15% (potentially up to 20% is achievable if apush/pulling unit is utilised);
- for a 90 degree bend a minimal corner radius of 35 m with an associated clear overhang of 40 m radius;
- for bends less than 90 degrees a minimal corner radius of 40 m with an associated clear overhang of 45 m

However, for all requirements it is important to clarify with the chosen WTG manufacturer the exact transport requirements for the actual WTG.

## 2.3 Construction

Construction of the wind farm will take approximately 19 months. The overall length of the construction period will be dependent on the weather and could be affected by ground conditionsSite working would be Monday to Saturday from 6:00 am - 08:00 pm, however during turbine erection and commissioning, site working would be seven days per week.

*Construction Program*

The expected sequence of events for the construction program would be:

- construct road improvements along the chosen off site access route to the site as required;
- construct and improve track to construction compound;
- fell/lop trees where required outside bird breeding season;
- construct access track to nearest borrow pit and excavate;
- construct the site access tracks, laydown areas and crane hardstandings, field gates and temporary fencing (if required);
- excavate and construct the turbine foundations;

- construct the substation and install the grid connection;
- excavate the trenches and lay the power and instrumentation cables;
- erect the turbines;
- commission the turbines; and
- carry out the land reinstatement including borrow pits, remove temporary accommodation, temporary compound and crane hardstandings areas and clear the site.

Construction Design

Whilst the general layout of the internal access roads has been developed, the detailed design of the internal access tracks and the selection of the method of construction would be carried out after a detailed site investigation prior to construction. The tracks are designed for an axle load limit of 12 tonnes.

The access tracks would have a running width of 4.5 m, with local widening on bends, at passing bays (underpasses) and around turbine bases. The internal site roads are assumed to be unpaved, i.e. compacted gravel/crushed stone roads. Construction of the roads is with few layers. On the subsoil there is layer of compacted bed with thickness approximately 300 mm to 1,000 mm (average 650 mm), dependent on ground conditions. Over this is a layer of compacted base layer of gravel (150 – 300 mm), and over is compacted top layer, ballast (150 – 250 mm). Shoulders to each side of the track would be approximately 1 m in width and would be reinstated post construction. The tracks have been routed with consideration of existing ecological features on site.

The access tracks would be designed and constructed with sufficient drainage channels to prevent erosion of the road structure and to allow the efficient drainage of rain water. Water running down the channels would be intercepted and diverted onto the surrounding vegetation for the natural filtering of any suspended silt before it reaches any watercourse. Direct drainage into the existing watercourses would be avoided.

Field drains and streams would be piped directly under the track through appropriately sized drainage pipes which would be designed to cope with storm water flows. The relevant consents and approvals for any culverts will be obtained from Ministry of the Environment and Tourism prior to construction. Detailed design for any culverts would be modified following detailed site inspection prior to construction and agreed with the same ministry.

*Chapter 5: Assessment of potential environmental and social impacts of the project* and *Chapter 6: Mitigation,* set out the identified impacts and mitigation measures, where works may affect sensitive features of interest.

Construction Method

The vegetation and soil would be stripped to the subsoil. The stone track (on average 650 mm thick dependent on ground conditions) would be constructed on the subsoil. Approximately 100-150 mm of the upper topsoil layer, together with turfs where present, would be stored separately from the rest of the subsoil in piles near the tracks for later reinstatement. Following construction the appropriate topsoil and vegetation would be used to reinstate the track shoulders and turbine foundation areas. Any excess material produced from access track construction would be spread along the track shoulders and reseeded as necessary.

Once the soil has been removed to the depth of a suitable founding layer, the track and running surface would be constructed by tipping and compacting stone to the required shape and thickness. Typical access track design that may be used in the project is shown in *Figure 7* below.

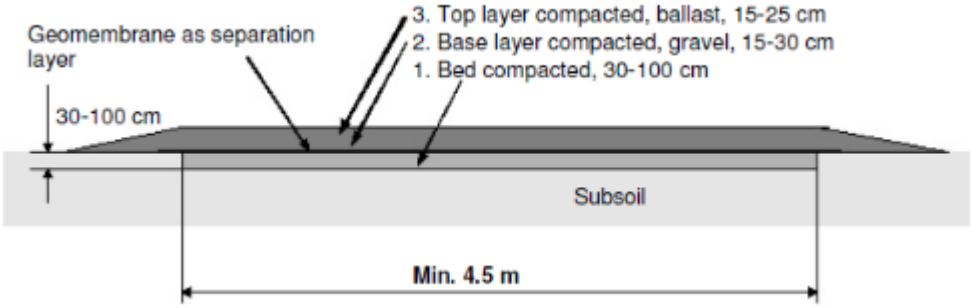



*Figure 7: Example cross-section of road*

Following construction any excess material and the appropriate topsoil would be used to reinstate any excess track areas such as passing places at the turbines and crane hardstanding areas.

*Reinstatement and Final Appearance*

The track surface is specified. The final section would be similar to those shown in *Figure 7*. More detail on reinstatement is contained in *Section 2.4 Reinstatement*.

*Crane Hardstanding*

There are two hardstanding arrangements that may be used at Vlašić Wind Farm, which are typical of what turbine manufacturers may require and the final design will depend on the choice of turbine.

For the rectangular arrangement, the large hardstanding area is used for the main crane and the auxillary crane to lift the turbine components. The two areas of widening from the access track are needed for the rigging crane which construct the main crane. The boom support is an area of hardstanding needed to support the main crane boom while it is being assembled on the ground. The area of track widening adjacent to the turbine location is where turbine components can be

laid down prior to being assembled on the foundation. The rotor assembly pad is where the rotor can be supported while bladers are fitted so the whole rotor can be lifted in one piece.

For the triangular arrangement, the large area is for the main and tailing cranes during turbine erection. The long section of track widening opposite the turbine location is for component laydown. The small area of track widening further away from the turbine is for the small crane which is used to construct the main crane boom. The two thin areas of hardstanding extending from the main crane hardstanding are where the turbine blades can be placed until they are used on the rotor assembly pad.

In addition to the two arrangements decribed above, a clear assembly area for the rotor (star assembly) is also required. This area depends on the local conditions and therefore the manufacturer has to be consulted before any action is taken. Space for at least two erection containers must be provided (for power generator and tools). Further space must be provided for one material container for temporary material storage, garbage containers, staff containers, construction vehicles, etc.

The access roads to the wind turbine must always be kept free for ambulance and rescue vehicles.

*Foundations*

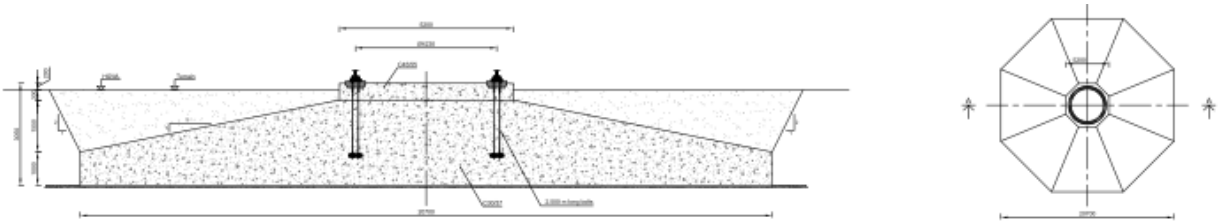
For the construction of the foundations, well-known principles are to be applied, and in general, the following tasks are to be performed:

- excavation for construction pit;
- placing/installing drainage system in the periphery of the construction pit;
- blinding layer in bottom of construction pit to ensure clean working environment for reinforcement works etc.;
- placing anchor ring, earthing system, reinforcement and cast in cable ducts, etc.;
- casting of concrete in foundation slab and in plinth (2 castings with different concretes);
- placing curing precautions and backfilling; and
- grouting below flange of WTG tower with high strength/low shrinkage grout.

The foundations for the turbines would be a gravity-base design. The foundation of geotechnical and structural design will be based on appropriate European standards, the BiH legislative and other specialist design guidelines. The geotechnical site investigation shall provide all necessary site specific information for design at the Construction Method Statement stage prior to construction but after planning consent.

A typical gravity-base foundation may be used if the ground conditions are found to be suitable, this would comprise of up to 607 $m^3$ of concrete reinforced by 67 tonnes of steel bar in a tapered octagonal block of approximately 20.7 m diameter and from 1-2.85 m depth (see *Figure 8*). Each turbine base would require up to 102 concrete deliveries (based on 6 $m^3$ of concrete in a truck), which would be brought to the site by local ready mix suppliers. Each base would be poured

over the course of a day and generally one base would be poured per day. The exact foundation design is very dependent on the turbine type, hub height, wind and ground conditions and is finalised during foundation design prior to construction, but would not be greater in volume or dimensions than those indicated above.



*Section A-A* *Plan*

*Figure 8: Gravity foundation*

The foundation surface lies up to 1.85 m below the normal ground surface and is backfilled with soil. All spoil that is excavated would be put back on top of the foundations. Any excess spoil would be spread in areas that are not environmentally sensitive and agreed with land owner and local authority and with regard to the SUDS[7] philosophy. The excess spoil would be layered into the contours of the existing topography and re-seeded as required.

An earth electrode consisting of up to three interconnected concentric rings of bare stranded copper conductors is laid around the foundation of each tower, transformer, met mast and substation approximately 0.5 m below the final ground level. In addition, earthing rods padded by bentonite (a water retaining clay mineral) are required at each of these locations. The number of rods and length is dependent upon the electrical conductivity of the soil which is confirmed prior to building the foundations.

The foundation footprint is based on the assumption of dry conditions, which consequently requires effective drainage of ground around the foundation. The proposed approach is to place drainage pipes in the ground around the foundation to a level minimum 200 mm below the lower face of the foundation.

A layer of crushed rock 100 mm in depth may be required to surround each turbine and its associated HV enclosure, for a distance of 1,500 mm out from the associated structure.

The exact quantities of concrete, reinforcement, diameters and depths would vary depending on the actual make of turbine used. Different turbine foundations may also be considered for different turbine locations depending on the local ground conditions. In the development of the foundation, geo-technical tests are carried out to determine the strength of the soil layers beneath

[7] *Sustainble drenage systems*

the turbines, and the soil behaviour under loading over time. This information is used to produce the foundation design into which are also incorporated factors of safety.

*Cabling, Sub-station and Control Building*

All cabling between the turbines and the substation on the site would be underground. All power and control cabling between the substations and the turbines would be laid in trenches approximately 0.5 m wide by 1 m (minimum) deep on the turbine side of the access tracks. These trenches would be partially backfilled with adjacent topsoil. The top 100 mm of soil would be stripped and laid beside the trench, and used to reinstate to original ground level immediately after the cables have been installed. Where practicable and necessary, vegetation over the width of the cable trench would be lifted as turfs, and replaced after trenching operations, to reduce disturbance.

Between the turbines, 30kV cable would be used to connect together the individual turbine transformers at the tower bases. All cables would be buried according to current best practice, and well below cultivation depth. During backfill of trenches, warning tape would be laid 300 mm above the cables in case of future excavation.

The substation would house switchgear and associated equipment. The substation compound would be approximately 62 m x 54 m, with standard security palisade fencing approximately 2,5 m in height. The control building would be adjacent to the substation compound and would be 27.25 m x 8.84 m, constructed from local building materials and finishes with a pitched roof, subject to agreement with the consenting authority. The control building would house switchgear, computer control equipment, small spares, toilet and wash basin.

*Temporary Works*

A temporary construction compound of up to 5,600 $m^2$ (indicative dimensions of 80 m x 70 m), would be located on the south western edge of the concession area, next to access tracks (see *Appendix 19.3. of this report)*. The compound would provide shelter facilities and office facilities for workers on site. There will be a temporary communication mast next to the compound. The compound may include:

- temporary 'Portacabin' type structures to be used for site offices, the monitoring of incoming vehicles and welfare facilities;
- toilets (self contained) with provision for waste treatment through a small package treatment plant which would be removed after construction;
- containerised storage areas for tools, small plants and parts;
- bunded refuelling areas;
- parking for around 10 cars/construction vehicles; and
- a receiving area for incoming vehicles.

A sump leading to a soakaway would disperse water accumulating in the borrow pits during construction; this would ensure unacceptable levels of suspended particles are not discharged into local watercourses. Any sods removed for the borrow pit excavation would be stored on the downslope of the storage mounds to stabilise them.

There would also be chemical toilets located at various places around the wind farm construction site for site workers. Disposal of the waste would be offsite at suitable facilities.

A laydown area may be constructed to allow turbine parts to be stored on site prior to turbine erection. Such an area would allow for turbine deliveries to be as fexible as possible and to ensure compliance with any timing constraints specified in the Traffic Management Plan. The laydown areas would be (storage room area for blades 60 m x 12 m) 720 $m^2$ (0.072 ha), assembly area for rotor 10 $m^2$, support of the booms 5 $m^2$, trestle area for blades 1 $m^2$ and would consists of stone laid over a geotextile membrane.

During construction, temporary fencing may be erected, as required, around the construction compound area, working areas, areas under restoration and, if necessary, areas identified as sensitive to disturbance to prevent inadvertent access of personnel, or vehicles. Permanent fencing of the complete development, individual turbines and access roads would not be required.

*Materials and Transport*

The materials used and the size and number of lorries required to transport these materialsare listed below:

- Each turbine would be delivered on 12 heavy trucks, comprising the blades (3 trucks for 3 rotor blades), the hub (1 vehicle), the nacelle (1 vehicle), drive train (1 vehicle), the tower (4 trucks for 4 tower sections), and swich cabinet (Bottom box), small parts and erection container (2 vehicles); a total of 216 deliveries for the wind farm (12x18);
- If a gravity-base design foundation is used it would comprise approximately 607 $m^3$ of concrete per turbine. Each turbine base would require up to 102 (based on 6 $m^3$ concrete in a truck), concrete deliveries in total which would be brought to the site by local ready mix suppliers in a total of 1,836 concrete deliveries;
- 28 $m^3$ of concrete is also required for each transformer base (504 $m^3$ in total). About 16 $m^3$ of concrete would be required for the communication mast foundation. Required is approximately 146 $m^3$ of concrete for the substation and control building foundation, which the overall is 666 $m^3$ of concrete. This would be realized in 111 concrete deliveries;
- Each foundation is reinforced by between 67 tonnes of steel bar which would be delivered on 4 lorries per base (based on 20 tonnes per truck), 61 deliveries in total;
- An estimated 45,293 $m^3$ of track stone would be required for the construction and upgrading of site tracks (approximately 12,904 m length of track x 4.5 m track width x 0.65 m depth x 1.2 m for widening and site entrance). Another 3,640 $m^3$ (5,600 $m^2$ x 0.65

m deep) would be required for the temporary construction compound and up to 16,965 $m^3$ (1,450 $m^2$ x 0.65 m deep x 18 hardstandings) for the crane hardstandings and rotor assembly pads based on the larger triangular option. The substation compound and control building would require 2,176 $m^3$ of stone (62 m x 54 m x 0.65 m). The laydown areas would require 478 $m^3$ of stone (736 $m^2$ x 0.65 m deep). The paths would require approximately 173 $m^3$of stone. About 26 $m^3$ would be required for the communication mast foundation. Approximately 8,594 tipper lorry journeys would be needed in total over the 19 month construction period to deliver the stone totalling 68,751 $m^3$;

- It is considered that the stone and all other material will be sourced from local suppliers where practicable. If the stone is found not to be adequate then local suppliers will be found where practicable. This would be concentrated in the initial construction period of 4-5 months;
- The erection of the turbines requires two mobile cranes, one of 1,200 tonne capacity (main crane), and one of 200 tonne capacity (auxillary crane);
- The electrical equipment associated with each wind turbine is generally 3 reels of cables, controllers and 1 transformer. This is typically 0.5 lorry load per turbine;
- Additional site traffic is required for the delivery of tools, temporary site huts, excavators, substation equipment, fancing, geotextile etc.;
- Tracked construction plant such as excavators and bulldozers would be transported to site on low loaders;
- Approximately 15 vans/cars would be on site at any one time being used by site personnel.

*Road Improvement Works*

At the curve at the exit of the port of Ploče, a widening of the lanes is required outside on the curve, in the width of 13.5 to 15 m (*Transport study, Draft no.239689-ATR-001*), in order to facilitate the movement of abnormal load and general construction traffic to the site and back. At this point, U-turn is not feasible within the limits of the road, and the visibility is bad for traffic. At the curve before the entrance to Jablanica, it is necessary to ease the curve, by widening the roadway to the inside of roadway curve, in a width of 5.5 m (*Transport study, Draft no.239689-ATR-003)*.

At the curve north from Podorašac, it is necessary to ease the curve, by widening the roadway to the inside of roadway curve, to a width of 28 m, as well as on the outside from the direction of Mostar, before the start of the curve, and when leaving the curve in the straight direction of a width of 11.5 m (*Transport study, Drafts no.239689-ATR-004 and 239689-ATR-004A*).

At the intersection of the E73 main road and the A1 motorway in Tarčin, it is necessary to widen the main road from the outside, from Mostar to the right, and in the place of turning and

connection to the A1 motorway. Widening in the width of 10.5 m (*Transport study, Draft no.239689-ATR-005*).

At the intersection in Turbe, where a vehicle leaves the M5 main road and goes on the R413 regional road, it is necessary to widen a roadway curve of the regional road on the outside in a longer belt *(Transport study, Draft no.239689-ATR-006*).

Along the access road to the Wind Farm site, five areas have been marked where physical activities are required to improve the radius of sharp curves and the degree of the longitudinal gradient *(Transport study, Drafts no. 238689-SK-011 – 239689-SK-013).*

Temporary traffic signals are proposed for controlling the movement of vehicles at the intersection. At the regional road and other unclassified roads, the use of mobile signaling is proposed, to the location. It should be transferred in accordance with the movement of abnormal load transport, in front of the same, before the abnormal load movement, because it will fall into the path of long vehicles.

The entrance on the west side of the Wind Farm site is from the existing improved local road, in the southwestern part of the site. Marks of roads in this area will be changed to suit the given schedule, with priority on movement southwest-southeast.

Further details about construction traffic are provided in *Chapter 4, Section 4.13: Traffic, transportation and access*.

*Pollution Control Measures and Environmental Management*

Appropriate site management measures would be taken to ensure that runoff from the construction site is not contaminated by fuel or lubricant spillages. Earth and concrete spillages into any watercourses would also be avoided. There would be no discharge of trade effluent, sewage effluent or contaminated drainage into any watercourse systems or ditch. Any dewatering from excavations would be via surface silt traps to ensure sediment does not enter surrounding watercourses. The concrete lorry wash out pit would be located adjacent to the construction compound. A waterless wheel wash would ensure excess mud is not taken onto public roads.

The operation of wind generators produces no discharges and, other than lubricants, uses no chemicals. Provided that reasonable care is taken during their routine maintenance and that vehicles using the access tracks are well maintained, the impact of the operation of the wind turbines on surface and ground waters would be negligible.

JP EP BiH has a policy that no wind turbines, auxiliary and electrical equipment shall contain askarels (synthetic non-flammable insulation for transformers).

A Construction Environmental Management Plan would be prepared and implemented for the construction, operation and maintenance and decommissioning phases, to ensure that any planning conditions associated with the consent are adhered to. As part of the JP EP BiH *Environmental Management System (EMS)* which is certified to ISO 14001, all subcontractors

commissioned to work on Vlašić Wind Farm site will be required to follow this plan. In addition, there are standards of JP EP BiH *Environmental Requirements for Subcontractor* document which outlines best practice on construction sites. This will be sent out to all subcontractors so that they can allow for such mitigation measures in their working practices.

In addition, prior to construction commencing on site, civil engineering contractors would be inducted specifically on pollution prevention and controlling water pollution from construction sites in line with the guidelines recommended by the Environmental Assessment (EA) such as within its Pollution Prevention Guidelines 5 and 6 for construction sites.

*Workforce*

During construction there will be a temporary workforce varying between 20 and 60 over a period of 19 months. Local contractors will be used where reasonably possible.

## 2.4 Traffic, transportation and access

*Preferred Route*

An assessment of all existing routes and access roads was made and a preferred route to WF Vlasic was identified. In selecting the preferred route to the site, the following criteria were considered:

- maximising the use of trunk roads and primary county roads;
- minimising the distance travelled on the public express roads;
- avoiding sensitive receptors such as schools and residential areas; and
- minimising land take and widening works.

The preferred route has been selected on the basis that it fulfils each of the above criteria and is considered to be most suitable for transporting abnormal loads.

This preferred route starts at the Port of Ploče, Croatia and then travels east along the D8 road until Sarajevo/Mostar/Metković exit. Vehicles leave in this location the D8, moving further along the D9 for approximately 10 km before joining the E73/M17. Vehicles then follow the E73/M17 road, passing next to Čapljina, Počitelj and Mostar, to the settlement of Jablanica, where they continue further through Konjic to the highway A1 near Tarčin, through Sarajevo and Visoko in the direction of Zenica, to the exit at the M5 in Lašva and following the main road M5, which leads to the town of Travnik. The distance of this route is approximately 270 km. On this route there are 32 tunnels, 19 bridges, 12 viaducts for road traffic, 3 viaducts for rail traffic and 80 km of high classified roads (equivalent of speedway roads). *Figure 9* shows the preferred route.

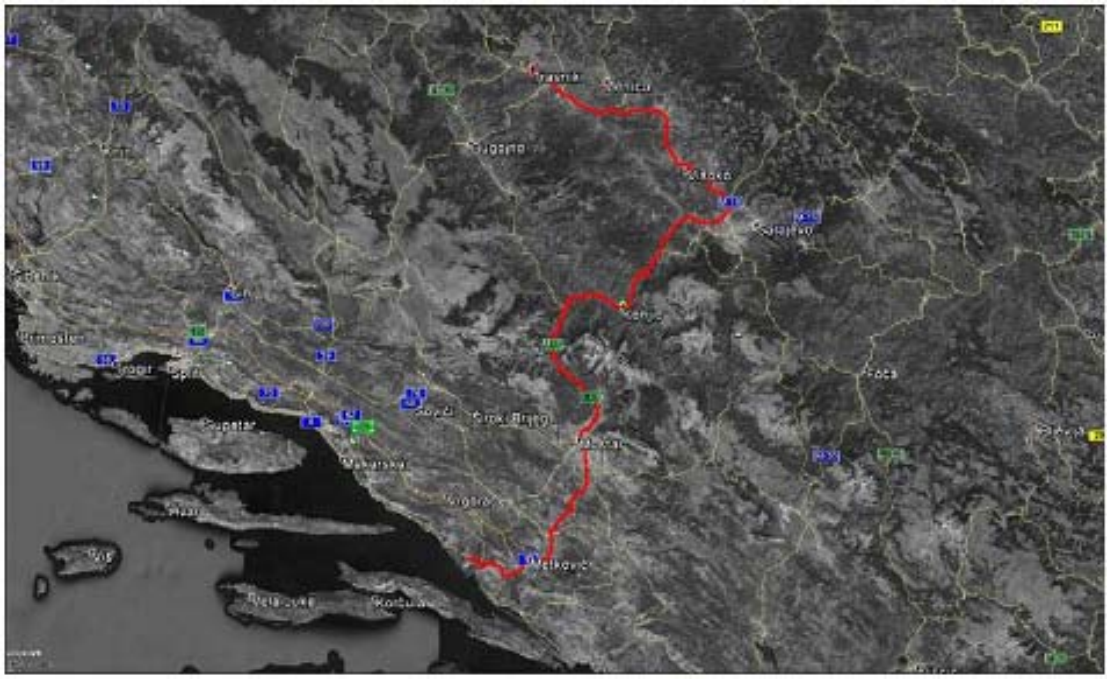


*Figure 9: The preferred route*

Description of the preferred route is given in the following *Table 4*.

*Table 4: Description of Preferred Route*

| Route Section | Description |
|---|---|
| (Port of Ploče)<br>D8 to D9 | |

| Route Section | Description |
|---|---|
| |  <br>D8 Adriatic highway<br><br>**D8 Adriatic Highway** (the Adriatic tourist road) is one of the main Croatian national road, which connects the northern and southern Adriatic. It stretches along the northern coast of the Adriatic Sea. It's a two-way road, no emergency lanes. Among the main junctions, in relation to Vlašić wind farm, there are Ploče (413) and Opuzen (425). The road also provides a link with the A1 highway, through the loop Ploče. From the port of Ploče, parallel to this road, there are the main, regional and local two-way roads that can take over the traffic flow.<br><br>  <br><br>The southern most section of the D9 route, where joins the D8 road (intersection the D8 and D9)<br><br>**D9** is a state road in Croatia, which connects through the border crossing Metković, Bosnia and Herzegovina to Čapljina and Mostar, further towards Sarajevo. It is a two-way road, with emergency lanes, with a total length of 10.9 km. D8 is part of the E73. The road also provides a link with the A1 highway, through loop Ploče.<br><br>From the port of Ploče to the exit for Sarajevo/Mostar/Metković, the route follows the D8 road, then at junction of Opuzen, follows the D9 road, to the border crossing Metković. At the stretch Opuzen - Metković, in parallel with D9 road, on the other side of the Neretva river there is a two-way local road, which can receive the traffic. Also, main, regional and local two-way roads, with proper redirection can take redirected traffic. |

| Route Section | Description |
|---|---|
| |  <br>Metković, on route D9 |
| D9 to E73/M17 |  <br>**European route E73** is in a class A of the north-south European route, which connects the central part of the continent, particularly Hungary and eastern Croatia with Bosnia and Herzegovina and the Adriatic Sea, in the port of Ploče. This route is also marked as a Pan-European Corridor Vc, a branch of the fifth Pan-European corridor. The route, to a large extent, consists of two traffic lanes, with at-grade intersections, although in the 2000s, roughly one-third of the route was upgraded to meet the standards of the highway. The rest of the route is currently being upgraded in all countries. The longest part of this corridor is passing through Bosnia and Herzegovina. The road also serves as the shortest connection of the eastern and southern parts of the Croatian. One of the important crossroads at the same is Opuzen, as the southern end point of the E73 road.<br><br>Section E73/M17, from Metković to crossing on the highway near Tarčin is not upgraded, and has the status of the main road. Which means that it is two-way road, generally without emergency lanes. Section from Metković to Mostar is followed on both sides by network of trunk, regional and local roads, which can take over traffic. From Mostar (place Potoci) to Jablanica, alternative local roads are a bit farther, because of the narrow valley of the Neretva River, which passes following the same road, and big mountains Prenj, Čvrsnica and Čabulja, which form the valley. The section with a number of tunnels. |
| **Route Section** | **Description** |

| | |
|---|---|
| E73/M17 to A1 |  <br>Highway A1, Bijača exit, in the direction of Zvirovići<br><br>**Highway A1** is a highway under construction in Bosnia and Herzegovina, which is part of the Pan-European Corridor Vc and European International Road E73. The same is being built by expanding parts of the main roads M5 and M17. Due to the complicated terrain configuration, the construction is somewhat hampered by the many tunnels and bridges.<br><br>Section E73/M17, near Tarčin goes to the A1 highway, along the same continues, passing by Sarajevo in Vogošća, then by Kakanj to go over the same at the Lašva junction, exit on the M5. Throughout this section, parallel to the highway, there are the main, regional and local two-way roads, which can take redirected traffic. |
| A1 to M5 |  <br><br>**M5** is a trunk road in Bosnia and Herzegovina. The road extends in an east-west direction through Central Bosnia, from the Croatian border at the border crossing Izačić, through Bihać, Jajce, Donji Vakuf, Travnik, Sarajevo, to the border with Serbia to the east, near Višegrad. M5 trunk road is part of the European International Road E761.<br><br>The section of the M5 from Lašva junction is passing through several small towns, then by Vitez, Nova Bila, Dolac on Lašva, and coming to Travnik. It is two-way road, generally without emergency lanes. The section follows the mutual network of trunk, regional and local roads, which can take redirected traffic. |

For further evaluation, the entire preferred transportation route is divided into three sections. The first section is from the port of Ploče to Travnik (route 2), the second section is from Travnik to existing access road, and the third section is from the existing access road to the location of the wind farm.

***The first section of the route***, Route 2 primarily follows the main roads from south to north and uses the recently completed sections of the highway A1, which is the highway with high quality standards and with minimal restrictions, in relation to the lower ranked roads. While this is the longest of the three routes analyzed, there is less restriction, it has a high standard of the road that is used, the total time of transport is probably shorter than other roads.

***The second section of the route*** starts in the northern part of the town of Travnik, before direction to the west to the settlement of Turbe. From here, the vehicle leaves the main road network and follows the R413 regional road uphill to the north, passing directly through and by small villages. Near the settlement Mudrike, at right angles it changes direction towards the east, going over the R413a, passing further next to Šišava settlement and leading up the hill to the south, to the beginning of the access path, which leads to the location of the wind farm. The second section of the route is shown in *Figure 10* below.

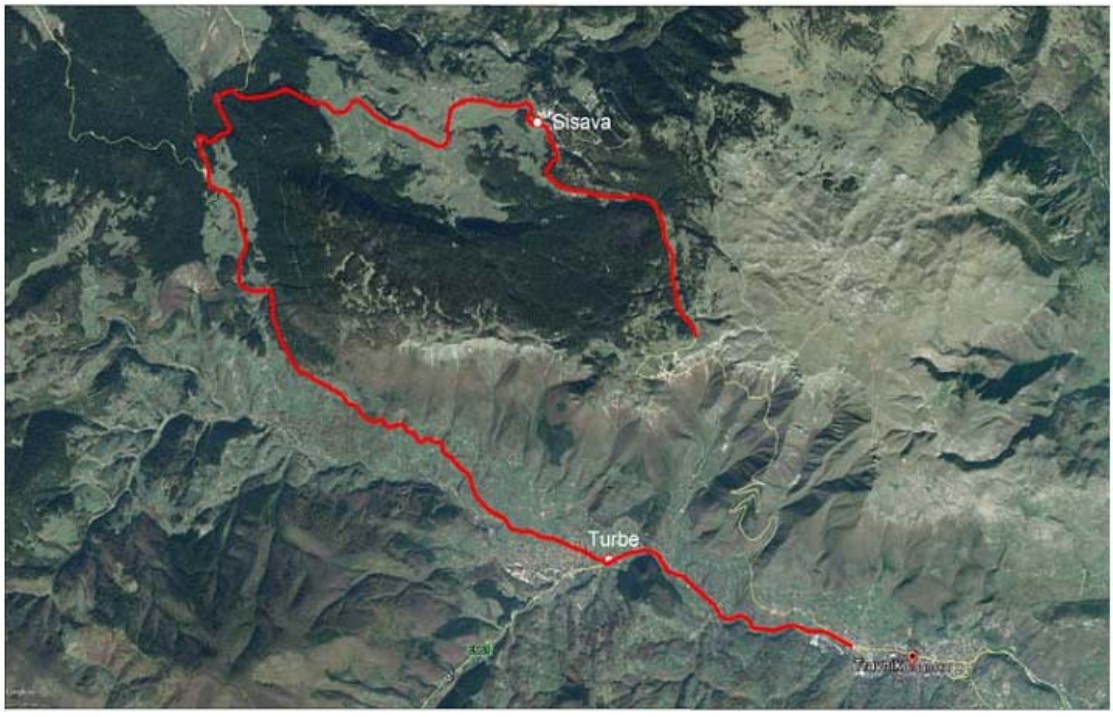



*Figure 10: Slope access road: Section two*

*Figure 11: Regional road R413 near Mudrike settlement on Vlašić mountain*

The second section of the route, which leads by regional roads R413 and R413a, is a two-way road, no emergency lane, passing through or next to smaller villages on Vlašić mountain. When analyzing the area downhill, it was noted that the road is recently improved, cut into the hillside. Therefore, the slope of the new road improvements for abnormal load transport would be significantly less than identified slope in the form of assessment, and is suitable for typical transport vehicles to be used for the wind farm. Additional, any needed improvements are minimal. Improvements were shown in the *Transport Study, Drafts*[8].

***The third section of the route*** is the access road to the wind farm site, and starts at the beginning of the existing access road, which leads to the same. This section is shown in *Figure 12* below.

[8] *Technical assistance for Vlašić Wind Farm – BiH, Second Interim Report, Transport Stud, November 2015.;*


*Figure 12: The access road to the wind farm site: Section three*

The preferred route is the one that is taken from the *Transport Study*[9].

## 2.5 Reinstatement of temporary construction compound

After completion of construction the temporary construction compound would be fully reinstated to the existing state. Cable trenches would be similarly covered with topsoil. Temporary areas of hardstanding will be removed at the end of the construction period in order to allow them to revert to the baseline habitat.

Material arising from excavations on site that cannot be accommodated close to the point of excavation would be placed in the borrow pits. The borrow pits would be landscaped at the end of the construction period and reseeded as appropriate.

## 2.6 Operation and Maintenance

Wind turbines and wind farms are designed to operate largely unattended. Each turbine at Vlašić Wind Farm would be fitted with an automatic system designed to supervise and control a number of parameters to ensure optimal performence (e.g. start-up and shut-down, rotor direction, blade pitch angles etc.) and to monitor wellbeing (e.g. generator temperature). The control system would automatically shut the turbines down, should the need arise. Sometimes the turbines would re-start automatically (if the shut-down had been for high winds or if the grid voltage had

[9] *Technical assistance for Vlašić Wind Farm – BiH, Second Interim Report, Transport Study, November 2015.;*

fluctuated outwith range), but other shut-downs (e.g. generator over heating) would require investigation and manual restart.

The wind farm itself will have a sophisticated overall *Supervisory Control and Data Acquisition system (SCADA)* that would continuously interrogate each of the turbines and the high voltage (HV) connection. If a fault were to develop which required an operator to intervene then the SCADA system would make contact with on-duty staff via e-mail or a mobile messaging system. The supervisory control system could be interrogated remotely. The SCADA system would have a feature to allow a remote operator to shut down one or all of the wind turbines. An operator would be employed to monitor the turbines, largely through remote routine interrogation of the SCADA system. The operator would also look after the day-to-day logistical supervision of the site and would periodically be on site.

After construction wind turbines require routine maintenance and engineers would be on site periodically. Site traffic would be limited to small maintenance vehicles with on average up to four maintenance crew visits per month. A maintenance crew consists of two people for safety. There is no requirement for waste collection or the provision of any services other than electricity and a telephone connection.

Routine maintenance of the turbines would usually be carried out approximately twice a year. This would not involve any large machinery or vehicles. In exceptional circumstances, a mobile crane and/or lorry may be required where large turbine componentAs need to be repaired. Should a fault occur the operator would diagnose the cause, if repair warranted the wind farm being disconnected from the grid then the operator would make contact with the grid operator. However, this is a highly unlikely occurence as most fault repairs can be rectified without reference to the network utility. If the fault was in the electrical system then the faulty part or the entire wind farm would be automatically disconnected.

Prominent signs would be placed on the site (substation, site entrance, and each turbine/transformer housing) giving details of emergency contacts. This information would also be made available to the local police station and the relevant Distribution Network Operator to which the wind farm would be connected.

Operational phase of the wind farm will take approximately 25 years.

## 2.7 Decommissioning

The anticipated operational life of the wind farm is twenty years from the date of commissioning. At the end of this period a decision would be made as to whether to refurbish, remove, or replace the turbines. If refurbishment or replacement were to be chosen, relevant consents would be obtained. If a decision were to be taken to decommission the wind farm this would entail the removal of all the turbine components, transformers, monitoring masts, crane hardstandings, the substation and associated buildings. Some of the access tracks could be left on site to ensure the continued benefit of improved site access for the land owner or they could be reinstated. Buried

cables and the concrete foundations would normally be left on the site as removal of these would cause more land damage than leaving them in situ: the entire foundation would be graded over with soil.

Should alkaline or neutral pH ground conditions be found at Vlašić Wind Farm site no chemical degradation of the concrete foundation would take place. The concrete mass would remain intact and have no effect on the local soil or ground water. Should detailed site investigation find areas of acidic ground conditions the concrete mix used would be designed to withstand sulphate attac in accordance with BS 5328. The chemical effects of leaving concrete foundations in the ground after decommissioning at the end of the wind farm's working life are therefore not expected to be significant. Prior to decommissioning of the site a method statement would be prepared and agreed with the local authority.

# 3 LEGAL AND PLANNING POLICY CONTEXT

## 3.1 Introduction

This Chapter of the ESIA describes the policy and legal framework relating to the management of environmental and social risks for the proposed WF Vlašić. BiH is on the accession path to EU membership and is in the process of aligning its national environmental legislation and standards to meet EU requirements. Hence, the EU framework for environmental and social protection is particularly relevant to this ESIA.

In addition, this ESIA has been prepared to meet the environmental and social requirements of EIB, which requires its clients to adopt EU standards for the construction and operation of new projects, where these standards are more stringent than national requirements. A gap analysis has been carried out to identify where differences exist between national/regional and EU legal requirements (*see GAP Analysis, Appendix 14.14*).

Specific environmental quality standards are discussed within the relevant baseline and impact assessment chapters of the ESIA.

## 3.2 Environmental Legislation

According to the Law on Environmental Protection and the corresponding implementing regulation (*the Regulation on facilities subject to obligatory EIA and facilities, which may be constructed and operated only with a valid environmental permit,* "*Official Gazette of the Federation of Bosnia and Herzegovina*" *no. 19/04*), wind energy facilities are classified, under Art. 6, as

> "*Facilities for which the environmental impact assessment is carried out on the basis of the assessment of the Federal Ministry*".

Wind farms are considered in this *Regulation* under paragraph 1, subparagraph a) *The energy industry, subclause 4 as "Installations for the harnessing of wind power for electricity production (wind farms) with a production capacity of 2 MW or 4 converters*".

The proposed WF Vlašić includes the potential for upto 18 turbines, each with a generating capacity of 2.5MW and a total maximum installed capacity of 45MW. Due to the the size of the proposal it is a requirement under the above mentioned legislation for an Environmental and Social Impact Assessment (ESIA) to be prepared and submitted to the Ministry of Environment and Tourism, prior to the issuance of the required environmental permit.

On conclusion of the ESIA process, information provided within the ESIA report should include:

- A detailed project description with information on location, purpose and size of facilities;

- The data needed for the identification and assessment of potential environmental impacts;
- A description of the measures envisaged to prevent, reduce, or if possible remediate significant adverse effects and increase positive effects;
- Description of alternatives considered and selected;
- Excerpt from a planning document of the area concerned to demonstrate how the project meets relevant development plans and policy objectives;
- A Non-technical summary (NTS).

On the basis of the prepared ESIA, the Federal Ministry of Environment and Tourism issues an environmental permit.

This ESIA has been prepared in accordance with the requirements set out in the Law of Environmental Protection and implementing Regulation.

### 3.3 The legal framework for the construction of new facilities for electricity production

The legislation listed below are those that relate to the construction of new facilities for electricity generation within Bosnia and Herzegovina:

- Law on Spatial Planning and Land Use of the Federation of Bosnia and Herzegovina ("*Official Gazette of F BiH", no. 2/06, 32/08, 4/10 and 13/10, 45/10*);
- Law on Expropriation *("Official Gazette of F BiH", no. 70/07, 36/10, 25/12*);
- The Law on Electricity of the Federation of Bosnia and Herzegovina *("Official Gazette of F BiH" no. 66/13)*;
- Law on Roads of the Federation of Bosnia and Herzegovina *("Official Gazette of F BiH", no. 12/10; 16/10; 66/13);*
- The Real Rights Law of F BiH (*„Official Gazette of F BiH", no. 66/13, 100/13*);
- The Law on Use of Renewable Energy Resources and Efficient Cogeneration ("*Official Gazette of F BiH" no.70/13, 5/14)*. With the entry into force of the Law, the Decree on use of RES and cogeneration ("*Official Gazette of F BiH", no.36/10 and 11/11)* was repealed, except for the provisions relating to the guaranteed purchase reference price of electricity, the reference price of electricity production etc.
- The Regulation on facilities subject to obligatory EIA and facilities, which may be constructed and operated only with a valid environmental permit, ("*Official Gazette of the F BiH", no. 19/04);*
- Decree on Single Methodology for Preparation of Documents related to Spatial Planning, ("*Official Gazette of F BiH", no. 63/04);*

- Regulation on Stimulation for Electricity Generation from Renewable Energy Sources and Efficient Cogeneration and Determining Fees for Incentives ("*Official Gazette of F BiH", no. 48/14);*
- Regulation of the procedure, criteria, form and the content of the requirements for issuance of energetic licenses for the construction of new and the reconstruction of existing production facilities (*„Official Gazette of F BiH", no. 27/14*), entered into force on 17/04/2014;
- Decree on Spatial Intervention and Buildings for which the Federal Ministry of Physical Planning issues urban permit and/or location information (*Official Gazette of F BiH", no. 32/14).*

### 3.4 The legal framework in the field of environmental protection

Environmental impact assessment was carried out taking into account a set of Federal environmental laws:

- The Law on Environmental Protection, ("*Official Gazette of F BiH", no. 33/03 and 38/09);*
- The Law on Nature Protection, ("*Official Gazette of F BiH", no. 66/13*)[10];
- The Law on Water, ("*Official Gazette of F BiH", no. 70/06*);
- The Law on Air Protection, ("*Official Gazette of F BiH", no. 33/03, 4/10*);
- The Law on Noise Protection, ("*Official Gazette of F BiH", no. 110/12*);
- The Law on Waste Management, ("*Official Gazette of F BiH", no. 33/03, 72/09);*

### 3.5 Other important legal acts – Federal and Cantonal level

- The Law on Environmental Protection, ("*Official Gazette of Central Bosnia Canton", no. 4/05);*
- The Law on Nature Protection, ("*Official Gazette of Central Bosnia Canton", no. 4/05);*
- The Law on Noise Protection, ("*Official Gazette of Central Bosnia Canton", no. 11/00*);
- The Law on Air Protection*, ("Official Gazette of Central Bosnia Canton", no. 11/00);*
- The Law on Spatial Planning, ("*Official Gazette of Central Bosnia Canton", no. 11/05);*

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[10] *Impact assessment acceptability for the ecological network is a document which is through the legal framework defined by the Law of Nature Protection ("Off. Gazette of F BiH" no., 66/13), Art. 25-29. However, the Rulebook which will be issued by the Federal Ministry of Environment and Tourism, and which will prescribe the content and scope of the said document has not yet been enacted in the F BiH. Additionally, Natura 2000 is not fully completed in Bosnia and Herzegovina, and thus in the F BiH, and there is no official decision of the competent institutions of official designations. Therefore, the same situation is with the Vlasic area, which is planned, but not officially declared as an area with the title Natura 2000.*

*Articles 25-29 defines the conditions under which it can be constructed within area of Natura 2000. Also, highlighted is the prevailing public interest, for certain objects, where the competent Ministry issues a Decision on the implementation permit of the planned project.*

- The Law on Concessions, *("Official Gazette of Central Bosnia Canton", no. 8/09);*
- The Law on Forests, *("Official Gazette of Central Bosnia Canton", no. 5/14),* entered into force on 18.03.2014. Since the umbrella law has not yet been adopted, i.e. the Law on Forests of the Federation, the question arises of its Constitutionality. Meanwhile, the Government of the Federation of BiH makes: "*The decision on extension of the agreement on the transfer of management tasks of state forests*", which application of cantonal, without a harmonized framework law, becomes legal;
- The Law on Cattle Breeding (*„Official Gazette of F BiH", no. 66/13*);
- The Law on Agricultural Land, ("*Official Gazette of F BiH", no. 52/09*);
- The Law on Agriculture (*„Official Gazette of F BiH", no.88/07, 4/10, 7/13*);
- The Law on Hunting, (*„Official Gazette of F BiH", no. 4/06, 8/10, 81/14*);
- The Red List of Endangered Wildlife Species and Subspecies of Plants, Animals and Fungi *(„Official Gazette of F BiH", no. 7/14);*
- The Law on the protection of properties designated as National Monuments of Bosnia and Herzegovina by decisions of the Commission to Preserve National Monuments, ("*Official Gazette of F BiH", no. 2/02 and 8/02*);
- The Law on Free Access to Information in the Federation of BiH, ("*Official Gazette of F BiH", no. 32/01*);
- Law on Occupational Safety and Health ("*Official Gazette of SR BiH", no. 22/90*);
- Regulation on facilities subject to obligatory EIA and facilities, which may be constructed and operated only with a valid environmental permit, ("*Official Gazette of the Federation of Bosnia and Herzegovina" no. 19/04)*;
- Rulebook on Requirements for Determination of Sanitary Protection Zones and Protection Measures for Water Sources Used or Planned to Be Used for Drinking, ("*Official Gazette of F BiH", no. 51/02*);
- Rulebook on Requirements to be met by Reference or Authorized Laboratories for Water Testing, including Content of Authorization and Methods of their Granting, *("Official Gazette of F BiH", no. 14/10 and 14/13);*
- Rulebook on Requirements and Criteria to be met by Legal Persons Specialized and Authorized to carry out Measures to Remove or Prevent Water Pollution in case of Sudden Water Pollution or Risk of Sudden Water Pollution, including the Methods of issuing authorizations, *("Official Gazette of F BiH", no. 06/11);*
- Rulebook on Requirements for Determination of Sanitary Protection Zones and Protection Measures for Water Sources Used for Public Water Supply, ("*Official Gazette of F BiH", no. 88/12*);
- Rulebook on the Establishment and Management of Information System for Nature Protection and Monitoring, *("Official Gazette of F BiH", no. 46/05);*

- Rulebook on Conditions for Access to Protected Area ("*Official Gazette of F BiH*", *no. 69/06);*
- Rulebook on Compensation for Damages to Wildlife, *(„Official Gazette of F BiH", no. 9/14);*
- Rulebook on Waste Categories with Lists, *("Official Gazette of F BiH", no. 9/05);*
- Rulebook on the Treatment of Waste that is not on the list of hazardous waste or which content is unknown, *("Official Gazette of F BiH", no. 9/05);*
- Rulebook on Determination of the Allowable Amount of Hazardous Materials into Soil and Test Methods thereof, *("Official Gazette of F BiH", no. 71/09);*
- Rulebook on content of adjusting waste management for existing plants for treatment or waste disposal and activities undertaken by the competent authority, *("Official Gazette of F BiH", no. 9/05);*
- Rulebook on health safety of drinking water *("Official Gazette of BiH", no. 40/10, 43/10, 30/13*);
- Regulation on Natura 2000 - protected areas in Europe, *("Official Gazette of F BiH", no. 41/11);*
- Regulation on Spatial Intervention and buildings for which the Federal Ministry of Physical Planning issues urban permit and/or location information, *("Official Gazette of F BiH", no. 32/14);*
- Regulation on Stimulation for Electricity Generation from Renewable Energy Sources and Efficient Cogeneration and Determining Fees for Incentives, *("Official Gazette of F BiH", no. 48/14);*
- Regulation on Dangerous and Harmful Substances in Water, *("Official Gazette of F BiH", no. 43/07);*
- Regulation on Forests, *("Official Gazette of F BiH", no. 83/09, 26/10 and 38/10 and 60/11)* – The Constitutional Court's judgment of 23 March 2011 *("Official Gazette of F BiH", no. 34/11*) repealed Regulation on forests, making it the conflict with the Constitution. Currently, the Law on Forests is in the preparation phase;
- Regulation on the Construction Site Organization, Compulsory Documentation at Building Site and Participants in Construction, *("Official Gazette of F BiH", no. 48/09, 75/09, 93/12 and 74/13);*
- Regulation on Unique Methodology for Assessment of Damages caused by Natural and Other Disasters, *("Official Gazette of F BiH", no. 75/04, 38/06 and 52/09);*
- Decision of Borders of River Basins within the Territory of Federation of BiH, *("Official Gazette of F BiH", no. 41/07);*
- Decision on Characterization of Surface and Ground Waters, Reference Requirements and parameters for the Assessment of Water Status and Water Monitoring, *("Official Gazette of F BiH", no.1/14);*

- The decision on the preparation, content and implementation of Forest Management Plans ("*Official Gazette of F BiH", no.15/14*);
- The decision on extension of agreement on the transfer of management tasks of state forests ("*Official Gazette of F BiH", no. 105/14*);
- Decision on the Establishment of Operator for Renewable Energy Sources and Effcient Cogeneration, (*„Official Gazette of F BiH", no. 90/13*);
- Decision on the fee for providing incentive for generation of electricity from renewable energy sources and in efficient cogenerationfor 2013, (*„Official Gazette of F BiH", no. 95/13*);
- The decision to amend decision to designate national monuments made as of the 50th session of the Commission to Preserve National Monuments ("*Official Gazette of BiH", no. 42/14);*
- The decision of deleting the monuments from the Provisional lists ("*Official Gazette of BiH", no. 37/04);*
- Provisional list of National Monuments of *(*"*Official Gazette of BiH", no. 33/02*);

## 3.6 Regulations of the European Union in the field of environmental protection, construction and use of renewable energy sources

Many EU regulations refer to the regulation and environmental impact assessment, including:

*Conventions – ratified by FBiH:*

- The Aarhus Convention– The Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Aarhus 1998., entered into force on 05.08.1998. *(„Official Gazette of BiH, International Agreements" no. 8/08);*
- The Convention on the Establishment of the European and Mediterranean Organization for Nature Protection;
- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), Bern 1979., (entered into force on 01.06.1982.; Ratification in procedure);
- The European Landscape Convention - Florence, 20 October 2000., the Council of Europe;
- Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 23 June 1979.;
- Ramsar Convention - Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar, Iran, on February 2, 1971.;
- The Convention on the Protection of the World Cultural and Natural Heritage, The United Nations Educational, Scientific and Cultural Organization, meeting in Paris from October 17 to November 21, 1972.

*Ratification by FBiH in process:*

- The Agreement on the Conservation of bats in Europe, London, 04.12.1991;
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds;
- Protocol amending the Convention on Wetlands of International Importance especially as Waterfowl Habitat, known as the Paris Protocol. Adopted at the Extraordinary Conference of the Contracting Parties, Paris, France, 2nd-3rd, December, 1982.

*Relevant Environmental EU directives:*

- Water Framework Directive 2000/60/EC of the European Parliament and the Council of Europe of 23 October 2000.;
- EU Directive on Urban Waste Water Treatment (91/271/EC);
- EU Directive on Emission Limit Values of Certain Dangerous Substances (76/464/EC);
- Directive 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment;
- Council Directive 79/409/EEC of 2 April 1979, on the Conservation of wild birds (The Birds Directive);
- Council Directive 92/43/EEC of 21 May 1992, on the conservation of natural habitats and wild fauna and flora (The Habitats Directive);
- Council Directive 96/82/ECon the control of major-accident hazards involving dangerous substances – the so-called Seveso II Directive;
- Directive 2003/4/EC on public access to environmental information and repealing Council Directive 90/313/EEC;
- Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directive 2001/77/EC and 2003/30/EC;
- Directive 2008/98/EC on waste (Waste Framework Directive);

## 3.7 Relevant Planning Policy Documents

Plans, within which land for the development of WF Vlašić is safeguarded include the following:

1. Draft of Spatial Plan of FBiH which requires the reservation of space for testing the feasibility of wind farms;
2. The Indicative Plan of production 2012-2021;
3. The Strategic Plan and Development Program; and
4. Amendments to the Spatial Plan of Travnik Municipality (2003-2020).

Important planning documents relating to environmental protection include the following:

- Strategy for Environmental Protection of the Federation of Bosnia and Herzegovina (2008-2018);
- Federal Waste Management Plan (2012-2017);
- Water Management Strategy of the Federation of Bosnia and Herzegovina (2010-2022);
- Guidebook through the types of habitats of Bosnia and Herzegovina, Support for the implementation of the Birds Directive and the Habitats Directive in BiH, Cooperation for Natura 2000, 2015;
- Cantonal Environmental Protection Plan for the period 2015-2025, the Action Plan, Central Bosnia Canton, Draft;
- Waste Management Plan for the area of Central Bosnia Canton for the period 2015-2025.

# 4. BASELINE ENVIRONMENT

This chapter provides a description of the baseline environment, i.e. the environmental that currently exists. Details are provided of the proposed site and study area itself in addition to more general information about the conditions within Bosnia and Herzegovina.

Information has been gathered through a combination of the following:

Published documentary information from a variety of sources, including historical and contemporary records;

Site survey information, including background noise levels, ecological features, townscape and landscape character, traffic levels on the road network and community facilities;

Other survey information including topographic surveys and site investigation; and

Data provided by stakeholders, including statutory and non-statutory consultees.

## 4.1 Site location

A description of the proposed project site is given in Chapter 2. A more general description of the regional environment is provided below.

Travnik municipality is located in the central part of Bosnia and Herzegovina, in Central Bosnia Canton, and borders the municipalities of Novi Travnik, Vitez, Zenica, Teslić, Kotor Varoš, Jajce, Donji Vakuf, Bugojno and Dobretići.

The area of Travnik municipality is on transit between the Pannonian Plain and the Adriatic coast. The position of Travnik in relation to the Sarajevo-Zenica valley, which up until the Bosnian war in 1992-95 included the largest concentraion of industrial units in BiH, is ideal for rapid industrial development. Travnik has developed as a strong urban center, complimenting other cities such as Zenica and Sarajevo in the Sarajevo-Zenica valley.

Through the area of the Municipality are passing a section of the main road Lašva-Travnik-Donji Vakuf and regional roads: Turbe-Vitovlje-Kneževo (Skender Vakuf), Travnik-Vlašić-Vitovlje, Vitovlje-Dobretići and Dolac-Guča Gora-Han Bila-Ovnak. The section of the main road is part of the European road and represents a traffic axis of Bosnia and Herzegovina in the northwest-southeast. The favorable position of Travnik municipality offers many development benefits to Travnik as the capital city of Canton, in order to take significant functions in the wider environment, and adequate linking of neighboring cantons.

## 4.2 Site Access

The proposed Vlašić WF is connected to the main road network of BiH by the main arterial routes from south to north in particular with D8, D9, E73, M17, A1, M5, R413 and R413a on which

transport will be carried out from the port of Ploče through the settlements and cities Metković, Mostar, Konjic, Sarajevo, Vitez and Travnik.

In the northern part of the town of Travnik, before direction to the west to the settlement of Turbe, the vehicle leaves the main road network and follows the R413 regional road uphill to the north, passing directly through and by small villages. Near the settlement Mudrike, at right angles it changes direction towards the east, going over the R413a, passing further next to Šišava settlement and leading up the hill to the south, to the beginning of the access path, which leads to the location of the wind farm.

## 4.3 Geological Characteristics

### *4.2.1 Geological Structure - general*

The terrain of Travnik area is very heterogeneous and complex, and is built from the creation of different ages, namely: the Paleozoic, Mesozoic, Tertiary and Quaternary. The geology of the area consists of the following:

***Mesozoic deposits*** occupy large areas around Travnik, in the complex of Vlašić mountain.

***Middle Triassic*** in the area of Lisce-Opara is presented in two facies, namely: as volcanogenic-sedimentary facies, and as a facies of limestone.

***Oligo-Miocene complex*** on the basis of lithological composition and paleontological features, in this area and the immediate neighborhood, is divided into three separate litostratigraphic units: colorful series that makes the slope of coal layers, travertine limestone and basal zone.

***Older Miocene polyfacial complex*** or second cycle of sedimentation is divided into the following lithostratigraphic units: the main coal zone: layers of clay marl, sandstone, clay and main coal layer (slope coal layer - I, II, III); the roof layer limestone zone: layered limestone with roof coal layer; the transition zone: thin-layered marls and sandstones with rare layers of conglomerates and Lašva series.

***Quaternary sediments*** are represented by sediments of Early and Late Quaternary.

***Sediments of older Quaternary*** are represented by fluvioglacial layers, which appeared during the Pleistocene (Wirma II and Wirma III) from the mountains Vlašić and Vilenice. Fluvioglacial deposits of clayey gravel and pebbles of rhyolite and shale are located in the valley of Lašva. Northwest of Turbe, then in the area of Mudrike, sandy gravel is made of pebbles of hornstones, limestones and sandstones.

***Younger Quaternary deposits*** are found in the river valleys, and build also spatial fluvioglacial fields.

The area of Vlašić Mountain is located mainly in the Mesozoic sediments, of Triassic and Jurassic age, and in the far northest of the terrain are Cretaceous clastics. Middle Triassic sediments are

present on a wide expanse, in the area of Vlašić (1,919 m a.s.l.), and in the southwest, the slopes are covered between Turbe and Travnik. On the southwest slopes of Vlašić (Paklarske rocks), Middle Triassic sediments are represented mainly by dolomites, and to the top of the plateau dolomites turn into limestone. Due to intensive tectonic stresses, dolomites easily decompose in dolomite sand.

Upper Jurassic, in the area of Vlašić Mountain, is represented by Tithonian deposits that build with ellipsactinias the highest peaks of Vlašić Mountain, occupying the entire plateau, but they occur in the lower parts around Šešić, Karaula, Ovčarevo and in Travnik. Jurassic deposits of Vlašić are represented by dolomitic limestone and Tithonian dolomite with shells, snails, corals in a typical zoogenic-reef facies. The thickness of the carbonate deposits of limestone and dolomite of Vlašić is about 300 m. Tithonian of Vlašić occupies the highest peaks of Vlašić plateau (1,919 m a.s.l.), Umac (1,397 m a.s.l.) in the east Paljenik (1,948 m a.s.l.), Devečani (1,790 m a.s.l.), Šupljevac (1,770 m a.s.l.), Crni vrh (1,731 m a.s.l.), Pavo (1,800 m a.s.l.), Harambašina voda, Galica, Bukovičko brdo (1,625 m a.s.l.).

### *4.2.2 Geological structure - Vlasic WF site*

Geotechnical investigations were carried out in 2 phases. In the first (I) phase of investigations, geological investigations were performed and a program of geotechnical investigation works for the second (II) phase was prepared. The II phase of investigations consisted of geomechanical and geophysical - seismic investigation.

The Phase I, geological investigations consisted of studying and reinterpreting the existing geological data and field investigations. Field investigations consisted of engineering-geological (EG) and hydrogeological (HG) prospection of the study area. The area of exploration belongs to geotectonic structure of Vlašić Mt. and represents Mesozoic overthrust on top of Palaeozoic basement. Limestones of Upper Jurrasic are predominant, while Triassic dolomites are surrounding limestone stratums. From a hydrogeological point of view, all the water from Vlašić plateau, sources out at one of the springs located within the borders of this plateau.

Karstic stratums which are forming the Vlašić plateau, from engineering geology point of view, are essentially fair to good rock mass grade. In accordance with criteria for construction feasibility with respect to geotechnical characteristic; there were selected 3 (three):

***Zone A***, with favourable geotechnical properties for construction;

***Zone B***, with favourable geotechnical conditions for construction, but with expected broader area of deeper effects of rock weathering;

***Zone C***, where construction is possible, but providing undertaking measures for ensuring global stability. Not recommended for construction.

The Vlašić study area is characterized as shown in the *Figure 13*.

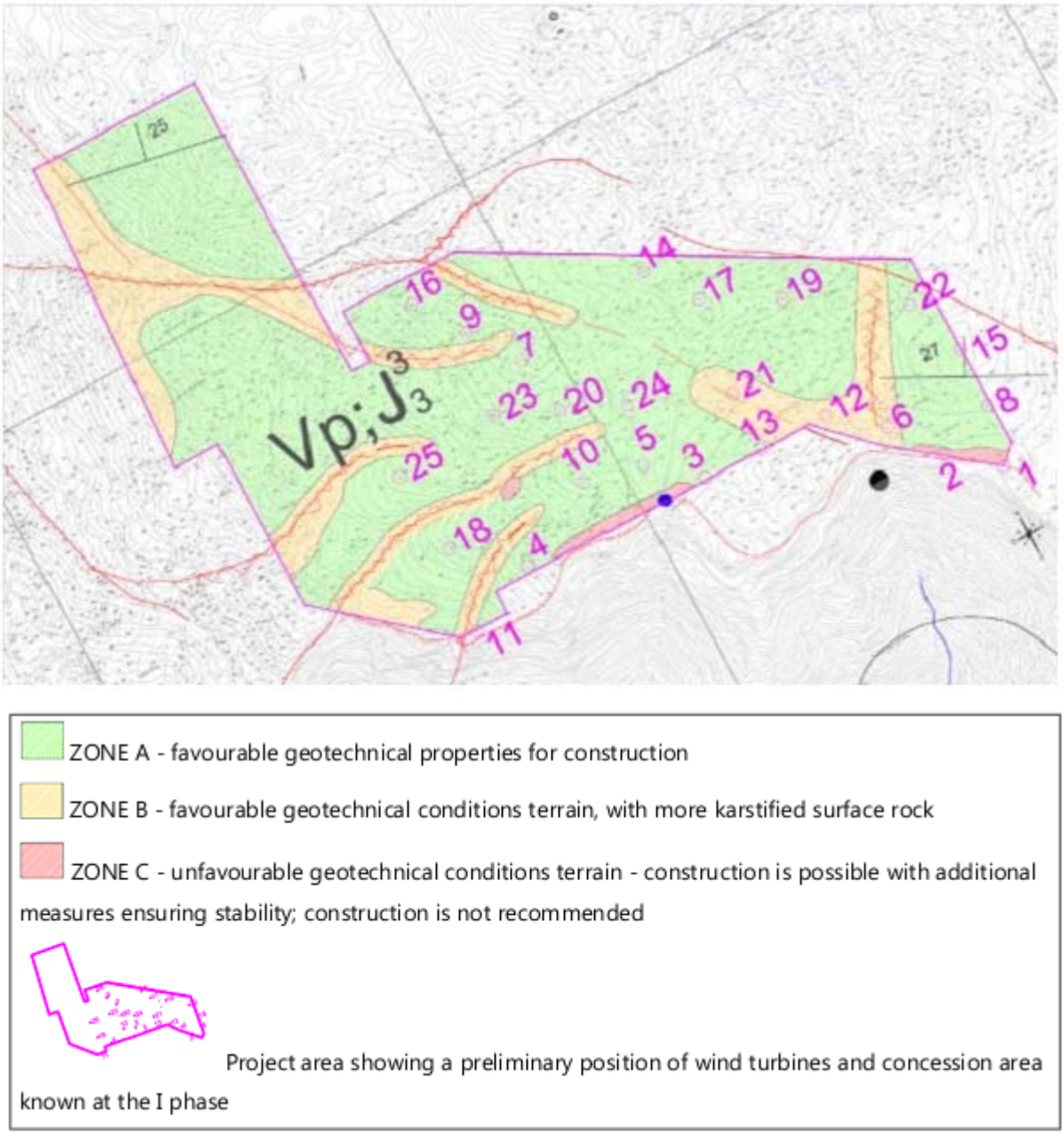


*Figure 13: Suitability for construction map – Vlašić project site (with an outline of the concession area known at the I phase (magenta))*

Within the II phase investigations, geomechanical and geophysical-seismic investigation works were carried out. Geomechanical investigation works - consisted of field investigations works and laboratory testing. A seismological study was made in which maximum intensity of earthquake and maximum acceleration at the level of bedrock were calculated.

The results of geotechnical investigation works indicate that the concession area is located in the terrain built of carbonate rocks of Upper Jurassic age. These deposits are represented by limestones and dolomites. Most of the terrain is built of limestone (≈90%), and only a small part

in the south-western and south-eastern part of the concession area is built of dolomite (≈10%). Most of the route of the access road lies on a terrain made of dolomite. The rock mass is tectonically disturbed and cracked and weathered to the depth greater than 10 m.

A Quartanery cover - delluvium has developed on the surface, with a variable thickness (from 1 to 9.5 m).

### *4.2.3 Hydrogeological characteristics of the area*

Vlašić mountain area mainly limestone and to a lesser extent of dolomite of Triassic, Jurassic and Cretaceous age. Limestone rocks are very karstified, chapped, and tectonically fractured. The existence of such separate limestone deposits results in the formation of separate accumulation of groundwater. With tectonic and denudation - erosion processes, carbonate deposits are separated from the rest of the field. Carbonate deposits form the peaks of the mountain, and at the footare Triassic and Paleozoic clastics. Triassic impermeable clastics completely surround a limestone aquifer which is placed in the sediments of high transmissivity.

The foot of karstified Mesozoic consists of the Paleozoic rocks, and the springs occur at the lowest points of contact of these two complexes. Impermeable layers act as hydrogeological watersheds between the basins of Vrbas and Bosna rivers. In the area of Vlašić plateau in the area of Ponikve there is a zonal watershed, as determined by rerouting the abyss in different pluviometric conditions. It is estimated that most of the water (about 70%) from Vlašić flows towards the Vrbas river, while only 30% towards the Bosna river. Limestone rocks are very well karstified and represent a very good permeable area of karst-fissure porosity. Fissure and cavernous permeability are equally represented where cavernosity is more important aspect of permeability. Jurassic limestones and dolomites represent the primary collector environment within which was formed the accumulation of groundwater Vlašić. Limestone massif of Vlašić represents a separate hydrogeological unit with a unique accumulation of groundwater.Capacity of the source "Plava voda" is Q=1.2 $m^3$/s, the source captured for water supply of Travnik "Bašbunar" 100 l/s, and "Šantići" source 15 l/s. According to the chemical composition, the water belongs to hydrocarbonate type, of calcium class with a total mineralization of 300 mg/l (J.Josipović 1974.).[11] The formation of source zone Plava voda[8] is predisposed with a tectonic or hypsometric relationship between the Permian-Triassic clastics and metamorphites with Triassic and Jurassic carbonates. Recharge of the source area is carried out along the tectonically defined fracture zone, stretching in the direction north - south. Periodical springhead Hendek represents the single

[11] *Technical assistance for Wind Farm Vlašić, Travnik-BiH; The program of geotechnical investigations and testing in the project area;*

source zone with Plava voda, while the springhead Bašbunar hypsometrically is significantly higher than the source area of the Plava voda, but in fact represent a unique confluence, which highlights the greater sensitivity of the space allocated for the construction of the wind farm on Mount Vlašić, given the potential problems of land and drinking water pollution. The area of the hydrogeological basin of the source area Plava voda is approximately 80 km$^2$. The boundaries of the basin of Plava voda spring are shown in *Figure 14*.

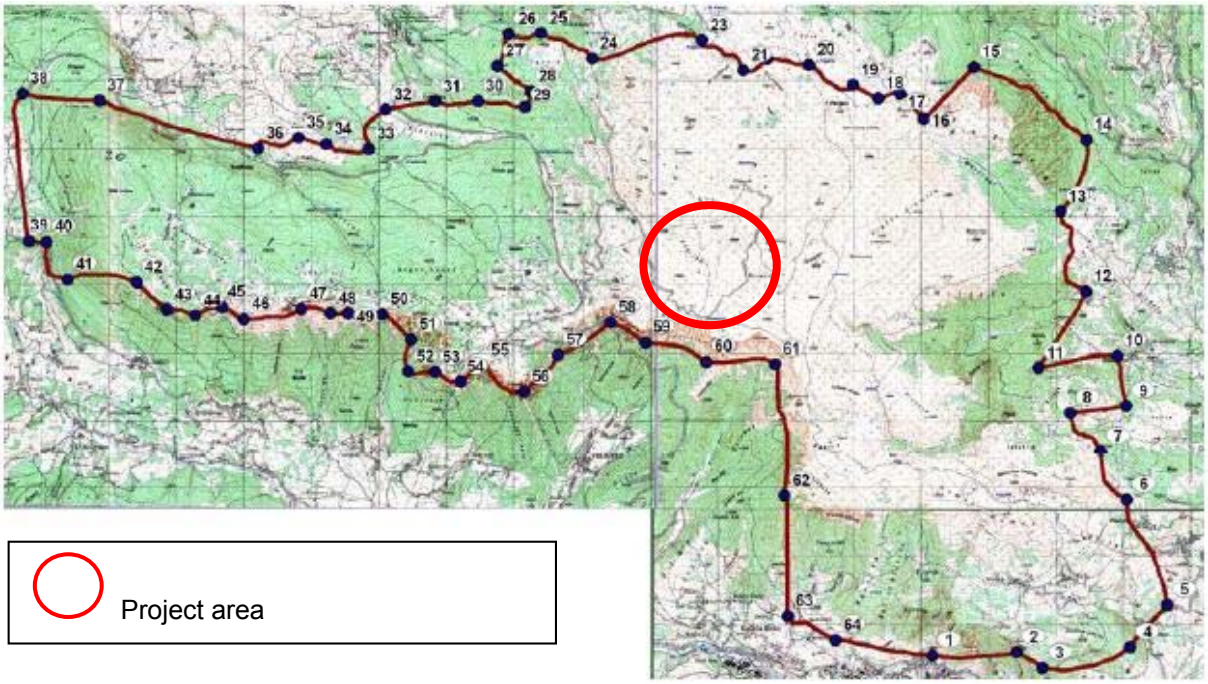


*Figure 14: The boundaries of spatial model of Plava voda spring*[12]

Since the Plava voda spring has the status of springs of regional significance, Travnik municipality has adopted a Decision which determines the spring protection by establishment and maintenance of sanitary protection zones and protective measures, as determined in accordance with local requirements, on the basis of the investigations and the Expert Study on Protection of the Plava voda spring.

In order to protect the Plava voda spring, there are four zones of sanitary protection. The project area of Vlašić wind farm is located in the zone IV of sanitary protection of the spring with some preventive prohibitions and restrictions.

In the narrower project area of Vlašić wind farm there are no surface water flows, because the terrain consists of carbonate sediments of Triassic with high porosity, except in a narrower area,

[12] *Technical assistance for Wind Farm Vlašić, Travnik-BiH; The program of geotechnical investigations and testing in the project area;*

in the area of Devečani. In this area there are two small karst springs, Devečani (1,800 m a.s.l.) in the concession area, and Ormanj (1,900 m a.s.l.), close to the concession area of Wind Farm Vlašić. These two springs do not dry up even during a severe drought. The spring Devečani is used to supply the mountain hut Devečani, nearby houses and TV tower on Mount Vlašić. It is estimated that the yield of these springs is: Q = 0,05 – 0,15 l/s.

*Groundwater sensitivity* [13]

Sensitivity is the degree of vulnerability of groundwater to potential impacts (hazards) that may cause degradation. Greater vulnerability means greater sensitivity. In the area of the Plava voda basin, cracking of rock mass, or low protection level of the zone of aeration most affects the high level of vulnerability.

The degree of vulnerability directly depends on the degree of karstification and permeability of surface coverage, as is the case with the area of the Plava voda basin. Given the hydrogeological characteristics of the terrain, the highest level of vulnerability has a zone immediately upstream from the spring, as well as the area of Grabova glavica with a very prominent fault tectonics, i.e. the area of I and II protection zone. The project area of Vlašić wind farm belongs to a zone of very high groundwater vulnerability.

The degree of groundwater vulnerability is shown in *Figure 15*.

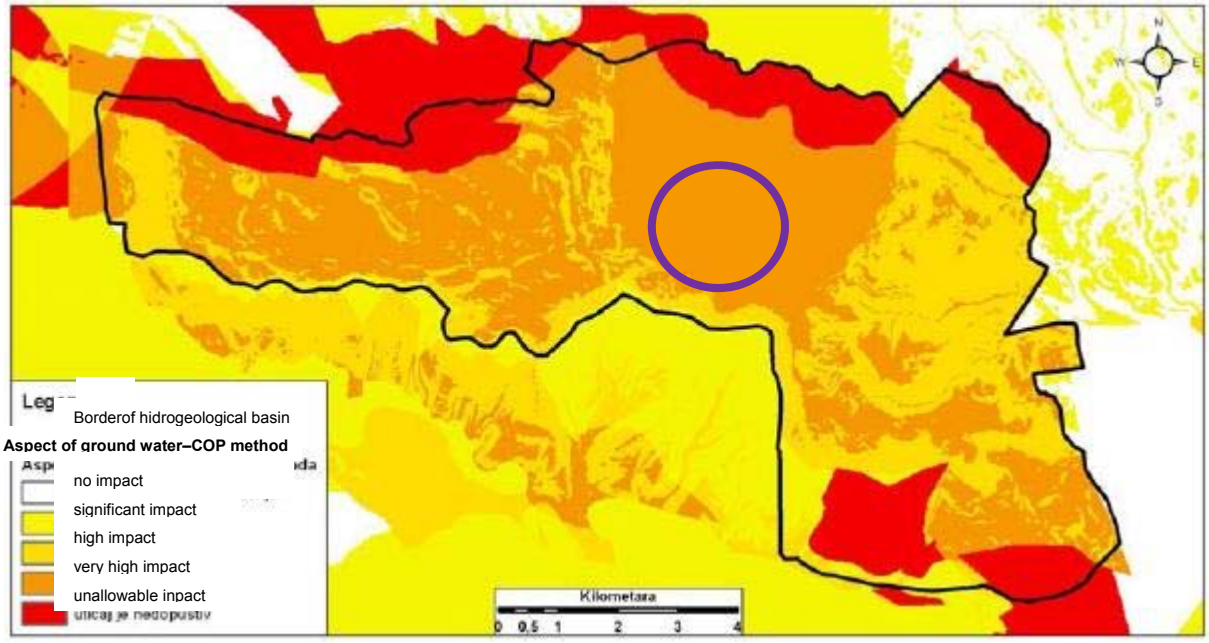


*Figure 15: Sensitivity (vulnerability) of groundwater of the Plava voda basin[14], project site location marked with circle*

[13] *Study on Plava voda water source protection, SENDO Ltd., Sarajevo, December, 2013.;*

[14] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

## 4.3 Seismic Characteristics

The area of Travnik municipality is located between two very characteristic faults (dijoklare) namely, Valjevački, which is defined in the Vrbas river valley, and Busovački, which is defined in the Lašva River valley, from Busovača to Banja Ilidža. Including the lithological composition of the field in the analysis, this area is located in a zone with a measured maximum degree of seismic intensity of $7^0$ MCS (Mercalli – Canvani - Sieberg) scale. It is necessary to do micro seismic zoning of the project site, and to define locations of constraints on the basis of thorough research.

In *the Spatial Plan of Travnik municipality 2003-2020*, on "Geological and seismic map", the subject area is marked "Stable seismic ground".

Engineering and seismological exploration have been carried out in order to determine parameters such as the maximum expected acceleration of the soil and the intensity of the earthquake on the location of any future wind farm at the proposed site. These parameters are necessary for calculation of impact of seismic forces on the objects in the area of investigation. In order to analyse the seismicity in the area of the future WF Vlašić, the earthquake catalogue by "*Federalni meteorološki Zavod - Centar za seizmologiju*" is used. Earthquakes within a radius of 50 km around the study area of research were used.

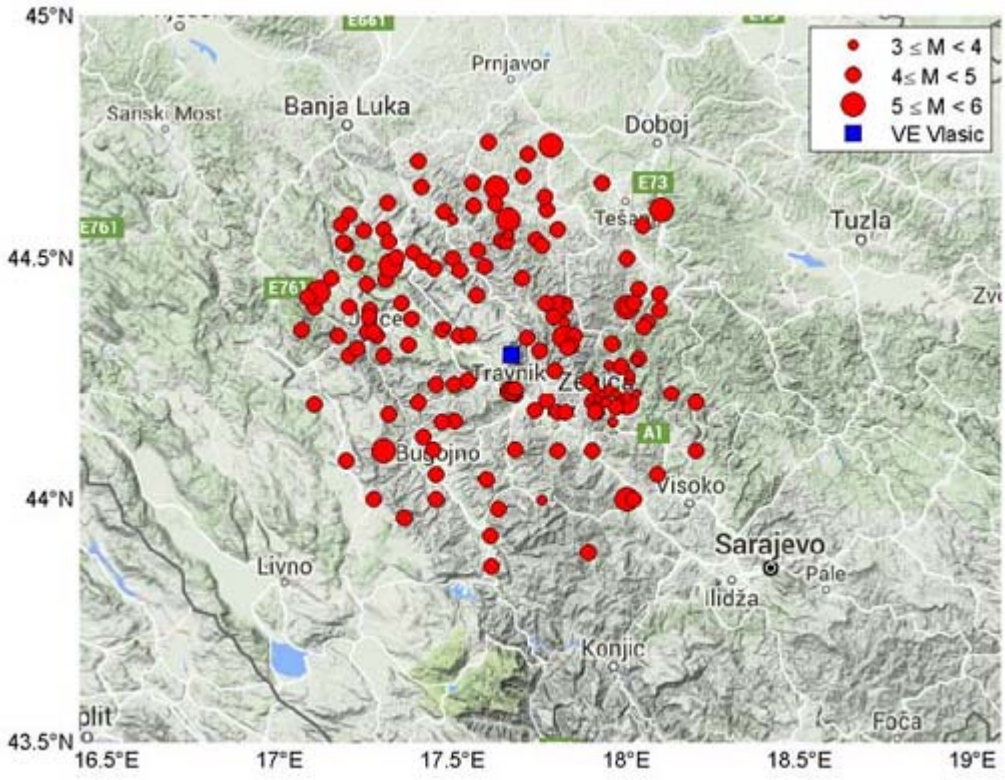


*Figure 16: Spatial distribution of earthquakes within a radius of 50 km around the area of WP Vlašić*

The epicentre areas were analysed and seismic sources defined in the area around the research site. Maximum expected earthquake magnitudes were estimated in accordance with the earthquake catalogue. Peak ground acceleration (PGA) and intensity on the site are calculated using expected magnitude 5.3, focal depth 10 km and epicentre distance 8 km. Maximum intensity of earthquake $I_{max}$ (°MKS) is 7.2°MKS, maximum acceleration on bedrock $A_{max}$ (g) is 0.12 and seismicity coefficient Ks is 0.029. The closest epicentre to the proposed project site is Banja Luka city cca 65 km away.

## 4.4 Hydrological Characteristics

The area of Travnik municipality, is one of the drier areas of Bosnia and Herzegovina with an average rainfall of 880 mm. Given present uniformity of rainfall and favorable geological, geomorphological and botanical composition, the hydrographic network of the area is quite well distributed. The waters of this area belong to the Black Sea River Basin, have nival-fluvial regime of transitional Central European type, which is characterized by the highest monthly water levels and flow rates in April and then in May and June, and the lowest in August or September.

A large number of wells and springs occur in the hilly and mountainous area, in contact with the impermeable rock layers, forming a dense river network. Rivers of the region are fed by precipitation waters, the source of which starts in the high mountains, initially as a thick snow cover. Snow melt reaches the rivers mostly in May, when a secondary rainfall maximum occurs. The river flows in May are therefore very high, compared to the rate of flow in the other months (2-3 times higher than the mean annual flow).

Formation of snow cover affects the decline of water level in mid-winter, hence the appearance of the secondary minimum in January. However, the first minimum, which occurs in late summer and early autumn, is caused primarily by large evaporation and the fact that the first minimum of precipitation occurs also at that time, in August or September. The second maximum of water levels and flows that occurs in November, when is the first rainfall maximum, is slightly higher than the mean annual level or flow.

The hydrological backbone of this area is the river Lašva. Lašva is the western tributary of the Bosna River. The Lašva River is formed by two "Lašvice", of Karaulska and Komarska that are connected in Turbe. Their sources are at Radalj mountain and Komar mountain, at 1,180 m a.s.l. Its source, the bulk of the flow and the basin are located in the area of Travnik municipality, and the estuary into the Bosna river and smaller part of the lower course, with its basin, are outside that area. The catchment area for the river Lasva is 949.70 $km^2$.

In the area of Devečani, close to the concession area of WF Vlašić there are two small karst springheads Devečani and Ormanj. In the narrower project area of vlašić wind farm there are no surface water flows.

## 4.5 Climatic Characteristics[15]

The climate of Travnik municipality is of basic moderate-continental character, but in the area can also be defined by several climate types or zones. Based on the analysis of basic elements (temperature, precipitation, winds and insolation), the typical types are as follows:

*Valley climate*, in river valleys and other depressions;
*Sub-mountain climate*, in the foot of mountains Vlašić, Vilenica and Radalj;
*Mountain climate, on mountains Vlašić* and Vilenica.

*Rainfall*

The average annual rainfall is relatively low and is about 880 mm which is quite evenly distributed during the year, with relatively small fluctuations, as well as a relatively large number of precipitation days, which during the year amounts to between 90 to 150 days. Maximum rainfall is in the spring (May-June), and the minimum in February-March. In addition to the main maximum in the spring, there is a secondary maximum in the fall (October-November). The area has a continental pluviometric regime, but modified by maritime influence.

Of the total number of days with precipitation, on average 19 days are with snow, namely at lower altitudes. As the altitude increases, the number of days with snow also increases (e.g. Komar 35 days and Imljani 64 days). In the lower parts, on average, snow cover lasts 40-60 days, while in the mountain belt, it lasts up to 90 days. The average height of snow cover is 30-40 cm.

The average annual rainfall on the Vlašić plateau is between 1,100 and 1,300 mm, and the largest amount falls in late autumn[16]. In November the average monthly rainfall is about 94 l/m$^2$, and the minimum average monthly precipitation occurs in February, about 67 l/m$^2$. Within this type of climate there is a secondary maximum rainfall in the spring months ofMay and June. Snowfalls are heavy, particularly at higher elevations, so the total number of days with precipitation of either snow or rain, depending on the height of the area ranges from 35 to 60 days. The average height of snow cover is 40 to 60 cm, and its average duration is over 90 days at elevations higher than 1,600 m meters above sea level.

*Fog*

There is no relevant data on fog for this area.

*Thunderstorm*

There is no relevant data thunderstorm data for this area.

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[15] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

[16] *Area Vlasic" - Zoning Plan; Spatial plan of areas with specific characteristics; Annex to Spatial Plan of Travnik Municipality 2003-2020;*

*Relative Air Humidity*

The annual mean relative air humidity in Travnik[17] is quite high and amounts to 78%. The annual range of relative humidity shows that it is lowest in the spring (74.6%) and summer (74.4%), but very high in the autumn (81.3) and winter (82%).

*Surface water Evaporation*

There is no relevant data on evaporation from water surface in this area.

*Temperatures*

The area of Travnik municipality is under the influence of a moderate continental climate. Summers are hot and winters are cold, resulting in large annual fluctuations in temperature. The warmest month is July, with average values between 19-20$^0$C. The mean temperature in January is about -2.5$^0$C. Annual fluctuations in temperature are very big and range between 20-23$^0$C and significantly higher than the fluctuations in the mountain area, which is characteristic of continental climate.

Mean annual air temperatures are relatively high and amount to 10.2-11.4$^0$C with clearly distinguished seasons. Duration of the period without frost in this area, on average is about 190 days, which means that the occurrence of frost during the year is possible for almost six months. It is generally between May to September that frost does not occur.

Mean minimum air temperature values have negative values in January, February and December, but the lowest temperatures are experienced in January and are between -3 and -5$^0$C. The mean maximum temperatures occur in July and August (between 27 and 30$^0$C).

Vlašić plateau[18] is under the influence of the mountainous (Alpine) climate. The main characteristic of this climate is a harsh winter, with temperatures that fall as a rule in the range of -24 to -34$^0$C. The maximum monthly temperature is in July, but ranges from 14.8 to 18.7$^0$C. The month with the lowest temperatures is January with averages in the range of -3.5 to -6.8$^0$C.

*Insolation and cloud cover*

Annual distribution of cloud cover indicates that the cloudier part of the year is winter, while in the summer cover is below 50%, which explains the high level of sunshine in this area with an annual average amounting to 1 600 - 1 700 sunshine hours. In the annual cycle, the sun is highest in July and on average, for this area, is 8.9 hours per day, and the least in December, when the average daily number of sunshine hours is 1.5 hours.

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[17] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

[18] *"Area Vlasic" - Zoning Plan; Spatial plan of areas with specific characteristics; Annex to Spatial Plan of Travnik Municipality 2003-2020;*

*Winds*

In terms of windiness, very significant differences are between the lower and upper regions of Travnik area with much windier conditions in the mountainous region (only 7.4% of silence/no wind in Imljani). While in Travnik the most frequent winds are westerly and easterly winds depending on the position of the Lašva valley, Imljani is heavily dominated by northerly and southerly winds, which are experienced 56% of the time. This means that the influence of the general atmospheric circulation is much more important than the topography of the ground. In the study area (tubular mast Vlašić III-Devečani), for the considered time period of one year, average wind speed was measured as 5.7 m/s at 63.4 m height above ground and SSW as the dominant wind direction.

The wind condition assessment for the Vlašić Wind Farm[19] is built on the available measurements from two on-site met-masts. The estimated long-term average Weibull distribution and mean wind speeds are at 63.41 m AGL at the location of the Vlašić III onsite met-mast:

| | |
|---|---|
| Mean Weibull A: | 7.39 m/s |
| Mean Weibull k-parameter: | 1.815 |
| Mean wind speed (Weibull): | 6.57 m/s |
| Average wind speed (arithmetic): | 6.55 m/s |

The resulting wind resource map at 100 m AGL is shown in *Figure 17*, which also shows the site boundaries and resulting developable area after applying the different site constraints identified in *Section 6.1*.

[19] *Technical Assisstance for Wind Farm Vlašić, Travnik – BiH, Draft Final Report, Feasibility Study*

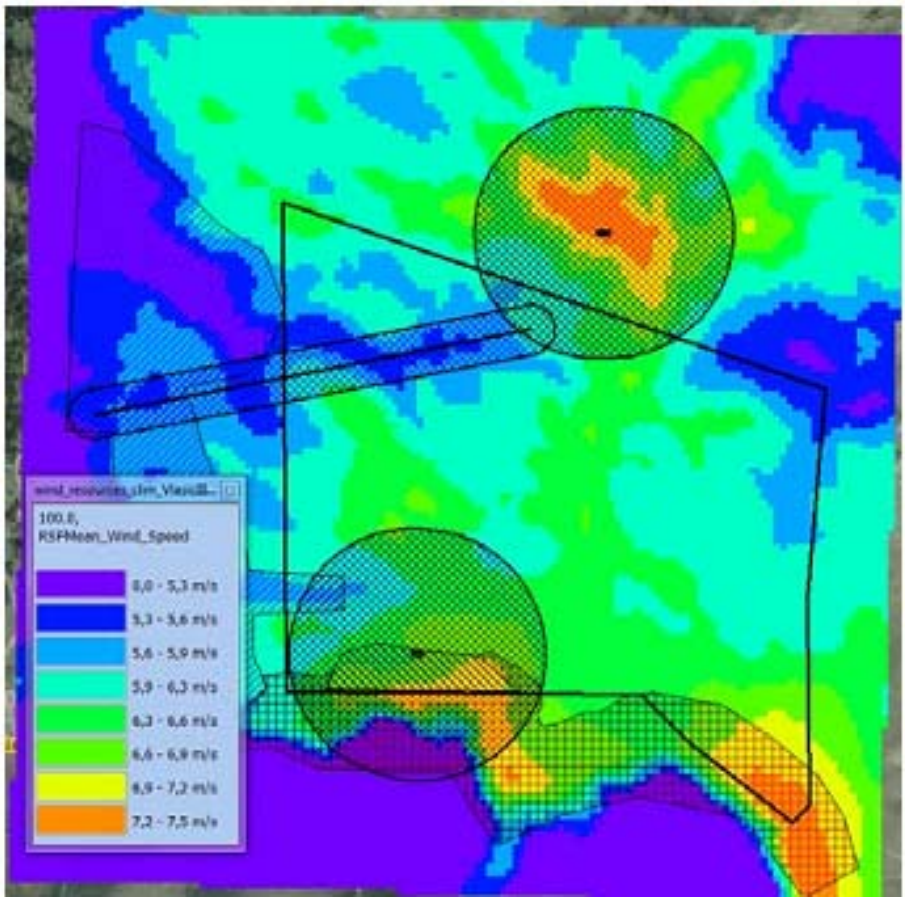


*Figure 17: Site concession area (thick lines), restriction areas (hatched) and wind resource map at 100 m AGL*

*Air quality*

There is no relevant data on air quality of the region.

## 4.6 Landuse and soil

### *4.6.1 Land use and land value*

The Municipality of Travnik has significant land resources. The largest area is a lowland, flat area in the Lašva river valley which is suitable for crop and vegetable production. The second largest zone is slightly elevated forming a gently inclined hilly relief that is extremely favorable for the development of fruit and vegetable production. This is a transition zone between the alluvial lowlands and mountainous pastures. The third zone is situated at a higher altitude and is suitable for growing crops and seed potato. Other resources include pastures and meadows on Vlašić mountain which are very suitable for the development of sheep farming.

Of the total area of Travnik municipality which amounts to 52,900 ha, agricultural land accounts for 22,774 ha (43.1%) and forest land for 28,364 ha (53.6%). In the structure of agricultural land, arable

land and gardens and meadows are almost equally represented with approximately 15%. Pasture areas are significant and cover 5,396 ha or 10.2% of the total area (*Table 5*).

| Crop | Area in ha | % |
|---|---|---|
| **Arable land and gardens** | 8,348 | 15.8 |
| **Orchards** | 1,007 | 1.9 |
| **Meadows** | 8,023 | 15.2 |
| **Pastures** | 5,396 | 10.2 |
| **Forests** | 28,364 | 53.6 |
| **Barren land** | 1,762 | 3.3 |
| **Total area** | 52,900 | 100 |

*Table 5: Land use in Travnik municipality*

Despite the huge potential, land and other resources are not fully utilized. Statistical data (2013.) in *Table 6*. indicate that out of the total arable land area only 1,364 ha is cultivated or 7,056 ha or 83.7% is not cultivated.

| Arable land and gardens | Zasijana površina | | | | | Other on arable land | Fallows | uncultivated arable land and gardens |
|---|---|---|---|---|---|---|---|---|
| | Total | Cereals | Industrial crops | Vegetable crops | Forage crops | | | |
| **8.426** | 1.364 | 582 | 2 | 405 | 375 | 6 | - | 7.056 |

*Table 6: Arable land by method of use (2014.); Source: SG/LJ FBiH 14- p. 439*

Conventional, mixed production systems are prevailing in practice. Numbers of livestock, according to estimated statistical data (2010.), in the area of Travnik municipality are as follows: 5 500 cattle, 35 000 sheep, 1 600 pigs, 500 horses, 40 000 poultry, 300 goats, 360 rabbits and 4 000 beehives.

Agricultural production in the mountainous area is very extensive. These are mainly forest lands of VI-VII category of use value with meadows and pastures on the slopes and plateaus. Agricultural crops grown on small, isolated areas include potato, rye, oats, barley and the like. Temporary livestock settlements (katuns) are typical of the area of Vlašić mountain. These are summer dwellings for people and animals built in a combination of stone and wood.

Land cover/land use for the project area as well as for the direction of the transmission line are shown in *Figure 18*. The data presented, which is sourced from CORINE 2012 at 1:100,000 scale, indicate that the proposed WF Vlasic is located on natural grasslands. The transmission line, in addition to natural grasslands, extends over the following categories: areas with sparse vegetation, pastures, groups of arable plots and agricultural areas with a significant share of plant cover.

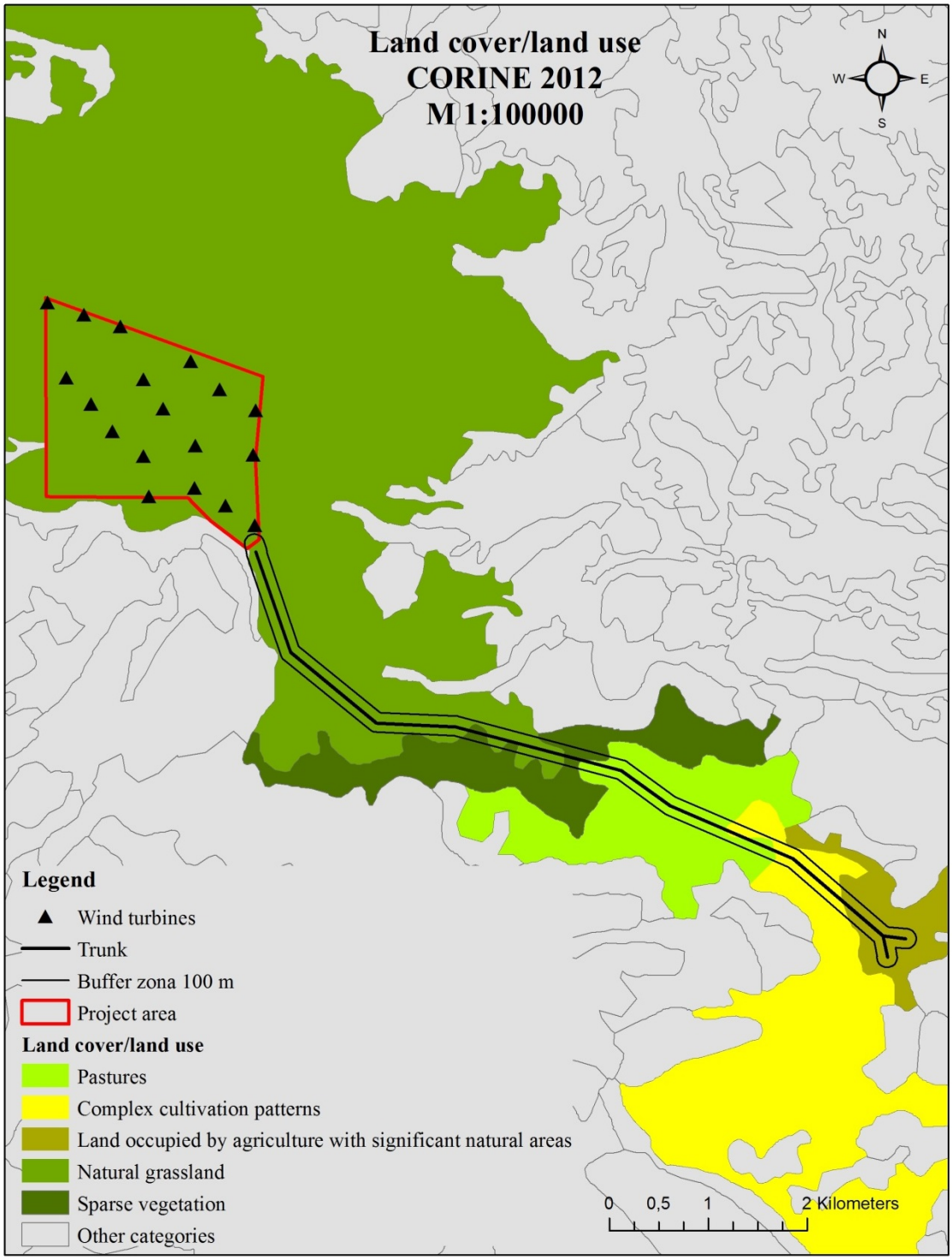


*Figure 18: Land cover/land use*

Site photgraphs from 2012 of the WF Vlasic site were additionally analyzed in order to verify or possibly establish more detailed landuse categories. The analysis showed that the study area, in addition to mountain pastures (or natural grasslands) encompasses cultivated land of about 2 hectares.

*Figure 19: Pastures in the project zone*

Forest land covers an area of 28,364 hectares. Up to the altitude of about 1,700 m above sea level, depending on the exposure, Vlašić is mainly covered by coniferous forests with spruce (*Picea excelesa*) as predominant species. Among other forest species there are beech (*Fagus silvatica*), maple *(Acer sp.)*, ash *(Fraxinus sp.)*, oak *(Quercus sp.)*, hornbeam *(Carpinus sp.)*, etc. Low vegetation, hazel (*Carylus avelana*), wild rose (*Rosa pendulina*), blackberry (*Rubus hirsutum and Rubus hipoglossu*m), wild grapes (*Ribes alpinum*), heaths (*Calluna vulgaris*), blueberries (*Vaccinium myrtilus*), goat willow (Salixcaprea) etc., are found in the transition zone between forest and pastures. These shrubs appear in lower positions of the mountain but they also go up to the high altitude pastures and meadows.

Pasture vegetation occurs in parallel with the forest one, already at an altitude of 1,000 meters, and gets increasingly prominent with altitude, and from 1,500 m above sea level it becomes predominant in the landscape.

There is no forest vegetation within the WF Vlasic site.

Agriculture, forestry and water management are the biggest users of land. Categorization of land use value showed that the area of Travnik municipality has very limited areas suitable for intensive arable production.

First, the best category, does not exist at all, while the surfaces of second and third category is very limited. The reason for this, among other things, lies in the great diversity of relief, which the existence of flat or slightly inclined surfaces are reduced to a very limited extent.

The fourth category (IVb), a category which, according to the possibilities of agricultural land use, makes the transition from arable towards meadow management methods, is the most common. However, this IVb category, due to the inclination of the field, is also limited in terms of growing arable crops. Depending on the inclination, the application of machine processing on it is partly limited.

The most recent study on "*Land Use Value*" indicates that in the total area of Travnik municipality, agricultural land accounts for 42.5%, forest land accounts for 52.5%; about 5% of the area of Travnik municipality is barren. There are no data specific to the Concession area within public documentation.

Lands within this area are mainly lands of VI-VII category of use value. The analysis as result of the site survey showed that Conncesion area includes natural grassland i.e. pastures and meadows (*Figure 18 and 19*), which are very suitable for the development of sheep farming.

Game and Hunting

The hunting ground boundaries match up with the boundaries of the Travnik Municipality. However, several neighboring municipalities share the hunting ground in the area of Vlašić. One hunting club „Vlašić" operates in the area of Travnik Municipality. The hunting ground is considered one of the richest, because it has rich variety of wildlife species. However, detailed information on the number and condition of animal populations of registered game species is not possible to be specified from the documentation required for each hunting area, such as the *Hunting Management Basis*. Given that for this hunting ground the same has not yet been innovated and has long been considered obsolete, all data from this field has been taken from the available documents, information obtained from contacts with members of the local hunting association, but also in cooperation with JP BH Šume, which supplied a map of "*Forest land and hunting areas*", indicating species registered of wildlife.

We note that the discrepancies in the information provided in this chapter are possible, and it is not possible to give an assessment on the state of populations of different game species.

Among the game in this hunting ground, and in terms of the Law on hunting *(„Official Gazette of F BiH", no. 4/06, 8/10, 81/14*), there are the following species of game[20]:

***Mammals***

***Rodents (Rodentia)****:* the European hare (*Lepus europeus Pallas), the Euroasian red squirrel (Sciurus vulgaris Linnaeus, 1758.);*

***Carnivores (Carnovora)****:* the Brown bear (*Ursus arctos Linnaeus, 1758.*), the Gray wolf (*Canis lupus Linnaeus, 1758.*), the European red fox (*Vulpes* vulpes *Linnaeus, 1758.*), the Euroasian lynx (*Lynx lynx Linnaeus,1758.*), and the European badger (*Meles meles*.);

***Ungulates (Arctidactylia): t***he European roe deer (*Capreolus capreolus Linnaeus, 1758.*) and the Wild boar (*Sus scrofa Linnaeus, 1758.*);

[20] *Game in the sense of Article 13 of the Law on Amendments to the Law on hunting („Official Gazette of F BiH", no. 81/14). In terms of this law, the game represents animal species, which live free in nature;*

***Birds***[21][22]

***Storks (Corvidae)****:* the Black stork (*Ciconia nigra Linnaeus, 1758.)*;

***Hawks (Accipitridae)****:* Western Marsh Harrier (*Circus aeruginosus Linnaeus, 1758.),* Montagu's harrier *(Circus pygargus Linnaeus, 1758.),* Common Buzzard *(Buteo buteo Linnaeus, 1758.),* Golden Eagle (*Aquila chrysaetos Linnaeus, 1758.),* Fish Eagle *(Pandion heliaetus Linnaeus, 1758.),* Eurasian Kestrel *(Falco tinnunculus Linnaeus, 1758.),* Red-footed Falcon *(Falco vespertinus Linnaeus, 1758.),* Eurasian Hobby *(Falco subbuteo Linnaeus, 1758.),* Rock Partridge *(Alectoris graeca Linnaeus, 1758.);*

***Cranes (Gruidae)****:* Common crane (*Grus grus Linnaeus, 1758.);*

***Pigeons (Columbidae)****:* Rock Pigeon *(Columba livia Linnaeus, 1758.),* Common Wood Pigeon *(Columba palimbus Linnaeus, 1758.);*

***Owls (Strigidae)****:* Tawny Owl *(Strix aluco Linnaeus, 1758.),* Little Owl *(Athene noctua Linnaeus, 1758.);*

***Crows (Corvidae)****:* Eurasian Jay (*Garrulus glandarius Linnaeus, 1758.),* Eurasian Magpie (*Pica pica Linnaeus, 1758.),* Spotted Nutcracker (*Nucifraga caryocatactes Linnaeus, 1758.),* Hooded Crow (*Corvus cornix Linnaeus, 1758.),* Common Raven (*Corvus corax Linnaeus, 1758.).*

As can be seen from the above data, in the hunting area, which is in the concession area of the Vlašić wind farm, birds exist mainly, while considering mammals we meet wolf, fox and hare. Other species of wildlife are typical for the hunting areas covered with forest vegetation, such as bear, deer, wild boar, and others.

Among hunting and commercial buildings in the area of hunting grounds, the following facilities are registered: one hunting-breeding facility located north-west of Paljenik, and two hunting-tourist facilities, one of which is located north-west and the other north-east of Paljenik. Neither facility mentioned above is in the concession area.

### *4.6.2 Soil characteristics*

The Soil Map of BiH at M 1:50,000 scale shows that the proposed location for wind power plants represents an association of Calcocambisol, Calcomelanosol and Rendzina. The transmission line extends over the following types/associations: Lithosol, Calcocambisol + Calcomelanosol, Calcocambisol + Calcomelanosol + Rendzina and Calcomelanosol + Calcocambisol.

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[21] *Among the species of game in terms of the Law on Hunting, was listed a number of species that are protected. However, Articles 15 and 16 of this Law explicitly state protected species, adjusting their status to the Red List;*

[22] *Listed bird species are taken from the Birds&Bats Baseline Conditions Monitoring – Twelve Month Report, M&M Consulting, 2016.and based on the hunting reports. Hunting reports are confirmed with Birds&Bats Baseline Conditions Monitoring – Twelve Month Report, M&M Consulting, 2016.;*

A more detailed analysis was made which indicates that the area of the proposed WF Vlasic is characterized by the following types/associations (*Figures 20 and 21*):

Lithosol+Calcomelanosol;

Calcocambisol+Rendzina;

Anthropogenic soil.

*Lithosol+Calcomelanosol association*

Lithosols are genetically young soils formed on loose substrates where the process of physical wear is much more pronounced than the process of chemical decomposition which is negligible. There is very little soil and it is distributed in the form of nests on loose substrate. The humus horizon is negligible as it is in the early stage of development. Products of mechanical disintegration are very often eroded away from the place of origin in the hills. On the flat terrains these soils are shallower (10 -20 cm), but on the slopes they are deeper and often in the form of rock creep. Floor cover is interrupted by emerging stones and/or rocks. Lithosol is therefore a bare rock or an area whose rockiness exceeds 90% with modest, mainly xerothermal vegetation. These are extremely dry habitats which are very heated and poor in accessible nutrients. They have no significance in either agriculture or forestry, but are important in the protection of nature in terms of connecting rock creeps and green landscape. The hooves of sheep or goats can „cut into" the soil and cause erosion.

*Figure 20: Association of Lithosol+Calcomelanosol*

*Figure 21: Lithosol*

Calcomelanosol is mainly formed on limestones and dolomites and is also known as the limestone-dolomite black soil. The depth of these soils ranges from several centimeters in the initial phase to 30 cm in the phase of full maturity which, of course, depends on the conditions

during formation. The humus horizon A, however, is usually 10-15 cm deep and occurs in the form of spots between the stones. It is very porous with a high water capacity thanks to the high content of humus. Soil reaction ranges from slightly acidic to alkaline, it is very humic and humus is distinctly black. Physical and chemical properties are favorable, but other limiting factors such as small depth, rockiness, stoniness and inclination make this soil less suitable for intensive cultivation of plants, hence it is mainly used for pastures. The sinkholes with colluvial deposits of limestone-dolomite black soil are very suitable for a successful cultivation of potato, especially seed potato. On the southern exposures they provide xerothermal habitats and in humid areas, at higher altitudes and on northern exposures they appear as mesophilic habitats which are relatively suitable for growing forests. At high altitudes and plateaus these are the areas of pasture with the presence of xerophytic and mesophytic grass vegetation. They fall into the VII category of use value of the land.[23]

*Figure 22: Calcomelanosols*

*Calcocambisol+Rendzina association*

Calcocambisol-brown soils and Rendzina alternate on small areas so they could not be separated. However, it can be stated that brown soils are predominant. Most of the complex is under mountain pastures while a smaller part is covered by forest vegetation. Very shallow brown and shallow soils of this complex are characterized by lighter mechanical composition and actual acidic reaction. As far as the physiologically active nutrients in this complex are concerned, phosphorus

23 *Identification of categories of land use value. Categories VI and VII mean lower land use value.*

is present in very small amounts while the level of physiologically active potassium ranges from low to medium. Soil reaction in the surface horizon ranges from slightly acidic to alkaline, the soil is quite humic in this horizon but the content of humus rapidly decreases with depth of soil. The soil is non-carbonate or slightly carbonate in the entire depth. According to its physical and chemical properties, this is a favorable soil but due to the surface rockiness and stoniness, small depth, high altitude and short vegetation period it is not suitable for intensive cultivation of plants. It is therefore mainly used for meadows and pastures (VI rating category), or is under the vegetation that has already adapted to the environmental conditions of the habitat.

Rendzina have developed mainly on limestones and dolomites, at - micro-locations protected from erosion and are therefore more covered by vegetation. Depending on the depth and productive capacity they can be classified in category VI of the use value. Otherwise, these are mostly forest soils, unless the trees are sensitive to carbonates. In our case, it is a high altitude exposed to high northern winds which enhance the xerothermal character of this soil which is usually shallow and skeletal on the permeable carbonate substrate. On the southern exposures they are shallower and eroded and deeper on the northern slopes. They can have a deep and developed humus horizon A, and is particularly favorable from the standpoint of the plant if the AC horizon is deepened, which is not the case here as we had a shallow horizon A. Genesis of Rendzina on limestones goes through Sirozem (Lithosols), while Rendzina in their development evolve into brown soils. These are soils with a typical A -C profile. A -horizon in most of them is characterized by dark grayish brown color, large content of humus of 10 -20%, and thus the increased content of nitrogen. The pH level varies depending on genetic stage from alkaline (which is the most common), neutral to slightly acidic actual reaction. Rendzina on limestone are well drained, moderately or poorly supplied with potassium and poorly supplied with phosphorus.

Unlike rendzina on limestone, rendzina on dolomite show alkaline actual reaction, poverty in physiologically active phosphorus and low to moderate supply of physiologically active potassium. Humus horizon is significantly richer in skelet and more permeable to water. These properties on the one hand and topographic position, altitude and climate on the other, cause the development of pasture grass vegetation where the soil is exposed to the water and wind erosions, as shown in *Figure 23 and 24*.

*Figure 23: Calcocambisol+Rendzina association*

*Figure 24: Calcocambisols*

*Figure 25: Rendzina*

*Anthropogenic soils*

Anthropogenic soils are found on very small areas and have been used or are still used for the production of vegetables, mainly potato, onion, cabbage and the like. These are usually soils of shallow coves and depressions which have been cultivated, very rich in organic matter and humus, and additionally fertilized with farm yard manure. These soils could be classified into the V rating category.[20]

[20] *Identification of categories of land use value. Category V means lower land use value.*

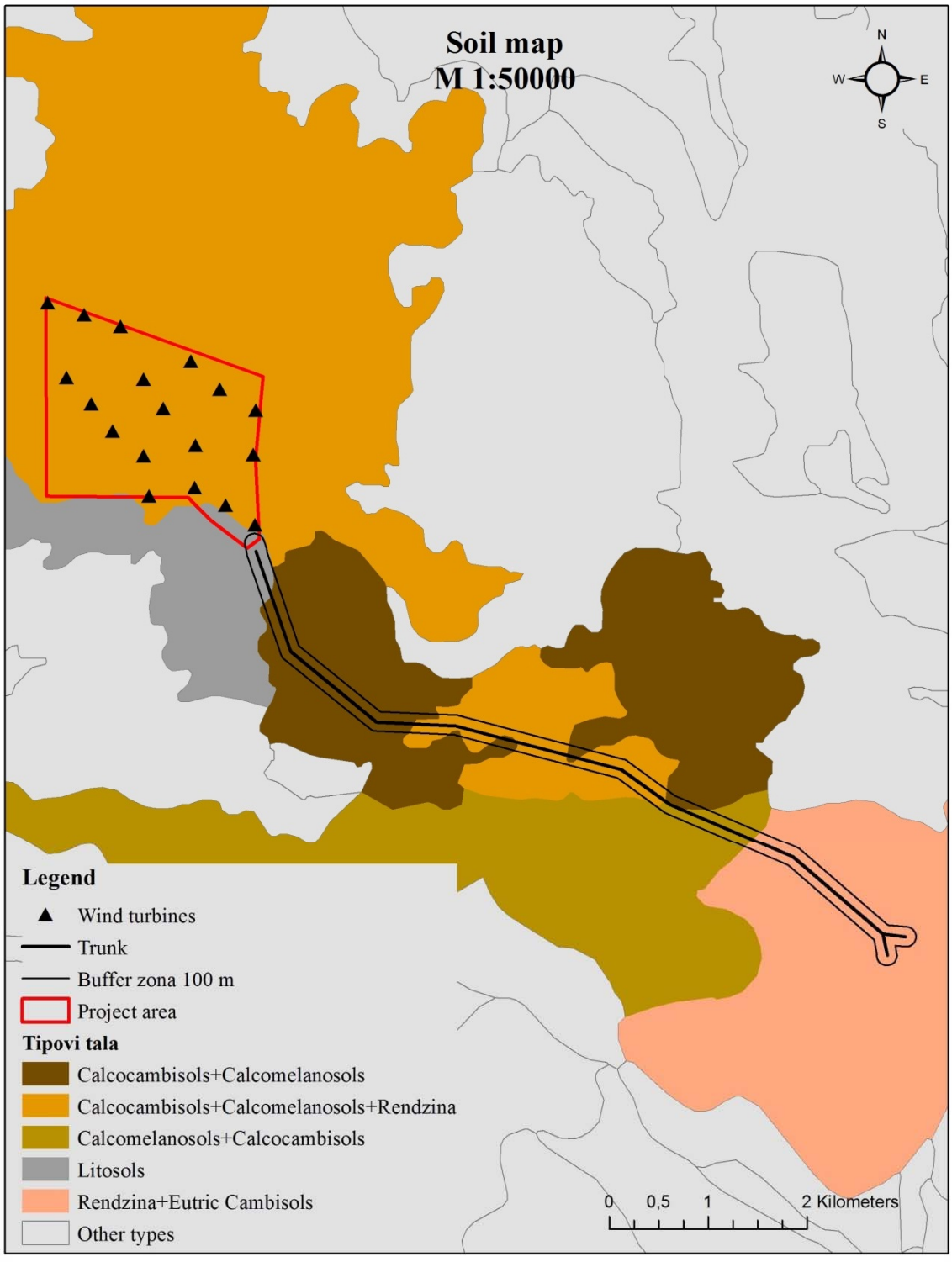


*Figure 26: Soil map*

### *4.6.3 Erosion*

Karst areas in BiH are among the most affected by the process of soil erosion. In some sub-Mediterranean areas this process has already reached the point of irreversibility. Due to climatic

conditions, the inner Dinaric karst is better covered by vegetation and less exposed to erosion. Such is the case with Vlašić. This study provides an assessment of susceptibility to erosion of major types of soil that have been previously described with respect to their general mechanical, physical and chemical properties, the coverage, length of the slope and inclination. In addition to the relief and climate, water and wind erosion depends on the intensity of the rain, wind strength, the texture of the soil, the amount of organic matter and the presence and type of vegetation on the surface. Soil erosion is defined as a process that leads to the destruction and removal, i.e. loss of soil caused by the action of water and wind. It is clear from this definition that the soil erosion is a natural process that has existed ever since the formation of land, hydrosphere and atmosphere. This process, which took place during the geological history and is taking place today, is referred to in literature as geological erosion. Such a natural process was not a problem since the amount of erosion was natural and replenished. Once the man started to practice agriculture and other activities, the amount of erosion has increased considerably due to the removal of natural vegetation cover. Erosion resulting from human activities is also called anthropogenic erosion, and due to the fact that the soil loss is much higher than can be replenished by pedogenetic processes, it is often referred to as accelerated erosion.

The current state of these areas is such that the land is mostly covered with grass vegetation. Soil erosion by water and wind involves three phases: i) the separation of the particles from the soil mass, ii) transport of erosion material, iii) and, deposition.

*Susceptibility to water erosion processes*

Lithosols are the most susceptible type of soil to erosion. These are shallow, skeletal and undeveloped soils. On slopes with an inclination higher than 15% soil losses by erosion are considerable. Most of the lithosols are found at higher elevations and on steeper slopes, therefore the exposure to erosion processes is bigger.

In this area, calcomelanosols occur on slopes which also exceed 15%, and are very common in a wider area and on slopes of 30-40%. On such slopes the amount of potential erosion ranges from moderate to high, especially on slopes of greater length.

Calcocambisols occur on slopes up to 30%, so erosion is somewhat less pronounced, but the loss of soil can still be very significant.

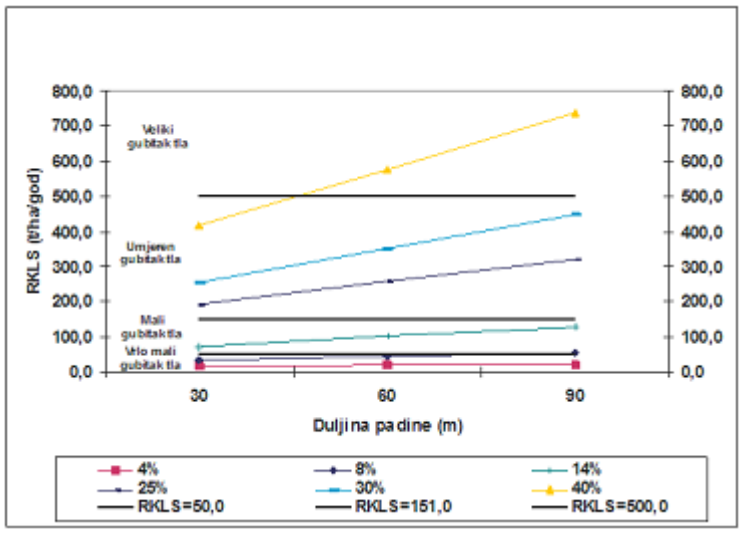


*Figure 27: Estimated potential erosion of the subject types of soil in the project area*

A large loss of soil by erosion in rendzina has potentially occurred on slopes exceeding 40% due to slightly lighter texture and porosity due to the presence of skelet. However, in the study area they occur on some milder forms of relief so that the level of erosion is medium.

All four types of soil in the study area are typical of karst, which means that they were formed on carbonate substrate (either compact or loose), shallow and skeletal. According to texture they are clayey loam. Their structure is granular and characterized by good permeability. The share of humus varies from low to high content.

According to the criteria for assessing soil erodibility (K factor), the analyzed soils of the project in terms of their physical and chemical properties, are of moderate erodibility and none of them is resistant to erosion, especially at steeper slope angles. The fact that the project area is of medium inclination, mostly <15% or 15-30%, represents a favorable circumstance.

After having looked into the subject soils of the project area under the same conditions in term of inclination and length of the slope, it can be concluded that:

on slopes of smaller inclination (1%, 4%), potential erosion in all the types of the soil is less than 50 t/ha/year, which means that the loss of soil by erosion is very small;

on slopes of up to 15% inclination, the amount of potential erosion is up to 150 t/ha/yr, which represents a small loss of soil by erosion;

slopes from 25% to 30% are characterized by moderate loss of soil (150 – 500 t/ha/yr) in all the observed soil types;

inclinations exceeding 30% are not present in the study area;

on slopes of the transmission line route of the inclination >40% (very small area) and lengths over 60 m, these four types of the soil show a huge loss by erosion >500 t/ha/year).

The inclination of the terrain in the direction of transmission line shows that it ranges up to 40%, with the exception of a very small area.

### *4.6.4 Risk of mines*[24]

According to the map, "Mine situation of Wind farm Vlašić", at a scale of 1:25.000 (August 2014), that was preparred by BH MAC Sarajevo, and the Notice no.DPA/04-36-13-1185-1/14 of 04.08.2014, by the Ministry of Civil Affairs, the Demining Commission in BiH, Centre for the removal of mines in BiH, the determined location of "Wind farm Vlašić" Travnik municipality is located outside the defined suspect area, and there is not expected to be a risk of mines, noting: ***Possible presence of unexploded ordnance (UXO) cannot be estimated, so it is advised for users to move cautiously on the location, and if they notice the UXO, they must not take any action but inform the expert team for UXO removal of Civil Protection.***

## 4.7 Flora

### *4.7.1 Methodology*

During field work and botanical research the principles of *Zürich-Montpellier school* have been used, which applies the methodology by *Braun-Blanquet*[25]*. Braun-Blanquet* (1964) is based on the principle of characteristic types. This approach reaffirms the primary ecological sense of community, by emphasizing the complex relations of habitats and organisms that inhabit it. To obtain information on the biological properties of certain species, the standard, generally accepted method of botany was used along with botanical *records*, which were made by *Braun-Blanquet*. These records include general information about abiotic ecosystem component (altitude, terrain exposure, geological surface, etc.).

The number and coverage of each type species was assessed according to the previously mentioned methodology *(Braun-Blanquet)*, and is expressed in numbers of *1-5,* and the mark *r* - if the species covers a minor area or is outside it's usual habitat range.

Field research was carried out on several occasions, the first being in December 2014, which included winter aspect, while the spring and summer aspects (of plant communities) were analyzed in the period of June and July. Given that this is the area that is under the pre-Alps and mountain meadows, surface area of recording ranged from 50-100 $m^2$.

Desk studies were also carried out in order to serve as a guideline, and mandatory identification of plant species was made on site. All species whose photos are included in the text, have been observed in the concession area, determined on the ground, and their photos taken by biologist.

Information from the EUNIS international databases has been used on the basis that FBiH legilstaion is becoming aligned with requirements of the EU.

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[24] *Spatial Plan of Travnik municipality for period 2003 – 2020;*

[25] *Phytocenology with an overview of forest phytocenoses of Yugoslavia, II expanded and revised edition; Prof.dr. Vitomir Stefanović; "Svjetlost", Sarajevo, in 1986.;*

"*Guidebook through habitat types in BiH*", 2015., lists all the registered habitats in BiH, whose codes correspond to those of the EUNIS classification and is the basis for selection of areas of the ecological network Natura 2000.

### *4.7.2 Ecosystems of mountain landscapes*

Ecosystems of mountain landscapes are characterized by high biological diversity of forms and types of habitats. They are typical for high mountains of Bosnian and Herzegovian Dinarides, and in the vertical profile cover pre-mountain and mountain belt, elevation of 1,600 m a.s.l. to the highest mountain peaks. In botanical terms, only the area of Travnik belongs to the *Euro Siberian-Boreo American Region and the Illyrian province*. However, the area of the highest Bosnian and Herzegovian mountains belongs to *High Dinaric Province*, which is broken down into three sectors, of which Vlašić, with Vranica, belongs to the *High Vranica Sector*.

Therefore the area of Mount Vlašićin botanically belongs to *Euro Siberian-Boreo American Region, High Dinaric Province and High Vranica sector*, which also includes the grassy vegetation of mountain meadows and vegetation of rocks and gullies in the belt of mountain pine scrub forests and subalpine forests (Horvatić, 1967).

The Vlašić Mountain enters the area of inner Dinarides in the central part of Bosnia and Herzegovina. The altitude of the highest peak Opaljenik/Paljenik[26], is 1,933 meters above sea level, while Devečani ( concession area) is located at 1,790 m a.s.l.

### *4.7.3 The structure of plant communities*

*Devečani plateau*

The area of interest is located on Devečani plateau, which has developed an ecosystem of mountain slopes on limestone. This type of vegetation occupies the space between 1,500-1,919 m above sea level, and mostly originated by degradation of ecosystems of subalpine beech forests on the southern exposures, subalpine spruce forests on northern exposures, pine scrub forests in all exposures.

Given the altitude of 1,790 m a.s.l., as well as the significat anthropogenic pressure, the mentioned area is not covered with forest vegetation, of the aforementioned types. At the extreme southern end of the concession area the vegetation is often found in rock crevices, developed in very inaccessible steep terrain. On the steep rocks, whose base consists of limestone, there are alluvial fan and rock communities of the order *Amphoricarpetalia*.

In addition to the ecosystem made up of vegetation in rock crevices, at the beginning of the concession area, on the southwestern, southeastern, southern and western slopes of Vlašić

[26] *Because of different literature citations regarding the names, which can be seen even on different maps, both names are used. Sometime the highest peak of Vlasic is given as Paljenik, and sometimes as Opaljenik;*

mountain, near Devečani plateau, there is a community of *Aurantiaco-Nardetum strictae Ht. 60*. The aforementioned community exists within the class *Caricetea curvalae Br.-Bl. 48*, which includes vegetation of mountain slopes on acid soils. It inhabits Poddevečani, Devečani and Vlašić plateau. The dominant species is the Matgrass *(Nardus stricta L.)*. In addition to these, there are other types: Vernal grass *(Anthoxantum alpinum L.)*, Red fescue *(Festuca rubra L.),* Stonecrop *(Sedum ohroleucum L.)*, Germander *(Teucrium montanum L.)*, Common cinquefoil *(Potentilla erecta L. Raeusch.),* Gold cinquefoil (*Potentilla aurea L.)*, Dwarf gentians*(Gentianella crispata Vis. J. Holud)*-(*Figure 28*) Thyme-leaved speedwell *(Veronica serpyllifolia L.)*, Balkans thyme *(Thymus balcanus L.)*, imperforate StJohn's-wort*(Hypercum maculatum Cranz.),* Heath speedwell *(Veronica officinalis L.),* Alpine bistort *(Polygonum viviparum L.)*, White clover *(Trifolium repens L.)*, Hoary plantain (*Plantago media L.),*Scabious *(Scabiosa leucophylla Bord.) – (Figure 29)*, and Horseshoe vetch *(Hypocrepis comosa L.)*.

*Figure 28: Dwarf gentians (Gentianella crispata Vis. J. H.), Photo by A.Cerić*

*Figure 29: Scabious (Scabiosa leucophylla Bord.), Photo by A.Cerić*

The abovementioned community is located in the zone of the Devečani plateau, and in the area of Devečani to Opaljenik and below Opaljenik/Paljenik, at an altitude of 1,700-1,900 m a.s.l. Exposure of the studied area includes the Southwestern, Southeastern and Eastern regions, on flat or slightly sloped terrain with the incline of the slope 1-5˚. Among the plant species recorded are: Tufted fescue *(Festuca amethystina L.)*, Violet *(Viola elegantula Schot.)*, Mountain buttercup *(Ranunculus montanus Willd.)*, Yellow lousewort *(Pedicularis brachydonata Schloss. et Vuk)*, White hellebore *(Veratrum album L)* etc.

In this area, there is also the vegetation of mountain slopes on limestone, vegetation class *Elynio-Seslerietea Br.-Bl. 48*. This community develops usually on southern exposures, on deeper and slightly acidic soils. Otherwise, this vegetation community is differentiated in the several associations. It is present in the area south and southeast of the mountain lodge "Devečani",

above the mountain lodge, as well as in the area below the water spring of the same name. This community is widespread mainly in the concession area, provided that it is differentiated in a number of different associations depending on the composition of plant communities. Among the species recorded are: Tufted fescue *(Festuca amethystina L.)*, Lady's mantle *(Alchmilla vulgaris L.)*, Violet *(Viola elegantula Schot.) – (Figure 32)*, and very numerous: Mountain buttercup *(Ranunculus montanus Willd.)*, Common kidneyvetch *(Anthyllis vulneraria L.) – (Figure 30)*, Alpine kidneyvetch *(Anthyllis vulneraria subsp. alpestris Kit. Asch. et Graebn) – (Figure 31)*, Rockfoils *(Saxifraga montana L.),* vulnerable or threatened Croatian carnation *(Dianthus croaticus D. giganteus D'Urv. subsp. croaticus Barbs. Tutin) – (Figure 34)*, Whorled lousewort *(Pedicularis verticillata L.) – (Figure 33)*, Thyme *(Thymus serpillyfolius L.),* White clover *(Trifolium repens L.)*, Red clover *(Trifolium pretensae L.)* and others.

*Figure 30: Common kidneyvetch (Anthyllis vulneraria L.), Photo by A.Cerić*

*Figure 31: Alpine kidneyvetch (Anthyllis vulneraria subsp. alpestris Kit. Asch.), Photo by A.Cerić*

*Figure 32: Violet (Viola elegantula Schot.), Photo by A.Cerić*

*Figure 33: Whorled lousewort (Pedicularis verticillata L.), Photo by A.Cerić*

*Figure 34: Croatian carnation (Dianthusgiganteus D'Urv. subsp. croaticusBarbs.T.), Photo by A.Cerić*

Above the mountain lodge in Devečani, to northern boundary of the concession area, there is vegetation of mountain slopes on carbonate base, associations *Seslerio - Gentianetum dinaricae - ass. nova (syn. Seslerietum juncifoliae bosniacum gentianetosum dinaricae)* the optimum of development growth is in the northern and northwestern exposures of Paklarske stijene and Devečani, at an altitude of 1,750-1,800 m a.s.l. Within this association as a dominant species are present: Reed *(Sesleria tenuifolia Schrad.)* and Dinaric Gentian *(Gentiana dinarica Beck.) – (Figure 35 and 36)*. There is also Alpine bistort *(Polygonum viviparum L.)*, Mountain buttercup *(Ranunculus montanus Willd.) – (Figure 35),* Sedges *(Carex cariophyllea L.)*, Milkwhite rock jasmine *(Androsacea lactea L.),* Violet *(Viola elegantula Schot .) – (Figure 32)*, Rockfoils *(Saxifraga montana L.)* and others.

*Figure 35: Dinaric Gentian (Gentiana dinarica Beck.) in central part and numerous Mountain buttercup (Ranunculus montanus Willd.), Photo by A.Cerić*

*Figure 36: Dinaric Gentian (Gentiana dinarica Beck.), Photo by A.Cerić*

Going further from Devečani to the eastern boundary of the concession area, already mentioned vegetation types alternate constantly. On the right side (south, south-east) of the gravel road there are also communities developed the community of *Seslerietalia comosae Horv 30*. Quite enough is present the violet (*Viola elegantula Schot.*) – (*Figure 32)*. Also, on this side of the road (on the right side) develops a community of mountain slopes of the community *Scabiosetum silenifoliae,* with a lot of present Grassy bells (*Edraianthus jugoslavicus Lakušić*, *Syn Edraianthus graminifolius L. DC.) – (Figure 37),* otherwise, a rare potentially endangered species. In addition to this type there is also rockfoils (*Saxifraga montana L.*), and milfoil (*Achillea lingulata Waldst. & Kit.*).

*Figure 37: Grassy bells (Edraianthus jugoslavicus Lakušić, Syn: Edraianthus graminifolius), Photo by A.Cerić*

The aforementioned bellflower was also registered in the wider locality of Devečani to Paljenik, on shallow limestone soil and the sides exposed to the wind.

As part of the vegetation class *Elynio-Seslerietea Br.-Bl. 48* and its corresponding order *Seslerietalia tenuifoliae*, develops the association *Hypochoereto - Festucetum amethystinae*. It was registered

at an altitude of 1,660-1,900 m a.s.l., on the south, southeast and southwest, and rarely in the western and northwestern exposures, with a slope gradient of 5-20˚. It is characterized by the following types some of which are primary producers, such as: Fescue (*Festuca amethystina L. and Festuca rubra L.*), which is differential type of the community, Scabious (*Scabiosa leucophylla Bord.),* then Yellow lousewort (*Pedicularis brachydonata Schloss. et Vuk*) – (*Figure 38*), Whorled lousewort (*Pedicularis verticulata L.*) -(*Figure 33*), Lady's bedstraw (*Gallium verum L.*), Alpine kidneyvetch (*Anthyllis vulneraria subsp. alpestris Kit. Asch.*) – (*Figure 31*), Lady's mantle *(Alchmilla vulgaris L.),* Mountain buttercup *(Ranunculus montanus L.)- (Figure 35),* Alpine milkworts (*Polygala alpestris L.*) – (*Figure 39*), Rockfoils (*Saxifraga montana L.)*, as well as Lady's mantle (*Alchemilla alpina susp. hoppena Rchb. Asch. et G.*) – (*Figure 40*). From acidophilus species of this community are significant: Common cinquefoil *(Potentilla erecta U. et Lebed.),* Spreading bellflower (*Campanula patula L.*), Catsfoot (*Antennaria dioica L. Gearthn.*). This type of vegetation is present in the Devečani area,going to the eastern boundary of the concession area, then the area along the road to Paljenik – on the west and the east side, behind the catchment on the way to Đenetići, but also on the west side of the road (north/northeast) on the ground with slight slope, exposure south-southeast.

*Figure 38: Yellow lousewort (Pedicularis brachydonata Schloss. et Vuk), Photo by A.Cerić*

*Figure 39: Alpine milkworts (Polygala alpestris L.), Photo by A.Cerić*

In the wider area of Vlašić, and therefore in the Devečani zone, it was registered an ecosystem of mezophile meadows of mountain belt of alliances *Pancicion*. This type of community occupies the lower part of the sub Alpine and upper alpine zone. The geological base consists of Mesozoic limestone, while land is made of brown limestone or ilimerized soils. Depending on the microclimate and pedological conditions, macrophytocenosis of these ecosystems are differentiated into two clearly delimited associations: *Alchemilla-Phyteumetum pseudoorbicularis* and *Violeto-Festucetum fallacis H-at.60.*

The ecosystem *Violeto-Festucetum fallacis H-at.60.*, is developing on a wider area of Vlašić in the mountain and subalpine belt, at an altitude of 1,000-1,800 m above sea level, at different exposures, while the slope ranges from 5 - 35˚. This plant community is registered in a wider area on the left side of the road within concession area. The geological base consists of Jurassic limestone, and land consists of mostly brown ilimerized soil on limestone. The main producers of phytomass within this ecosystem are: Fescue *(Festuca falacis L.),* Violet *(Viola elegantula Schot.) – (Figure 32),* Lady's mantle (*Alchemilla vulgaris L.),* Alpine meadow grass *(Poa alpina L.),*Common meadow grass *(Poa pratensis L.*), Red clover *(Trifolium pratense L.),* White clover *(Trifolium repens L.)* and others.

*Figure 40: Lady's mantle (Alchemilla alpina susp. hoppena (Rchb.) Asch. et G., Photo by A.Cerić*

Community *Seslerietalia juncifoliae Horv 30* continues again and covers the areas of Đenetića and the zone of Đenetića to Paljenik, up to about 1,800 m a.s.l., within which are present all the previously mentioned types, except that it was also registered Black Vanilla Orchid (*Nigritella nigra L. Rchb.*) – (*Figure 41*),and besides *Alchemilly vulgaris*, appear also *Alchemilla alpina subsp. hoppena Rchb. Asch. et G. – (Figure 40),* and also Bladder Gentian *(Gentiana urticulosa L) – (Figure 42)*.

*Figure 41: Black vanilla orchid (Nigritella nigra L. Rchb.), Photo by A.Cerić*

*Figure 42: Bladder Gentian (Gentiana urticulosa L), Photo by A.Cerić*

In the southeastern part of the concession area, near surface water sources, a different vegetation community has developed of hygrophile and hygromesophile meadows of mountain and sub Alpine vegetation belt, class *Molinio-Arrhenateretea*. Intense sunlight, deeper and much wetter soil, has led to the development of this community, which appears in the form of smaller enclaves. It develops on the deeper and more humid soils. Among the species that have been registered here, there are: Rush *(Juncus sp.)*, Mountain buttercup *(Ranunculus montanus L.) – (Figure 35)*, Round-Headed Rampion *(Phyteuma pseudorbiculare Pant.)*, Annual bluegrass *(Poa annua L.)*,

Common cinquefoil *(Potentilla erecta L. Rauschel.),*Violet *(Viola elegantula Schot.) – (Figure 32)* and others.

In this area vegetation of so-called mountain hay meadows has also developed as evidenced, in some places, by the very numerous Globe-flower *(Trollius europaeus L.) – (Figure 43).*

*Figure 43: Globe-flower (Trollius europeus L.), Photo by A.Cerić*

Going higher toward the north and north-eastern border of the concession area, on slopes there is even more important vegetation in rock crevices of the class *Asplenietea rupestris (H.Meier) Br.-Bl. 34.*

Also, vegetation of mountain slopes of Bosnian fescue covers some important areas of Vlašić mountain that developed as pastures on carbonate ground with shallow soil. One of the most important botanical communities, not only of Vlašić mountain, but also all Dinaric mountains, is slopes of Bosnian fescue grass ((*Festucetum bosniacae = Festucetum pungentis*) – *(Figure 46).* This community borders with the area that is under the impact of the Project. The dominant species is the Bosnian fescue (*Festuca bosniaca = F. pungens*). Also, there are: Spring crocus (*Crocus vernus L.*), Ragwort (*Senecio sp.*), Purple Viper's Grass (*Scorzonera purpurea L*), Carnation (*Dianthus sp.*) and others. Mountain hawksbeard (*Crepis alpestris* L.), as well as other species such as Alpine kidneyvetch (*Anthyllis alpestris L.*), Thyme (*Thymus serpyllum* L.), Greater Yellow-rattle (*Rhinanthus angustifolius L.*), Common Bird's-foot Trefoil (*Lotus corniculatus L.*), Field Mouse-Ear (*Cerastium arvense L.*) and others can also be found. It occupies locations where the spring snow remains longer, often on the edge of sinkholes and the south-exposed slopes, while at the bottom of sinkholes, where the soil is deeper, more acidic and wetter, with extreme microclimates ("frost areas"), appear grasslands of the matgrass *(Nardus stricta L.)*, forming a community already described of *Aurantiaco-Nardetum strictae Ht 60.*, with which the aforementioned community is often in alternation.

A significant number of species inhabiting these communities are rare, endemic or endangered species. The first site visit took place at the end of the growing season, and therefore

determination of plants in the field was difficult. However, this initial visit was only an informative tour of the area. During later site visits during the growing season it was possible to identify numerous species listed in the Red List of the Federation of BIH. Although only 12 species were registered, their coverage is significant, and they have their share in biodiversity of Bosnia and Herzegovina.

*Figure 44: Vegetation of mountain slopes – winter aspect, Photo by A.Cerić*

*Figure 45: Vegetation of mountain slopes with very numerous fescue (Festuca amethystina L. and Festuca rubra L.), Photo by A.Cerić*

*Figure 46: Vegetation of mountain slopes of the community Festucetum bosniacae on the border of the concession area-to Paljenik, Photo by A.Cerić*

Among the medicinal plants in the area of interest there are the following plant species: St John's wort (*Hypericum perforatum L.*), Thyme (*Thymus serpyllum L.*), Camomile (*Matricaria chamomilla L.*), Valerian (*Vallariana officinalis L.*), Common yarrow (*Achilea millefolium L.*), Germander Speedwell (*Veronica chamedrys L.*), Common lungwort (*Pulmonaria officinalis L.*), Yellow Gentian (*Gentiana lutea* L.), Lady's mantle (*Alchemilla vulgaris L.*).

*Figure 47: Carnation (Dianthus petraeus Walds. & Kit.; Syn: D. kitaibelii),rare species recorded on the border of the concession area, Photo by A.Cerić*

Additionally, common to the area are mosses *(Lihenea)* and mushrooms *(Fungia)*. According to the field work and literature data[27,28,29,30], in the investigated area are identified some endangered, endemic or vulnerable species. All of these species are listed in *Table 7*, which makes distinction between species from literature citations, and those whose presence is confirmed by field research. The list identifies the status of these specieis within the *Red List of Flora of the Federation of BiH*.

[27] *Book 2; Red List of Flora of F BiH, Sarajevo, 2013.;*

[28] *Č. Šilić, 1996.: List of plant species (Pteridophyta and Spermatophyta) for Red Book of BiH;*

[29] *Red List of endangered species and subspecies of plants, animals and fungi ("Official Gazette of F BiH", no. 7/14);*

[30] *Ecological Monographs, Series A; Bulletin of the Society of Ecologists of Bosnia and Herzegovina; Number 1: Ecosystems of the Vlasic mountain, Sarajevo 1982.;*

*Table 7: Endangered, vulnerable and endemic plants in the concession area*

| ***Name of the species*** | ***Bosnian/English name*** | ***Šilić*** | ***Red List of F BiH*** | ***IUCN Red list*** | ***Results from the site*** |
|---|---|---|---|---|---|
| ***Species registered in the wider area of Vlašić according to the literature data*** | | | | | |
| *Amphoricarpos autoriatus Blečić. et Mayer* | *Autariatska krčagovina / -* | *(R)* | *(EN)* | - | |
| *Allium ochroleucum Waldst. et Kit.* | *Gorski luk / Mountain onion* | *(V)* | *(EN)* | *(DD) Data Deficient* | |
| *Gymnodenia odoratissima (L.) Rich.* | *Mirisni vranjak / Scented Gymnadenia* | *(V)* | *(EN)* | - | |
| *Festuca bosniaca Kummer. et Sendtner.* | *Oštra vlasulja / Bosnian fescue* | *(R)* | *(EN)* | - | |
| *Crepis dinarica G. Beck.* | *Dinarski dimak / Dinaric hawksbeard* | *(R)* | *(EN)* | - | |
| *Genitiana dinarica G.Beck* | *Dinarski encijan / Dinaric gentian* | *(E)* | *(VU)* | - | |
| *Gentiana lutea L. subsp. symphyandra Murb. Hayek.* | *Žuta sirištarka / Yellow gentian* | *(V)* | *(EN)* | - | |
| *Campanula latifolia L.* | *Širokolisni zvončić / Wide-leaved bellflower* | *(V)* | *(VU)* | - | |
| *Telekia speciosa (Schrb) Boumg.* | *Žuti kolotoč / Yellow Oxeye* | *(V)* | *(VU)* | - | |
| *Aster alpinus L.* | *Alpski zvjezdan / Alpine Aster* | *(V)* | *(VU)* | - | |
| *Arnica montana L.* | *Arnika/ Mountain arnica* | *(V)* | *(VU)* | *(LC) Least Concern (Ver.3.1)* | |
| *Centaurea alpina L.* | *Planinska zečina / Alpine centaury* | *(V)* | *(VU)* | - | |
| *Cicerbita pancicii (Vis.) Beauv.* | *Pančićeva mliječ / Blue sow thistles* | *(V)* | *(VU)* | - | |
| *Tofieldia calcyculata (L) Wahlenb.* | *Čaškasta baluška / Alpine asphodel* | *(V)* | *(VU)* | *(NT) Near Threatened* | |
| *Fritillaria tenella M.B.* | *Nježna kockavica / Fritillary* | *(R)* | *(NT)* | *(DD) Data Deficient* | |
| *Gladiolus imbricatus L.* | *Crepasta gladiola / European marsh gladiolus* | *(V)* | *(EN)* | - | |
| *Phleum alpinum L.* | *Planinska mačica / Alpine cat's-tail* | *(K)* | *(VU)* | - | |
| *Lilium bosniacum (G.Beck.) Fritch* | *Bosanski ljiljan / Bosnian lily* | *(V)* | *(LC)* | - | |
| *Picea omorica (Pančič) Purkyne* | *Pančićeva omorika / Serbian spruce* | *(R)* | *(NT)* | - | |
| ***Plant species registered during fieldwork - Devečani, Đenetić, Buhačice, Oštrike (concession area)*** | | | | | |
| *Hypochoeris illyrica K Maly* | *Ilirski jastrebnjak* / Illyrian hawkweed | *(R)* | *(EN)* | - | + |
| *Polygala alpestris Reichenb.* | *Apski krestušac / Alpine milkwort* | *(R)* | *(EN)* | - | + |
| *Pedicularis brachydonata Schloss. et Vuk.* | *Kratkozubičasti ušljivac / Lousewort* | *(V)* | *(VU)* | - | + |
| *Genitiana punctata L.* | *Pjegava lincura / Spotted gentian* | *(V)* | *(VU)* | - | |
| *Phyteuma orbiculate L.* | *Okruglasta zečica / Round-headed rampion* | *(R)* | *(LC)* | - | |
| *Achillea lingulata Waldst. et. Kit.* | *Jezičasti stolisnik / Yarrow* | *(V)* | *(VU)* | - | |
| *Arnica montana L.* | *Arnika / Mountain arnica* | *(V)* | *(VU)* | *(LC) Least Concern (Ver.3.1)* | |
| *Centaurea kotschyana Heuff. ex Kouch.* | *Kočijeva zečina / Centaury* | *(V)* | *(VU)* | - | + |
| *Viola elegantula Schot.* | *Ljupka ljubica / Violet* | *(V)* | *(LC)* | - | + |
| *Nigritella nigra L. Rchb* | *Crno smilje / Black Vanilla Orchid* | *(V)* | *(NT)* | - | + |
| *Gentianella crispata (Vis.) J. H.* | *Gorčica / kovčavi srčanik / Dwarf gentians* | *(R)* | *(VU)* | - | + |
| *Scabiosa leucophylla Bard.* | *- / Scabious* | *(R)* | *(LC)* | - | + |
| *Dianthus giganteus subsp. croaticus* | *Hrvatski karanfil / Croatian carnation* | *(V)* | *(LC)* | - | + |
| *Edraianthus jugoslavicus Lakušić, Syn:Edraianthus graminifolius* | *Jugoslovensko zvonce / Grassy bells* | *(R)* | *(NT)* | - | + |
| *Trollius europeus L.* | *Planinčica / Globe-flower* | *(R)* | *(LC)* | - | + |
| *Genitiana dinarica G.Beck* | *Dinarski encijan / Dinaric Gentian* | *(E)* | *(VU)* | - | + |

***V -** endangered or vulnerable species* ***VU** - vulnerable species*

***R -*** *rare or potentially endangered species*

***K -*** *species of still undetermined degree of threat*

***NT*** *- almost endangered species*

***EN*** *- endangered species*

The species listed in *Table 7* provides an overview of plant species that were on the *List of plant species (Pteridophyta and Spermatophyta) for the Red Book of Bosnia and Herzegovina (Šilić, 1996.*), and today are an integral part of the *Red List of endangered wild species and subspecies of plants, animals and fungi of F BiH ("Official Gazette of F BiH", no. 7/14)*. Some of the above have been recorded in the area under consideration, and are indicated in the previous table, in the column "Results from the site".

In the area of interest 12 species important for biodiversity of BiH (with different status and degree of threat) were recorded. In the area that is not directly affected by the project, or located outside the concession area on the way to Opaljenik/Paljenik, the previously described endemic community *Festucetum bosniacae* was recorded.

### *4.7.4 EUNIS*

*EUNIS*

For the needs of EUNIS, a "*habitat*" is defined[31] as: "*a place where plants and animals can live a normal life. It is characterized first of all by its physical features (topography, soil characteristics, climate, water quality, etc.), as well as secondary plant and animal species that live in it.* "

Classification of *EUNIS* habitat is final. It covers the territory of Europe (land and sea), or the European mainland to the east to the Ural Mountains, including the islands on the sea (Cyprus, Iceland, but not Greenland), and the archipelagos of the Member States of the European Union (Canary Islands, Madeira and Azores) , Anatolian Turkey and the Caucasus.

Designation "*E*"[28] carry grasslands and lands dominated by dicotyledons, mosses and lichens. This covers a no coastal land that is dry or only seasonally wet (no longer than six months) with more than 30% of the plant cover. In terms of vegetation dominate grasses and other herbaceous plants, including mosses, ferns, macrolichen and reed. It includes semi-arid steppe regions, as well as areas covered with weed vegetation such as grasslands that serve as recreation areas. Here are excluded regularly cultivated habitats in which dominates the cultivated herbal vegetation, which we meet on arable land.

Natura 2000 is a network of core breeding and resting sites for rare and threatened species, and some rare natural habitat types which are protected in their own right. The network covers both land and sea. The aim of the network is to ensure the long-term survival of Europe's most valuable

[31] *EUNIS habitat classificatin, Cynthia E Davies,Dorian Moss, Mark O Hill, Revised 2004;*

and threatened species and habitats, listed under both the Birds Directive and the Habitats Directive.

Considering the aspiration of Bosnia and Herzegovina to join the EU Member States, many guidelines from documents important for the environment in the EU are implemented into domestic legislation, and those which have not yet been due to financial constraints, will be subject to subsequent harmonization. Therefore, in this document, the guidelines were also respected, and the known codes are listed for habitats of interest. Considering the space of Vlašić in the context of *EUNIS classification*, as well as *Natura 2000 sites*, the observed habitat types are given in *Table 8:*

*Table 8: Review of plant communities in the context of EUNIS and Natura 2000*

| ***Name of habitat*** | ***The wider area of Vlašić*** | ***Narrow zone of concession*** |
|---|---|---|
| *Acidophilous forests of hilly to mountain belt (Vaccinio-Picetea)*<br>*NATURA 2000 code: 9410*<br>*EUNIS code: G3.1b, G3.1c, G3.1f*[32] | + | |
| *Alpine and sub-alpine meadows on limestone*<br>*NATURA 2000 code: 6170*<br>*EUNIS code: E4.41, E4.43, E4.37, E4.38*[22] | + | + |
| *Matgrass lawns (Nardus stricta L.)*[33]<br>*NATURA 2000 code: 6230*<br>*EUNIS code: E1.7, E4.31*[22] | + | + |
| *Hilly hay meadows*<br>*NATURA 2000 code: 6520*<br>*EUNIS code: E2.31*[22] | + | |

[32] *Centre for Environmentally Sustainable Development Sarajevo: Natura 2000 in B&H, Sarajevo, 2011;*

[33] *Matgrass lawns (Nardus stricta L.) are listed in the EUNIS classification, and also mentioned in the context of the Review of flora, fauna and habitats (important for Natura 2000), were mentioned in the context of natural matgrass grasslands, which probably is not the case with Vlašić mountain, given that pasturage is very intensively on this mountain.*

## 4.8 Fauna

*Survey Methodology*

During the preparation of this study, data from literature have been used, as well as data from the site visit and data obtained in cooperation with public enterprise JP BH Šume.

The concession area is approximately 4.5 $km^2$ (450 ha) although a wider study area of about 5 km has been considered due to the mobile nature of fauna. In particular, this approach has been applied when considering large mammals (carnivores), whose habitat extends over larger areas and therefore may extend beyond the concession area.

Information presented has been taken from „Birds & Bats Baseline Condition – Monitoring - Twelve Month Report", prepared by M&M Consulting.

### *4.8.1 Fauna of the observed area*

Vlašić Mountain is characterized by considerable biodiversity, which ranks among the potential areas of *Natura 2000*. As already mentioned above, a large presence of forest communities and very diverse habitat conditions in the area under forest stands, as well as those in zone of mountain pastures, has contributed to the development of the rich fauna of the area. Also, literature data and information, obtained from the local forest workers, confirmed the presence of specimens of large carnivores, which supports the quality of the habitat itself.

According to available data, the following animal species have been registered:

among the large carnivores from the class of mammals (*Mamalia),* there are present representatives of carnivores (*Carnivora*): Brown Bear (*Ursus arctos Linnaeus, 1758.*), Wolf (*Canis lupus Linnaeus, 1758*), Fox (*Vulpes vulpes Linnaeus, 1758.*), Lynx (*Lynx lynx Linnaeus,1758*), and Badger (*Meles sp.*);

from ungulates (*Arctidactylia*), there are present: European Roe Deer (*Capreolus capreolus Linnaeus, 1758.*) and Wild Boar (*Sus scrofa Linnaeus, 1758.*);

from rodents (*Rodentia*) there are: European Brown Hare (*Lepus europeus Pallas),* Euroasian Red Squirrel *(Sciurus vulgaris Linnaeus, 1758.);*

among the representatives of amphibians (*Amfibia*), there is Greek Stream Frog (*Rana graeca Boulenger*), but one can find also different types of reptiles (*Reptilia*), among which there are some of our most poisonous snakes, such as Bosnian Viper (*Vipera berus bosniensis Boettger*), and Horned Viper (*Vipera ammodytes Linnaeus 1758.);*

from bird fauna there are: Short Toed-Eagle (*Circaetus gallicus Linnaeus 1758.),* Golden Eagle *(Aquila chrysaetos Linnaeus 1758.),* Rock Partridge *(Alectoris graeca Linnaeus 1758.),* Alpine Chough *(Pyrrhocorax graculus Linnaeus 1758.),* daily birds of pray*:* Common Kestrel *(Falco tinunnculus Linnaeus 1758.)*, Euroasian Buzzard *(Buteo buteo Linnaeus 1758.)*, Peregrine Falcon *(Falco peregrinus Linnaeus 1758.)*, Harriers *(Circussp.),* Grey Partridge *(Perdix perdix Linnaeus 1758.)*, Common Quail *(Coturnix coturnix Linnaeus 1758.)*, Euroasian Eagle-Owl (*Bubo bubo*

*Linnaeus 1758.)* and many others. More information about the bird fauna will be given under the subheading 4.9.3, and detailed description of the bird fauna will be provided under *Annex 1*, for which the data were taken from *Birds & Bats Baseline Condition – Monitoring - Twelve Month Report*.

*Within the concession area*, because of the high altitude, the fauna consists of mostly smaller carnivores, such as the wolf, and a significant number of bird species. More specifically, according to the findings of the research team that has followed the activity of birds in this area, 107 species of birds were recorded, 26 of them being priority species. Therefore, the bird fauna of the studied area can be evaluated as moderately rich. Also, 20 species of bats were registered.

Within the narrow area of the concession zone, the Brown bear (*Ursus arctos Linnaeus, 1758*) is not expected to be present, while the presence of the Gray wolf (*Canis lupus Linnaeus, 1758*) is evident. Also, the European red fox (*Vulpes vulpes Linnaeus, 1758*) is very common and present representative of carnivore. Among rodent the most common is European Brown Hare (*Lepus europeus Pallas)*. Of significance is the finding of the Golden Eagle *(Aquila chrysaetos Linnaeus 1758),* and there are also registered representatives of the family of hawks (*Accipiteridae*), including Common Buzzard (*Buteo buteo L.*), Long-Legged Buzzard (*Buteo rufinus L.*), Fish Hawk (*Pandion haliaetus L.*), Kestrel (*Falco tinnunculus L.*), Euroasian Hobby (*Falco subbuteo L)* and others. It is important to note that some of these species have permanent nests in the concession area or its vicinity *(Oenanthe oenanthe, Aquila chrysaetos, Falco tinnunculus, Alauda arvensis, Pyrrhocorax graculus)*.

The concession area is adjacent to the area in which the following species are registered: the Brown Bear (*Ursus arctos Linnaeus, 1758.*), Wild Boar (*Sus scrofa Linnaeus, 1758.*), and European Roe Deer (*Capreolus capreolus Linnaeus, 1758.*). Therefore, taking into account that some of these listed animals cross daily up to 60 km, it is very difficult without their extensive monitoring to predict the eventual arrival in the concession area. In this connection, the possibility of their presence under certain circumstances is not entirely excluded, although all of these species, because of the abundance of food and shelter, are attached to forest areas, lower elevations, located below the Devečani plateau.

The wolf and bear are also included in the *Red List*. According to the IUCN list, both species are marked by LC category of threat, and in Bosnia and Herzegovina the bear has the status of vulnerable species (VU), numbered as the 24th, while the wolf is in the category of endangered (EN), numbered 23rd.

Based on literature review there are Lynx on Vlašić. It is important to note that during the 19th century the Lynx was extinct in Bosnia and Herzegovina, but was reintroduced following reintroduction in Slovenia in 1973 (*Mirić, 1981, Kotrošan et al., 2006* ). The latest data point to a small number of individuals recorded in the mountains of northwestern, western and central

Bosnia and Herzegovina, among others, on the site of Vlašić, (*Adamić et al., 2006; Sofradžija and Muzaferović, 2007; Soldo, 2001*).

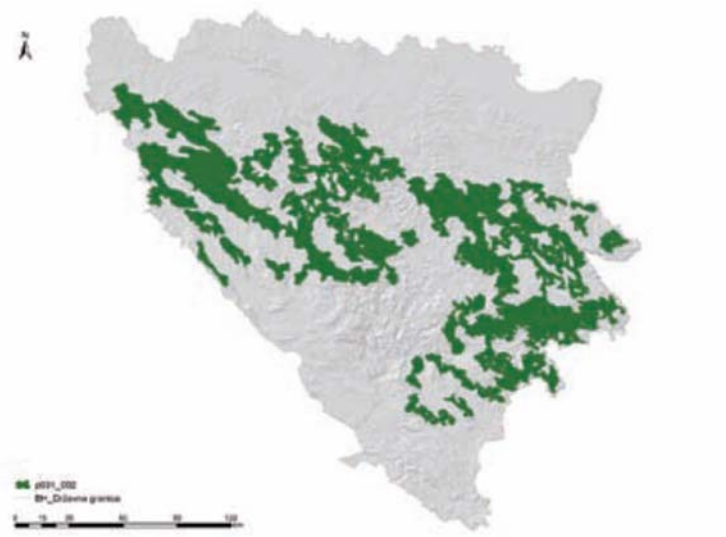

*Figure 48: Area of the lynx in B&H*

According to the IUCN list, the lynx is marked by LC category of threat. In general, world population of lynx are stable, but in some countries it is considered as a very endangered species. It is provided in *Appendix II of the CITES Convention, Annex III of the Bern Convention* and *Annexes II and IV of the Habitats Directive*. Lynx population in Bosnia and Herzegovina is estimated at around 60 individuals. The lynx[34] is permanently protected species under the *Law on Hunting of the Federation of BiH and Republika Srpska (Adamić et al., 2006.; Breitenmoser et al., 2008.)*. According to the *Red List of endangered wild species and subspecies of plants, animals and fungi ("Official Gazette of BiH", no. 7/14)*, the lynx is numbered as the 26th, designated as a vulnerable species (VU). However, the presence of lynx in the field has not been confirmed, and for now there is no evidence of its presence within the concession area.

Some of these species are on the endangered species list, which must be protected, *(under the Habitats Directive ). According to* ***Annex - II*** *(Animal and plant species of community interest whose conservation requires the designation of special areas of conservation), and* ***Annex - IV*** *(Animal and plant species of comunity interest in need of strict protection)*, of the above Directive, the significance was given to the following game species:

*Ursus arctos L.*

*Canis lupus L.*

*Rana graeca L.*

[34] *Center for Environmentally Sustainable Development Sarajevo: Natura 2000 in BiH, Sarajevo ,2011.;*

*Lynx lynx L.*

The above-mentioned Annexes aim to protect the habitat of these animals and thus the protection of populations, ensuring survival in their natural habitats.

Below is an overview *Table 9,* which contains the status of the carnivore species mentioned above, according to the current conventions – *CITES, Berne,* as well as *the Habitat Directive*

*Table 9: Large carnivores in the context of the applicable Directives and Conventions*

| Takson | IUCN | CITES | Berne Convention | Habitat Directive |
|---|---|---|---|---|
| *Ursus arctos L.* | *LC* | *Annex I for Central Asia*<br>*Annex II* | *Annex II* | *Annex II and IV* |
| *Canis lupus L.* | *LC* | *Annex II* | *Annex II* | *Annex II and IV* |
| *Lynx lynx L.* | *LC* | *Annex II* | *Annex II* | *Annex II and IV* |

Given the involvement into the food chain of birds and bats, Insects of the area are also important including different types of *Orthoptera*, of which the most numerous are grasshoppers (*Caelifera*), crickets (*Ensifera*) and butterflies (*Lepidoptera*). *Hymenoptera* is represented by wasps (*Vespidae*), and different groups of organisms from the order of beetles (*Coleoptera*).

### *4.8.2 Birds (Aves)*[35]

*Survey Methodology*

Observation points (*OP*) were defined so as to cover the entire site of the future wind farm and the immediate environment, as well as a control/reference area (*Figure 49*). Positions of OP were carefully selected in order to allow for a maximum visual coverage with a minimum number of points. For this purpose, it 9 OP were established in the concession area and 2 in the control area, wherein the number and the position of points were determined by topography (*Figure 50*).

[35] *Birds&Bats Baseline Conditions Monitoring – Twelve Month Report, M&M Consulting, 2016.;*

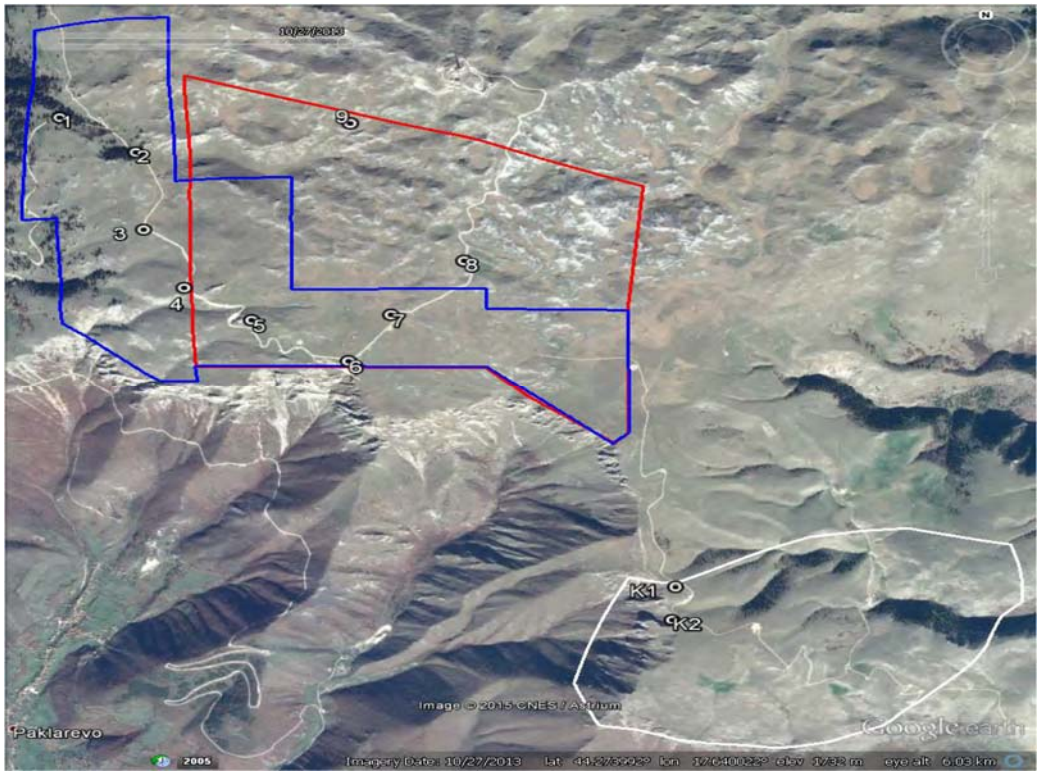


*Figure 49: Positions of observation points for the monitoring of birds within the primary concession area (valid until the beginning of research works) – blue, the new concession area (valid during research works) – red, and reference point – white; Source: GoogleEarth 2013 with modification, M. Paunović, original*

The concession area changed over the course of the bird survey period, however since a significant part of the bird surveys had already been done it would not have been possible to change the OPs without significant delays to the study. On consideration it was determined that the OPs were still valid.

The surveys were carried out from dawn to dusk in conditions of good visibility. Each observation i.e. research unit, mostly lasted one hour at each OP during each day of surveys. Two types of data were collected – the number of all species per site visit at each OP, and the number, duration, flight height and other relevant characteristics of overflight of target (priority) species. From the moment of detection, a specimen of target species was followed visually until the end of the flight or the disappearance out of the sight. The path of overflights was sketched at the site on an appropriate map. Information on overflights of target species registered includes also a date and time of observation, type and flight direction, distance from the observation point and behaviour. Overflight altitude of individual specimens, aggregations or flocks of birds was recorded in particular, estimated in relation to the turbine blades, and the classification has been done into three classes, based on the recorded overflight altitudes, (*Table 10*).

*Table 10: Altitude zones of bird overflight*

| Class | 1 | 2 | 3 |
|---|---|---|---|
| Area of turbine action | Below | Within | Above |
| Radius (m) | <32 | 32-150 | >150 |

In addition, standard ornithological surveys include also surveys of nesting, i.e. detection of nests and nesting activities/behavior. Special attention was paid to the specific characteristics, behavior, characteristics and overflight altitudes of target species, as well as their use of space and habitats.

*Table 4: Overview of implemented field activities per month with the sum of field working days and hours*

| Month | Date of bird surveys | Day | Hour |
|---|---|---|---|
| December | 23,24,25,26,27 | 5 | 40 |
| January | 27,28,29,30,31 | 5 | 35 |
| February | 22,23,24,25,26 | 5 | 35 |
| March | 21,22,23,24,25 | 5 | 40 |
| April | 24,25,26,27,28 | 5 | 45 |
| May | 5, 26, 27, 28, 29 | 5 | 55 |
| June | 25, 26, 27, 28, 29 | 5 | 65 |
| July | 27, 28, 29, 30, 31 | 5 | 70 |
| August | 4, 12, 13, 14, 15, 16 | 6 | 84 |
| September | 9, 10, 11, 12, 13 | 5 | 60 |
| October | 6, 7, 8, 9, 10 | 5 | 55 |
| November | 25, 26, 27, 28, 29 | 5 | 40 |
| Total: | | 61 | 624 |

During each day of the surveys, observation was done from all 9 OP of the concession location, as well as from both OP of the control area. Exceptions are made only for the extreme weather conditions of certain days or parts thereof. The order of OP was randomly changed each day of the surveys.

As shown in the previous table (*Table 11*), bird surveys were carried out during 12 months and 61 days of research, with a total of 624 hours of field work. Hours differed depending on the length of days in a month. The shorest working hours during the day was recorded in January and February, where the field work lasted 7 hours, and in December, March and November 8 hours. The longest field work was recorded in July and August, each lasting 13 hours.

Exceptions were made only in extremely bad weather conditions. Some days during the winter period (January, February and March), it was difficult or impossible to implement the surveys due to very bad weather conditions (heavy fog, very strong wind, flurries of snow, a storm with or without precipitation).

*The results of monitoring of birds (Aves)*[36]

The overall monitoring of the bird fauna lasted from December 2014. to November 2015. According to the findings of the research team, who monitored the activity of birds in this area, there were 107 bird species recorded (*Annex 1*), of which 26 are priority species, accounting for about 1/3 of the entire bird fauna of the Federation of Bosnia and Herzegovina (*Škrijelj et al. 2013.*). Therefore, the bird fauna of the studied area can be assessed as moderately rich. It is also important to note that the representatives of many species recorded during the monitoring, were recorded in a small number and/or nearby the concession area.

Of the total number of species, 26 of them were categorized as target (priority) species based on their national and international importance, the status of conservation and protection, the risk of collisions with wind turbines and/or risk of devastation of their habitats during the construction and operation of the wind farm.

Target (priority) species are defined as species with high conservation status (*Škrijelj et al., 2013.*) and/or species, which can be significantly impaired by wind turbine operation, (*Table 12*). They are birds of prey (*Accipitriformes, Falconiformes*), which are usually considered to be at high risk, as well as daily birds like the crane (*Grus grus L.)* and stork (*Ciconiiformes*). Also, the target species may be those that are customary in the field of research or the surrounding area, and for which one can expect a significant negative impact from wind farms. These species are: Euroasian Skylark (*Alauda arvensis L.*), Alpine Chough (*Pyrrhocorax graculus L.*), as well as European bee-eater (*Merops apiaster L.*).

*Table 5: List of target bird species observed in the Vlašić Wind Farm site, the concession area (OP 1-9) and the reference point (OP K1 and K2)*

| No.Species | nest | Vantage points (VP) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | K1 | K2 |
| 1 ***Ciconia nigra* (Black Stork)** | | | | | + | | | | | | | |
| 2 ***Platalea leucorodia* (Euroasian Spoonbill)** | | | | | | | | + | | | | |
| 3 ***Pernis apivorus* (European Honey-buzzard)** | | | | | | + | + | | + | + | + | |
| 4 ***Gyps fulvus* (Eurasian Griffon)** | | | | | | | | + | | | | |
| 5 ***Circaetus gallicus* (Short-toed Snake-eagle)** | (i) | | + | + | | | | + | + | + | + | + |
| 6 ***Circus aeruginosus* (Western Marsh-harrier)** | | | + | | | | | + | | | | |

[36] *Birds&Bats Baseline Conditions Monitoring – Twelve Month Report, M&M Consulting, 2016.;*

| No. | Species | nest | Vantage points (VP) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | K1 | K2 |
| 7 | *Circus cyaneus* (Northern Harrier) | | | | + | | + | | | + | | | + |
| 8 | *Circus pygargus* (Montagu's Harrier) | | | + | + | + | + | + | + | + | + | + | + |
| 9 | *Accipiter gencilis* (Northern Goshawk) | (c) | + | | | | | + | | | | + | + |
| 10 | *Accipiter nisus* (Eurasian Sparrowhawk) | (c) | + | | | | | + | | | | + | + |
| 11 | *Buteo buteo* (Common Buzzard) | c | + | + | + | + | | + | + | + | + | + | + |
| 12 | *Buteo rufinus* (Long-legged Buzzard) | | + | | | | | | + | | + | + | |
| 13 | *Buteo lagopus* (Rough-legged Hawk) | | | | | + | + | | | | | | |
| 14 | *Aquila pomarina* (Lesser Spotted Eagle) | | | | | | | + | | | | | |
| 15 | *Aquila chrysaetos* (Golden Eagle) | c | + | + | | + | + | + | | + | | + | + |
| 16 | *Aquila pennata* (Booted Eagle) | (i) | | | | | | + | | + | | | |
| 17 | *Pandion haliaetus* (Osprey) | | + | | | | | | | | | | |
| 18 | *Falco naumanni* (Lesser Kestrel) | | | + | | | | | | | + | | |
| 19 | *Falco tinnunculus* (Common Kestrel) | c | + | + | + | + | + | + | + | + | + | + | + |
| 20 | *Falco vespertinus* (Red-footed Falcon) | | + | | | + | + | + | + | + | + | + | + |
| 21 | *Falco subbuteo* (Hobby) | (c) | + | + | | | + | + | | + | + | + | + |
| 22 | *Falco peregrinus* (Peregrine Falcon) | (c) | | | | | | | + | + | | + | |
| 23 | *Grus grus* (Common Crane) | | | | + | | + | | | + | | | |
| 24 | *Merops apiaster* (European Bee-eater) | | + | | | | | | + | | | | + |
| 25 | *Alauda arvensis* (Eurasian Skylark) | c | + | + | + | + | + | + | + | + | + | + | + |
| 26 | *Pyrrhocorax graculus* (Yellow-billed Chough) | c | | | | | + | + | + | + | | + | + |
| | **Number of target species** | **5 (6)** | **11** | **9** | **7** | **8** | **11** | **13** | **13** | **13** | **10** | **14** | **13** |
| | | | | **17** | | | | **25** | | | | **16** | |

The total number of all target species recorded at the observation points in a period of research, given in the above *Table 12*, clearly shows that the minimum number of species (15) was recorded at OP 3, and the maximum (75) was recorded at OP1. However, the registered number of target species is relatively uniform in the whole area of research. Considering the total number of species recorded, it is clear that forest habitats (OP1 and OP2) have by far the most diverse fauna of birds. In the concession area (OP4 to OP9), covered by alpine pastures and rocky habitats, the total number of bird species is significantly lower, and the bird fauna in this area consists of birds in open habitats. Such relatively low diversity of birds in the concession area can be explained by the relatively low diversity of habitats, and also habitats being demanding due to severe alpine weather conditions.

In the wider area, 81 nesting birds were registered, and during the study of the area, nesting was confirmed for 37 species. Among the major species in the study area, were Alpine Chough (*Pyrrhocorax graculus L.*), whose nests in specific rocky habitats are present almost exclusively in the study area. The tagged locations of nests of this species, as well as others, are given in *Figure 50*.

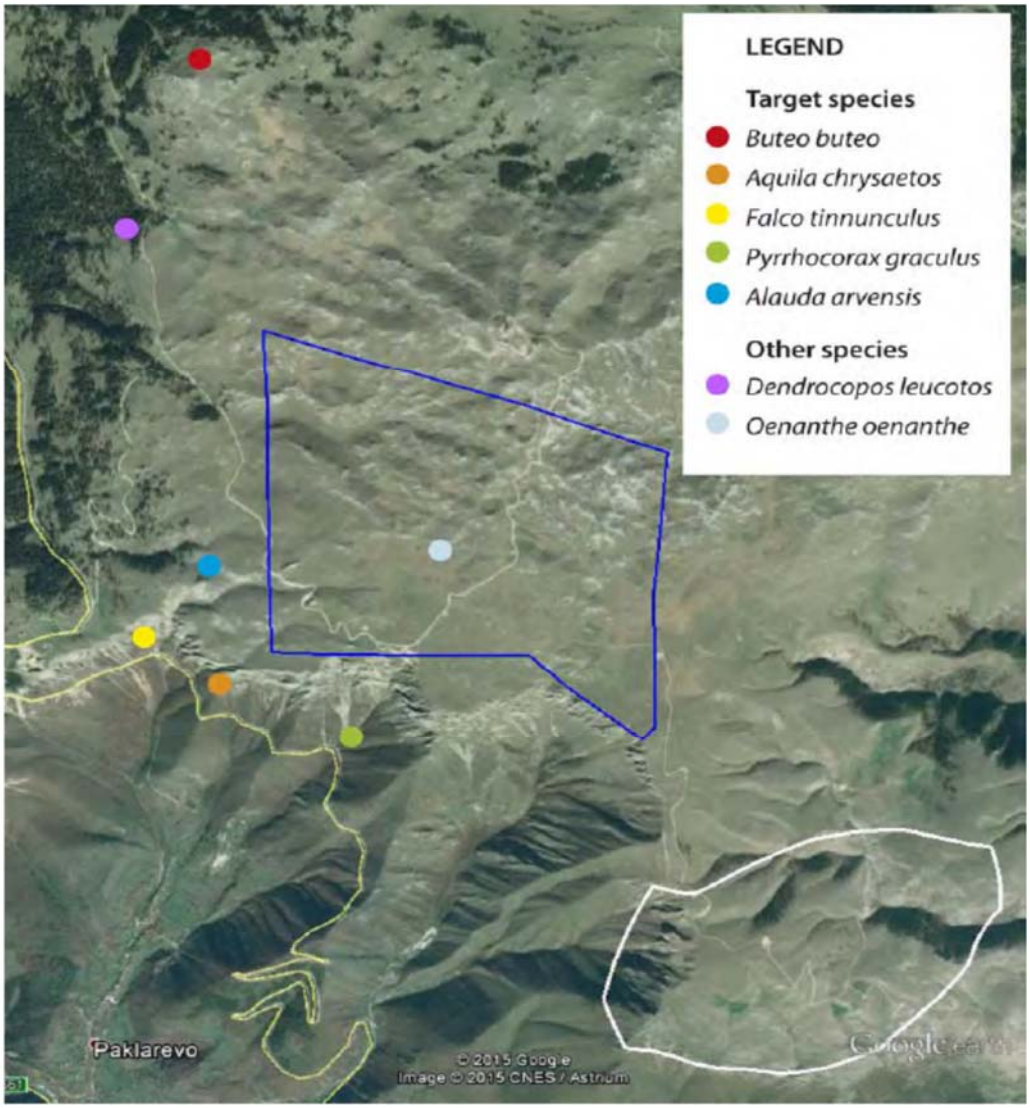


*Figure 50: Position of nests in the concession area of the Vlašić Wind Farm (blue) and in its surrounding; Source GogleEarth 2013, with modification, B. Karapandža,original*

Birds of prey (*Falconiformes*) are constantly present in the entire study area. This phenomenon can be explained by the fact that in the study area there are favorable even optimal alpine habitats, as well as significant trophic base – abundance of small rodents. Due to the sensitivity of target or priority species, special attention will be dedicated to this group of birds of 26 species. Of special importance is 5 target species whose nests are located in the concession area or its vicinity, and the two species that are not in this category. Among the target species are: Common Buzzard (*Buteo buteo L.*), Golden Eagle (*Aquila chrysaetos L.*), Common Kestrel (*Falco tinnunculus L.*), Yellow-billed Chough (*Pyrrhocorax graculus L.*) and Eurasian Skylark (*Alauda arvensis L.*), while among the species outside of this category were registered nests of Parent wheatears (*Oenanthe oenanthe L.*) and White-backed Woodpecker (*Dendroscops leucotos L.*). The tagged locations of nests are given in the previous figure (*Figure50*).

In addition, located on the migration routes of many species of birds of prey, alpine meadows and rocky terrain of the Vlašić plateau rich of numerous karst geological elements provide favorable living conditions. These are the reasons for the numerous observed overflights of various birds of prey such as: Common Buzzard *(Buteo buteo*), Common Kestrel (*Falco tinnunculus*), Montagu's Harrier and Western Marsh-harrier (*Circus pygargus L.* and *Circus aeruginosus L.*), Hobby (*Falco subbuteo*) and Red-footed Falcon (*Falco vespertinus*), and even Short-toed Snake-eagle (*Circaetus gallicus*) and Long-legged Buzzard (*Buteo rufinus*).

Due to the presence of plenty of prey there are numerous data on the presence of vultures (*Buteo spp.*), Falcons (*Falco spp.*), and also seasonal harriers (*Circus spp.*). Some species of falcons, as well as medium-sized mammals, use insects as prey. The presence of rocky habitats, suitable for lizards and snakes, ensure the presence of highly specialized eagle - Short-toed Snake-eagle (*Circaetus gallicus L.*). Also, small and medium-sized herds of sheep, deer and rabbits, make a good trophic base for nesting pairs of Golden Eagle (*Aquila chrysaetos L.*). Other birds of prey were registered only in passing - Osprey (*Pandion haliaetus L.*) during the migration, as well as the Honey Buzzard (*Pernis apivorus L.*) in the circulation.

Another important group of birds are waterbirds, whose members are not recorded in this study. This fact is quite unusual, especially during migration, which was not expected. The absence of a flock of geese or ducks during the day was surprising, but large flocks were recorded by radar during the night, but the precise identification failed due to the impossibility of precise identification of the radar at night.

Storks and herons, as the following ecologically important group of birds were observed during the monitoring at very low frequencies. Such result of the monitoring of waterbirds - herons and storks, can be explained by the absence of wetland habitats necessary for the survival of these two environmental groups.

Also, among the important species of birds there is a Common Crane (*Grus grus L.*) whose medium-sized flock was recorded during migration.

Within the order of *Coraciiformes*, the representative is European Bee-eater (*Merops apiaster L.*). Although listed as a target species, its flocks were rarely recorded and exclusively on very high altitude, during the day monitoring.

Also, there are kinds of owls (*Strigiformes*), which are considered nationally endangered (*Škrijelj et al. 2013.*). However, it is important to emphasize that this group of birds is not particularly vulnerable in this particular case, because of their specific way of life and use of forest habitats located at lower altitudes.

Songbirds (*Alaudidae*) are presented with a large number of species, but mainly a small number of samples. Taken as species of low-risk due to the low status of IUCN, positive population trends, ecological status, as well as optimal conditions of feeding in the entire concession area. Within this family, as a target species is marked Skylark (*Alauda arvensis L.*), otherwise very numerous nesting bird.

Within the order of passerine (*Passeriformes*) as the target species was singled out Alpine Chough (*Pyrrhocorax graculus L.*), which use this habitat in a specific way. A smaller number of flocks in the spring indicates the nesting which in this region may be in the caves, pits and on the rocks.

However, the most significant data is the presence and possible nesting of one pair of Golden Eagles (*Aquila chrysaetos*), whose nest is likely situated in Paklarske rocks.

From a total of 107 so far recorded bird species, 99 of them were classified in the Appendices to the Berne Convention *(„Official Gazette of Bosnia and Herzegovina", no. 8/08),* and 83 in *Appendix II* – strictly protected species and 16 in the *Appendix III* – protected species. These species should, therefore, be considered as strictly protected wild species (SP) and protected wild species (P) in the Federation of Bosnia and Herzegovina under the Nature Protection Act *(„Official Gazette of F BiH", no. 66/13).*

7 of 8 remaining species not listed among wild species of birds should be considered as protected in accordance with the article 86-97 of the Nature Protection Act *(„Official Gazette of F BiH", no. 66/13)*, but their exact status of protection cannot be precisely determined. Thus, only one of recorded species is not legally protected – The domestic pigeon *Columbia livia f.domestica*. This species do not use habitats of the concession area.

Below is a *Table 13* showing the categories of protection according to the *Berne Convention* (Appendices II or III), *the Bonn Convention* (Appendices I and II), *the Birds Directive* (Appendices I, II and III), *the IUCN status* at the global level *(LC – species of low risk, NT – almost an endangered species)* and the national status of legal protection *(P – protected, SP – strictly protected),* as well as the status of the species in the F BiH.

*Table 6: Overview of protection categories under applicable conventions*

| No. | Species | The Berne Convention | The Bonn Convention | The Birds Directive | Legislation of F BiH | IUCN | Status in F BiH |
|---|---|---|---|---|---|---|---|
| 1 | ***Ciconia nigra* (The black stork)** | II | II | I | SP | LC | SP |
| 2 | ***Platalea leucorodia* (Euroasian Spoonbill)** | II | II | I | SP | LC | RE/EN |
| 3 | ***Pernis apivorus* (European Honey-buzzard)** | II | II | I | SP | LC | NT |
| 4 | ***Gyps fulvus* (Eurasian Griffon)** | II | II | I | SP | LC | RE/EN |
| 5 | ***Circaetus gallicus* (Short-toed Snake-eagle)** | II | II | I | SP | LC | VU |
| 6 | ***Circus aeruginosus* (Western Marsh-harrier)** | II | II | I | SP | LC | VU |
| 7 | ***Circus cyaneus* (Northern Harrier)** | II | II | I | SP | LC | DD |

| No. | Species | The Berne Convention | The Bonn Convention | The Birds Directive | Legislation of F BiH | IUCN | Status in F BiH |
|---|---|---|---|---|---|---|---|
| 8 | ***Circus pygargus* (Montagu's Harrier)** | II | II | I | SP | LC | VU |
| 9 | ***Accipiter gencilis* (Northern Goshawk)** | II | II | | SP | LC | LC |
| 10 | ***Accipiter nisus* (Eurasian Sparrowhawk)** | II | II | | SP | LC | LC |
| 11 | ***Buteo buteo* (Common Buzzard)** | II | II | | SP | LC | LC |
| 12 | ***Buteo rufinus* (Long-legged Buzzard)** | II | II | I | SP | LC | EN |
| 13 | ***Buteo lagopus* (Rough-legged Hawk)** | II | II | | SP | LC | VU |
| 14 | ***Aquila pomarina* (Lesser Spotted Eagle)** | Ii | II | I | SP | LC | CR |
| 15 | ***Aquila chrysaetos* (Golden Eagle)** | II | II | I | SP | LC | EN |
| 16 | ***Aquila pennata* (Booted Eagle)** | II | II | I | SP | LC | |
| 17 | ***Pandion haliaetus* (Osprey)** | II | II | I | SP | LC | EN |
| 18 | ***Falco naumanni* (Lesser Kestrel)** | II | I,II | I | SP | LC | CR |
| 19 | ***Falco tinnunculus* (Common Kestrel)** | II | II | | SP | LC | LC |
| 20 | ***Falco vespertinus* (Red-footed Falcon)** | II | I,II | I | SP | LC | CR |
| 21 | ***Falco subbuteo* (Hobby)** | II | II | I | SP | LC | VU |
| 22 | ***Falco peregrinus* (Peregrine Falcon)** | II | II | I | SP | LC | DD |
| 23 | ***Grus grus* (Common Crane)** | II | II | I | SP | LC | RE/NT |
| 24 | ***Merops apiaster* (European Bee-eater)** | II | II | | SP | LC | NT |
| 25 | ***Alauda arvensis* (Eurasian Skylark)** | III | | II | P | LC | LC |
| 26 | ***Pyrrhocorax graculus* (Yellow-billed Chough)** | II | | | SP | LC | NT |

Three species included within *Appendix I of the Bonn Convention*, were recorded, while 43 species included within *Appendix II* were registered. From the Brids Directive, 30 species were recorded that are included within Appendix I, 15 in *Appendix II*, and 2 species in *Appendix III*.

*Findings of the target species and the characteristics of their overflight*

From a total of 26 target species, 5 target species have been studied in more detail as they were found to be nesting near and within the concession area. Among them are: Common Buzzard (*Buteo buteo L.*), Golden Eagle (*Aquila chrysaetos L.*), Common Kestrel (*Falco tinnunculus L.*), Yellow-billed Chough (*Pyrrhocorax graculus L.*) and Euroasian Skylark (*Alauda arvensis L.*). The remaining 21 target species will be presented within *Annex 1* of this document.

Common Buzzard (*Buteo buteo L.*)

A total of 98 flights were registered in the surrounding concession zone and reference points, while in the concession area, an overflight of this species was registered in the late summer and autumn. The only OP from where this species was not observed is OP 5. It is interesting to note, that in comparison to other target species, they generate the most flights in the critical altitude zone[37] - as much as 41%, while about 56% of flights were recorded below the critical altitude zones.

In the area of the concession zone nesting of common buzzard was not recorded because there are no conditions for it. Nesting has been confirmed in the nearby area within the larger forest complex. The nearest recorded nest is about 2 km northwest of the concession area (*Figure 51*).

*Figure 51: Common Buzzard (Buteo buteo L.)*

*Golden Eagles (Aquila chrysaetos)*

During the whole period of the previous surveys, from December 2014. until April 2015., a pair of Golden Eagles *(Aquila chrysaetos)* was constantly observed from all the OPs, except OP 3,7 and 9. A total of 49 samples of Golden Eagles during 49 flights were recorded in the region, in the concession area and at reference sites. This was taken during the yearlong monitoring, except

[37] *The danger zone in which they may get affected by turbines (32 – 150 m;*

during the winter months - January and February. Flights were usually in March and April (49%). Of the registered flights, 39% were in a critical altitude zone. Of the recorded flights, 10 were recorded in the concession area. Otherwise, flights of individual specimens, and sometimes a pair over the concession area and its surroundings, were generally associated with the cliffs of the southern slopes of Vlašić mountain. It has been reported 18 flights whose height was 30 meters above the ground, and were directed to the positions indicated on Paklarske stijene, where a nest was registered (*Figure 50*). 12 flights were registered 150 m above the ground. In 13 cases were also recorded by short circular flights from the plateau to the Lašva Valley, as well as the occasional short circular return flights to the top of Vlaška gromila. Obviously, the main activities and flights are directed to and around the rocks. In the concession area, the nesting activity of this species was not reported, although suitable rocky habitats are present in the surrounding.

The birds were constantly present on Paklarske stijene and always gravitated towards one position on them (geographical coordinates: 44°16'28.59"N, 17°36'46.42"E). For this reason, special attention was paid to finding the nest and its precise position, resulting in a determination of the final location of nests of this species, (*Figure 52*). The presence of the golden eagles on Vlašić is in line with published data, whether they are very old (*Obratil 1971.*), or that are very recent as those recorded by a colleague Ilhan Dervović from May 2013. *(I.Dervović, in lit.* Otherwise, this species is a nesting bird in BiH, (*Kotrošan, 2007.*).

*Figure 52: Golden Eagle Aquila chrysaetos with the city of Travnik in the background; Photo: I. Dervović, original.*

*Common Kestrel* (*Falco tinnunculus L.*)

This species was registered with the largest total number of recorded flights - 240, and 554 registered units. In overflights they have used relatively equally all three studied areas, but were usually recorded in the observation from OP 2 to OP 8, above and around Paklarske stijene, cliffs and adjacent steep slopes, or the southern boundary of the concession area. However, many birds have been recorded during the feeding on the Vlašić plateau. As was expected, a small number of flights was recorded in the critical altitude zone, but the surprise is their absolute lack of over 150 meters from the ground. The maximum number of birds under observation was 9. A greater number of birds is present during the post-reproductive period.. Nesting has been confirmed on the cliffs of Paklarske stijene (*Figure 53*). Although the nest of one pair was found, territorial behavior of other birds in the area of cliffs of Paklarske stijene, indicates that there are at least three active pairs. There are very old data on the presence of this species in the area of Travnik, (Obratil, 1971.).

For this species, based on the monitoring, we can say that this is a population homogeneously staggered in the entire study area. The concentration of activities on the southwest side of the Vlašić plateau, marks the site of reproduction of this species, which has been confirmed. In the opinion of the expert team, this kind of behavior and the data obtained on these specimens, do not apply to other species within the class, because although they are taxonomically closely related, their behavior and habitat use are significantly different.

*Figure 53: Female of the Kestrel Falco tinunnculus is hunting in the vicinity of VP 5; Photo: I.Dervović, original*

Eurasian Skylark *(Alauda arvensis L.)*

Euroasian Skylark is the second species related to the highest recorded number of flights - 162, and 662 identified specimens. It uses equally all three studied areas, but it was registered most commonly outside the boundaries of the concession area. Most birds were recorded during vertical flights during mating on Vlašić, but also in the environment and in the reference area. As expected, a small number of flights was recorded in the critical altitude zone, but the flights at

altitudes greater than 150 m from the ground, were absolutely absent. The first recorded appearance was in the spring, and most units left the area in the second half of September. A larger number of birds was recorded during the post-reproductive flights in August.

Nesting has been confirmed in the whole study area, especially on the plateau or the concession area. This species is nesting bird in BiH (*Kotrošan, 2007*.).

*Figure 54: Euroasian Skylark (Alauda arvensis L.)*

Alpine Chough (*Pyrrhocorax graculus L*.)

Throughout the study period, from December 2014. to November 2015., Alpine Chough was regularly observed from all the OPs, except OP 3, 7 and 9. In the winter months - January and February data were very modest. Later, a total of 943 specimens were recorded during the 80 flights in the environment, the concession zone and at reference sites. In critical altitude zones, there were only 6% of recorded flights (5 of 80). Only three flights were recorded within the concession area, while all the others were oriented to Paklarske stijene and steep slopes in the south. The specimens were observed from OP 5, 6, 7, 8, K1 and K2. The number of birds in flocks varied from a few to 38, and 12 in the average. All flights within the critical zone were low, up to 30 m above the ground. It is completely obvious that all activities aimed at the rocks on the southern slopes of Vlašić.

Otherwise, this species is a nesting bird in BiH (Kotrošan, 2007.). At the concession area its nesting was not recorded, given that there are no conditions for it, such as adequate underground shelters, although nesting is present on the surrounding rocky habitats. Permanent residence of these birds are Paklarske stijene (*Figure 55*). There are old data on the presence of this type on Vlašić (Obratil, 1966.). Otherwise, Drocić et Drocić (2011/2012), assumed the nesting of this species on Vlašić, which could be the northernmost nesting in BiH.

During the work of the research team, nesting was confirmed on the basis of their territorial behavior, as well as the presence of typical alpine rocky habitats, with numerous optimal karst shelters. Otherwise, density of this population is much higher on the southern slopes of Vlašić and towards the valley (Turbe-Travnik). This indicates the importance of this area, as the flight corridor of this group of birds with present nesting of colonies on the valley or on the mountain slopes.

During the autumn, this group of birds is characterized by concentrations along the edge of the southern part of Vlašić plateau and valley (Turbe-Travnik). On the contrary, spring activity, (due to the mating season), is characterized by larger groups. Later, they use the same corridors as corridors for feeding.

*Figure 55: Alpine Chough (Pyrrhocorax graculus L.)*

Taking into account the remaining target species, monitoring results showed that some of them fly to/or above the critical altitude zone, or even below it. Critical height is the coverage zone of blades, which is from 32 to 150 m above the ground.

In general, below the critical height (32-150 m) has been recorded the presence of the following species: Honey Buzzard (*Pernis apivorus L.*), Northern Harrier (*Circus cyaneus L.*), Montagu's Harrier (*Circus pyrgargus L.*), Northern Goshawk (*Accipiter gentilis L.*), Eurasian Sparrowhawk (*Accipiter nisus L.*) and Hobby (*Falco subbuteo L.*).

Within the critical altitude zone, have been reported: Short-toed Snake-eagle (*Circaetus gallicus J. F. Gmelin, 1788.*), Rough-legged Hawk (*Buteo lagopus Pontoppidan, 1763.)*, Lesser Spotted Eagle

(*Aquila pomarina C. L. Brehm, 1831.)*, Booted Eagle (*Aquila pennata L.*) and Lesser Kestrel (*Falco naumanni Fleischer, 1818.).*

### *4.8.3 Bats (Chiroptera)*

*Survey Methodology*

According to internationally accepted standards *(Rodrigues et al. 2015.),* the survey of bat actitivites (manual and automatic) should be conducted when weather conditions allow the activity of bats (temperatures above 7°C, wind speeds below 5 m/s, without rain and fog). However, as there are few and mostly very new studies on activities of bats in the (sub)alpine areas of Europe (*Galand et al. 2010, Bontadina et al. 2014., Alberdi et al. 2015.)*, it was decided start of research activities when expected temperatures at dusk were clearly above 0°C. By pre-planned schedule, it was envisaged that this monitoring element begins in April, when the activity of bats after hibernation usually starts in the region. However, long-term very adverse weather conditions lasted for the entire April (and most of May). According to our findings, the activity of bats has never been recorded at these temperatures and in such conditions, it is concluded that the activity of bats is not yet started then.

All potential shelters (buildings, caving objects, trees) within the limits of the site and at least 200 m beyond the borders, as well as within the control area must be identified and evaluated.

Appropriate methodology for the study of potential bat shelters (*Mitchell-Jones, 2004.; Paunović et al. 2011.; Hundt 2012.*), especially in inaccessible or difficult to access structures, consists of the visual detection of possible flying of bats out/in potential shelters, using hand-held lamps, combined with audio-detection of ultrasonic signals using manual bat detectors. Surveys of bats flying out of potential shelters usually starts about 30 minutes before sunset and lasts up to 2 hours after sunset. The surveys of flight in/return to potential shelter is usually realized in the period between 2 hours before sunrise to 15 minutes after sunrise or it is extended after this to 10 minutes after the last registered bat.

Search (identification) and inspection of potential bat shelters was conducted over two days in December (24-25) in 2014., and in 2015. (*31/05, 28/06, 31/07, 26 and 31/10.*).

Manual detection of activity of bats on transects, according to all relevant international recommendations and guidelines, is considered essential in all locations of the planned wind farms.

The potential ecological functions of the study area and elements of habitats important for bats were identified during the preliminary environmental assessment. As potentially important hunting territories of most species, the forest elements have been identified in the valleys, springs and watering places, while the predominant lawns can be used by only few specialized species.

It is known that bats use the lines of the landscape as a way of flight orientation, for example paths, streams, forest edge, etc., (*Limpens et Kapteyn 1991., Dietz et al. 2009., Paunović et al. 2011.,*

*Rodrigues et al. 2015.)*. These structures were not identified on the location of the concession area, due to their lack of, and bats use roads and different elements, for example valleys and cliff edges, (*Paunović et al. 2011.)*.

Five transects (lines marked with different colors on (*Figure 56*) along gravel roads are preliminarily defined to cover and represent the study area as fully as possible spatially and environmentally, and in particular its environmental elements, which are potentially important for bats. Three transects are provided in the concession zone (2, 3, 4), one in the immediate vicinity (1), and one on the reference site (0).

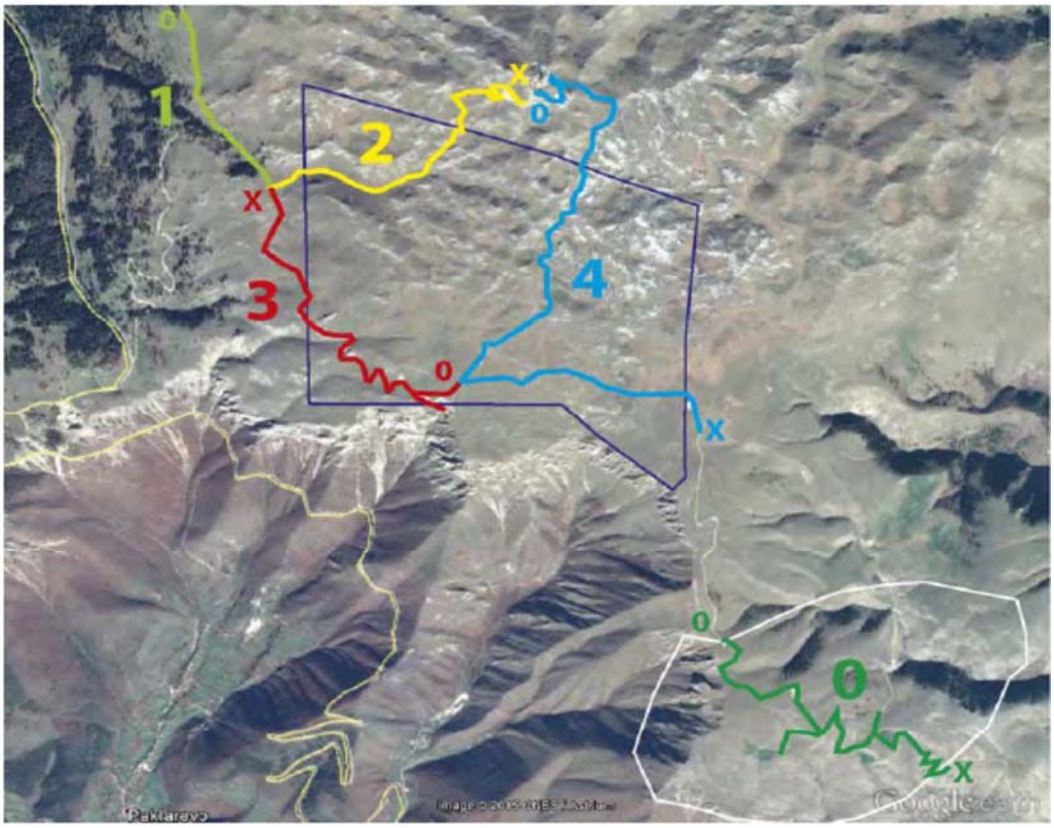


*Figure 56: Positions of transects (yellow, orange, green, light blue and red line) to detect activity of bats at wind farm location (blue) and in the control area (white); Source: GoogleEarth 2013. with modification, B.Karapandža*

The activity of bats along transects were registered by audio detection of their ultrasound echolocation signals and sounding with ultrasonic bat detector *Pettersson D240x* with visual detection using reflector hand lamp. Detection of activity on transects would be implemented during the whole night with three consecutive unit transect along the same transect in one night:

the unit transect at dusk (from sunset until the completion of transect in one direction);

the unit transect at midnight (more or less immediately upon the completion of the transect at dusk, until the completion of the transect in the opposite direction);

the unit transect at dawn (before sunrise as far as the expected duration of the transect to be completed in one direction until sunrise).

In addition to these methods, a method of catch with special nets has been used, which ensured precise determination of species.

A total of 21 points of the census was identified within the current location (this number to be corresponded approximately to the number of wind turbines of the planned wind farm), and 7 within the control area (*Figure 57)*.

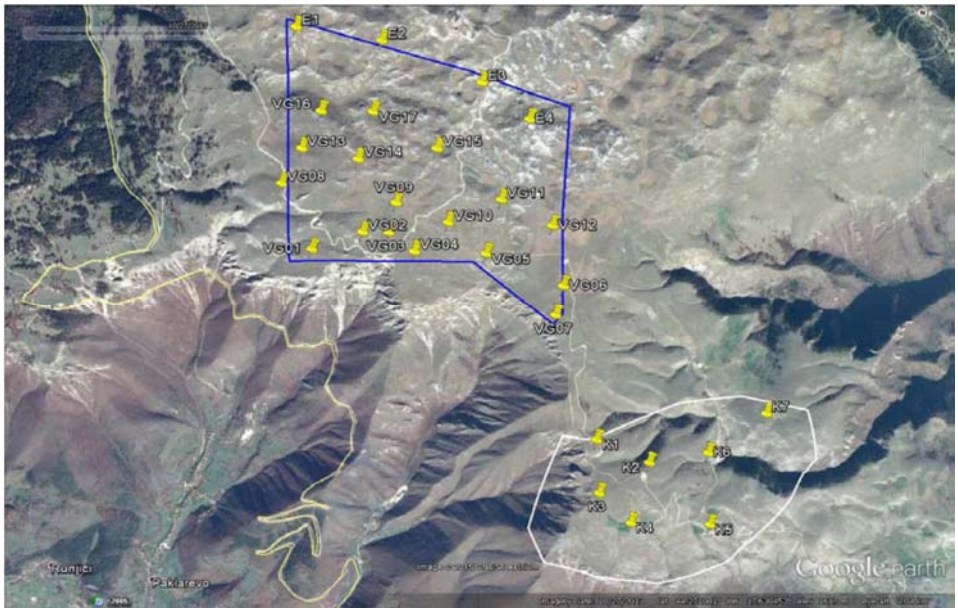


*Figure 57: Preliminary positions of the census points to detect automatically the activity of bats in the wind farm site (blue) and in the control area (white);*
*Source: GoogleEarth 2013 with modification, B. Karapandža, original*

*Results of Bat Monitoring (Chiroptera)*[38]

[38] *Birds& Bats Baseline Conditions, Twelve Month Report, M&MConsulting;*

For the entire complex of rock formations around Paklarske stijene, it was estimated that during all seasons it has a very high potential for shelters of lithophilic species of bats, especially those whose shelters are in cracks and fissures.

Neither in the available literature, nor in any available museum collections, is there any data on bats from the area of Vlašić Mountain (*Zagmajster et al. 2008., Karapandža et al. 2014.*). However, as a curiosity, two exemplars of species *Plecotus macrobullaris* are mentioned, one from the Natural Museum in Vienna and one from the Regional Museum in Travnik, for which the museum document stated that they were collected in Travnik in 1894. (*Mulaomerović 2013.*). Taking into consideration the ecology of species, they could actually be from Vlašić.

There are only few recent studies of bats in the (sub) alpine areas, which are not yet fully published, and they treated the alpine areas of southern European mountains. According to current knowledge, Bontadina et al. (2014.), conducted continuous research from spring to autumn, with automatic detection of activity of bats in the area of the Alps. And this, as some other studies have shown a surprisingly high activity of bats above the trees, especially in the valleys and passages.

Survey of bat fauna lasted from May to October 2015., and based on the results obtained so far and the number of species, which is not definitive, we can say that they represent almost 50% of the total bats species in BiH (*Karapandža et al. 2014.*). Therefore, we can say that the study area is moderately rich in species. Since all species were recorded within a relatively small total number of samples/contacts, most of them are only staying peripherally and within a very limited space; ecologically very specific area of cliffs and forested valleys.

Activity of 10 species of bats (which can be clearly identified on the basis of their echolocation signal), was registered in the study area using ultrasound and audio detection. Among them are:

Common Bentwing Bat (*Miniopterus schreibersii Kuhl, 1817*),

Common Pipistrelle (*Pipistrellus pipistrellus Schreber, 1774*),

Kuhl's pipistrelle (*Pipistrellus kuhlii Kuhl 1819*), N

athusius' pipistrelle (*Pipistrellus nathusii Keyserling&Blasius, 1839*),

Savi's Pipistrelle (*Hypsugo savii Bonaparte, 1837*),

Leisler's Noctule (*Nyctalus leisleri Kuhl. 1819*),

Noctule (*Nyctalus noctula Schreber R, 1774*),

Parti-coloured Bat (*Vespertilio murinus L.*), Serotine (*Eptesicus serotinus Schreber, 1774*); and

European Free-tailed Bat (*Tadarida teniotis Rafinesque, 1814*).

All of these species have been positively identified, based on the frequency of their sound. Two types have been identified based on morphological character of specimens - Whiskered bat (*Myotis mystacinus Kuhl. 1819*) and Alpine Long-eared Bat (*Plecotus macrobullaris Kuzyakin, 1965*).

However, it is very likely that the actual number of species is even greater,(potentially 18),, because besides morphological confirmations for Whiskered Bat and Alpine Long-eared Bat (*Myotis mystacinus and Plecotus macrobullaris*), at least 5 species are present occasionally and/or sporadically (*Myotis brandtii, M. alcathoe, M. myotis, M. oxygnathus and Plecotus auritus*), which is almost certainly, based on their distribution and presence of appropriate environmental requirements, (*Dietz et al. 2009., Paunović et al. 2011.*) in the study area. Data on the presence of these species in similar alpine habitats of mountains of southern Europe (*Barataud 2004., Alberdi et al. 2013.*), support these results.

Considering all the previous analysis of spatial dynamics of bat activity in the study area, based on analysis of transects, we can reliably conclude that in the greater part of the concession area (as well as the reference points), which are under typical (sub) alpine pastures, the bat activity is low to very low. Significantly greater activity (usually moderate, but on occasion and/or localized high and even very high), was registered only in certain areas on the ecological limits of the concession area and in its surroundings, - the edges of cliffs and steep slopes.

The most bat activity was recorded at the southern border of the concession area in the zone of Devečani water source, especially at the beginning of seasonal activity in May. Table 14 below gives a tabular overview of all determinated species, as well as data on their numbers.

*Table 7: List of bats (or groups, which cannot be clearly differentiated on the basis of echolocation signal or it has not been possible in certain cases), with their abundance (such as N=the number of contacts and the percentage of registered contacts =%), recorded by manual detection activity on transects (T0-T4), in the concession area, its immediate environment and the reference point*

| Species/Group | Ref. point | | Concession area of WF | | | | | | | | Environment | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TO | | T2 | | T3 | | T4 | | Total | | T1 | | | |
| | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| Miniopterus schreibersii (Common Bentwing Bat) | 7 | 17,5 | 3 | 8,6 | 3 | 2,5 | 1 | 3,7 | **7** | **3,8** | | | **14** | **5,5** |
| Myotis brandtii M.mystacinus M.alcathoe (Myotis)[39] | | | 12 | 34,3 | 4 | 3,3 | 2 | 7,4 | **18** | **9,9** | 5 | 15,6 | **23** | **9,1** |
| Myotis myotis M. oxygnathus (Greater Mouse-eared Bat) | | | | | 2 | 1,7 | | | **2** | **1,1** | | | **2** | **0,8** |
| Myotis sp. (Myotis bat) | | | 3 | 8,6 | 3 | 2,5 | 2 | 7,4 | **8** | **4,4** | 3 | 9,4 | **11** | **4,3** |
| Plecotus sp. (Long-eared species) | 7 | 17,5 | 1 | 2,9 | 4 | 3,3 | 3 | 11,1 | **8** | **4,4** | 2 | 6,3 | **17** | **6,7** |
| Pipistrellus kuhlii (Kuhl's pipistrelle) | 5 | 12,5 | | | 24 | 20 | 1 | 3,7 | **25** | **13,7** | 5 | 15,6 | **35** | **13,8** |
| Pipistrellus nathusii (Nathusius' pipistrelle) | 2 | 5,0 | | | 9 | 7,5 | | | **9** | **4,9** | | | **11** | **4,3** |
| Pipistrellus kuhlii P. nathusii (Kuhl's and Nathusius' pipistrelle) | 4 | 10,0 | | | 15 | 12,5 | 4 | 14,8 | **19** | **10,4** | | | **23** | **9,1** |
| Pipistrellus pipistrellus (Common Pipistrelle) | 2 | 5,0 | | | 5 | 4,2 | 2 | 7,4 | **7** | **3,8** | 1 | 3,1 | **10** | **3,9** |
| P. nathusii / Hypsugo savii | | | | | 2 | 1,7 | 2 | 7,4 | **4** | **2,2** | | | **4** | **1,6** |
| Hypsugo savii (Savi's pipistrelle) | 2 | 5,0 | | | 4 | 3,3 | 1 | 3,7 | **5** | **2,7** | | | **7** | **2,8** |
| Pipistrellus / Hypsugo sp. | 1 | 2,5 | 1 | 2,9 | 4 | 3,3 | | | **5** | **2,7** | | | **6** | **2,4** |
| Nyctalus leisleri (Leisler's bat) | 3 | 7,5 | 3 | 8,6 | 10 | 8,3 | 3 | 11,1 | **16** | **8,8** | 7 | 21,9 | **26** | **10,2** |
| Nyctalus noctula (Noctule bat) | 4 | 10,0 | 1 | 2,9 | 5 | 4,2 | 1 | 3,7 | **7** | **3,8** | | | **11** | **4,3** |
| N. noctula/leisleri | | | | | 1 | 0,8 | 2 | 7,4 | **3** | **1,6** | | | **3** | **1,2** |
| Vespertilio murinus (Parti-coloured bat) | | | 8 | 22,9 | 15 | 12,5 | 1 | 3,7 | **24** | **13,2** | 5 | 15,6 | **29** | **11,4** |
| Eptesicus serotinus* (Serotine) | | | | | | | | | **+*** | | | | | **+*** |
| E.serotinus / V.murinus / Nyctalus | | | 1 | 2,9 | | | 1 | 3,7 | **2** | **1,1** | 2 | 6,3 | **4** | **1,6** |
| Tadarida teniotis (European Free-tailed Bat) | 3 | 7,5 | | | 8 | 6,7 | 1 | 3,7 | **9** | **4,9** | | | **12** | **4,7** |
| Chiroptera indet. | | | 2 | 5,7 | 2 | 1,7 | | | **4** | **2,2** | 2 | 6,3 | **6** | **2,4** |
| **Total** | **40** | **100,0** | **35** | **100,0** | **120** | **100,0** | **27** | **100,0** | **182** | **100,0** | **32** | **100,0** | **254** | **100,0** |
| **Activity index (contacts/h)** | **1,4** | | **2,1** | | **4,5,** | | **0,9** | | **2,4** | | **2,5** | | **2,2** | |
| **Minimal number of species** | **9** | | **7** | | **12** | | **10** | | **13** | | **6** | | **13** | |

[39] *Brandt's Myotis (Myotis brandatii Eversmann, 1845.), Whiskered Myotis (Myotis mystacinus (Kuhl,1817.), Alcathoe Myotis (Myotis alcathoe von Helversen & Heller, 2001.);*

** One contact positively identified only by automatic detection during the study of the concession area WF Vlašić*

As already stated, the total number of registered contacts in the course of research, as well as overall activity, is low or lower in most parts of the concession area, compared to other southern European mountains (*Barataud 2004., Galand et al. 2010., Alberdi et al. 2013.*). The slightly greater activity has been registered (only occasionally high, and even very high), only in few ecologically very specific locations in the concession area, namely the southern and western immediate environment.

Also, there are 6 species / groups registered, present almost exclusively in the same environmentally specific areas (*Pipistrellus kuhlii, P. nathusii, Hypsugo savii, Myotis brandtii/mystacinus/alcathoe*, *Vespertilio murinus and Tadarida teniotis*), while only 5 species/ groups are widespread in the concession area, (*Miniopterus schreibersii, Plecotus sp., Pipistrellus pipistrellus, Nyctalus leisleri and N. noctula*), where it is clear that no species/group is very dominant. Special attention was paid to their spatial and temporal activities, and analysis of their environmental specifics in the study area.

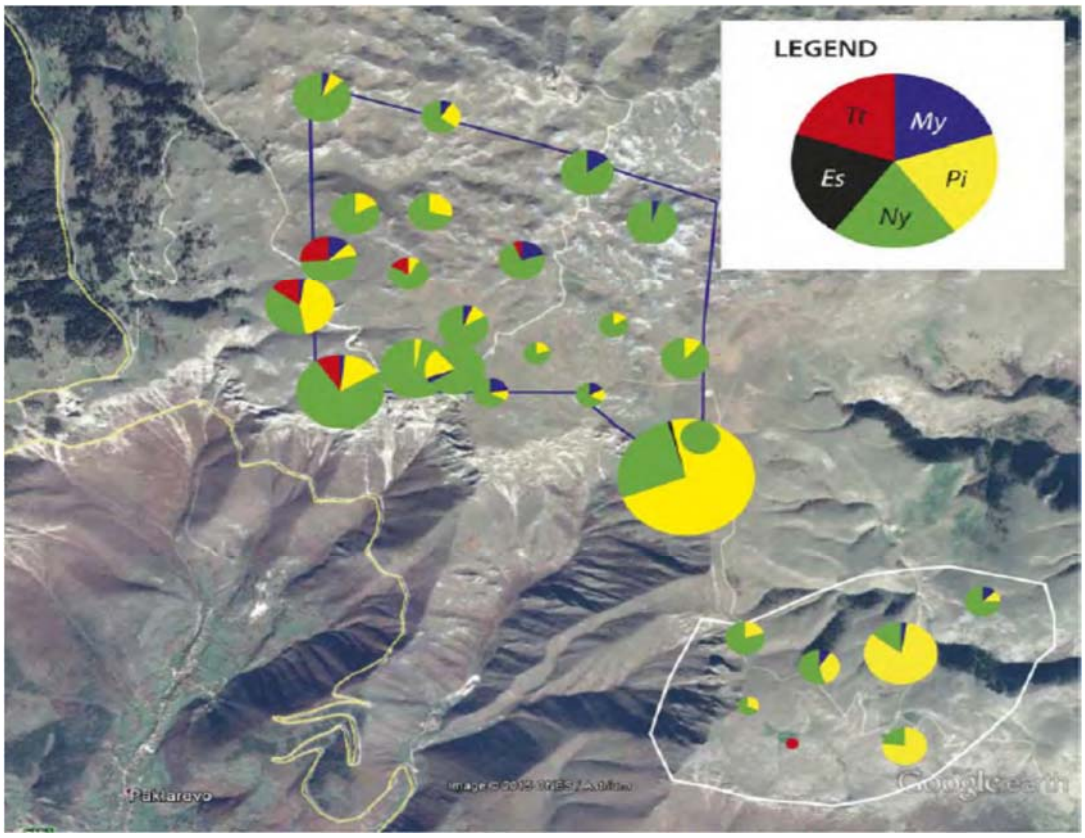


*Figure 58: The distribution of species/groups in the concession area (My-Myotis/Plecotus/Barbastella spp.) Pi - Pipistrellus/Hypsugo/Miniopterus spp.;Ny - Nyctalus/Vespertilio spp.; Es - Eptesicus serotinus; Tt - Tadarida teniotis);Source: GoogleEarth 2013, with modification B. Karapandža, original*

As higher the overall activity of bats at the border of the concession area and in its immediate vicinity (rocks and steep slopes, edges, wooded valleys), it indicates the abundance of trophic

resources, as expected in the study area. The explanation for greater activity of bats in the inner part of the concession area, lies in the abundance of trophic resources of the study area.

As all European bat species are listed in *Appendix II of the Bern Convention* (except species *Pipistrellus pipistrellus* which is in *Appendix III*), they should be considered as strictly protected wild species (*Pipistrellus pipistrellus* protected wild species) in the Federation of Bosnia and Herzegovina, and according to the Law on Nature Protection ("*Official Gazette of BiH", no. 66/13*).

Also, according to the Red List of Threatened Wild Species and Subspecies of Plants, Animals and Fungi in the Federation of Bosnia and Herzegovina ("*Official Gazette of the Federation of Bosnia and Herzegovina", no. 7/14)*, the bats are in the category of threatened species (threatened or vulnerable), and must be considered as strictly protected wild species in the Federation of Bosnia and Herzegovina, according to the Law on Nature Protection ("*Official Gazette of F BiH", no. 66/13)*, Articles 109-110. Review of these statuses for each registered species, is given in *Table 15*.

*Table 8: A list of (potentially) present bat species in the concession area and the status of their protection*

| ***Species/Group*** | ***The Berne Convention*** | ***The Bonn Convention*** | ***EU Habitat Directive*** | ***Legislation of F BiH*** | ***IUCN Red List*** | | |
|---|---|---|---|---|---|---|---|
| | | | | | ***Global*** | ***Europe*** | ***F BiH*** |
| *Miniopterus schreibersii (Common Bentwing Bat)* | *II* | *II* | *IV, V* | *SP* | ***NT*** | ***NT*** | ***EN*** |
| *Myotis brandtii (Brandt's Myotis) (Myotis)*[40] | *II* | *II* | *IV* | *SP* | ***lLC*** | ***LC*** | |
| *Myotis mystacinus (Whiskered Myotis)* | *II* | *II* | *IV* | *SP* | ***LC*** | ***LC*** | ***VU*** |
| *Myotis alcathoe (Alcathoe Myotis)* | *II* | *II* | *IV* | *SP* | ***DD*** | ***DD*** | ***VU*** |
| *Myotis myotis (Greater Mouse-eared Bat )* | *II* | *II* | *IV, II* | *SP* | ***LC*** | ***LC*** | ***EN*** |
| *Myotis oxygnathus (Lesser mouse-eared bat)* | *II* | *II* | *IV, II* | *SP* | ***LC*** | ***NT*** | ***EN*** |
| *Myotis nattereri (Natterer's Bat)* | *II* | *II* | *IV* | *SP* | ***LC*** | ***LC*** | |
| *Plecotus auritus (Brown Big-eared Bat)* | *II* | *II* | *IV* | *SP* | ***LC*** | ***LC*** | ***VU*** |
| *Plecotus macrobullaris (Mountain Long-eared Bat)* | *II* | *II* | *IV* | *SP* | ***LC*** | ***NT*** | |
| *Barbastella barbastellus (Western Barbastelle)* | *II* | *II* | *IV, II* | *SP* | ***NT*** | ***VU*** | |

[40] *Brandt's Myotis (Myotis brandatii Eversmann, 1845.), Whiskered Myotis (Myotis mystacinus (Kuhl,1817.), Alcathoe Myotis (Myotis alcathoe von Helversen & Heller, 2001.);*

| Species/Group | The Berne Convention | The Bonn Convention | EU Habitat Directive | Legislation of F BiH | IUCN Red List | | |
|---|---|---|---|---|---|---|---|
| | | | | | Global | Europe | F BiH |
| *Pipistrellus kuhlii (Kuhl's Pipistrelle)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | **VU** |
| *Pipistrellus nathusii (Nathusius' Pipistrelle)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | |
| *Pipistrellus pipistrellus (Common Pipistrelle)* | *III* | *II* | *IV* | *P* | **LC** | **LC** | **VU** |
| *Hypsugo savii (Savi's Pipistrelle)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | **VU** |
| *Nyctalus leisleri (Lesser Noctule)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | |
| *Nyctalus noctula (Noctule)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | **EN** |
| *Vespertilio murinus (Parti-coloured Bat)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | **VU** |
| *Eptesicus serotinus (Serotine)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | |
| *Eptesicus nilssonii (Northern Bat)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | |
| *Tadarida teniotis (European Free-tailed Bat)* | *II* | *II* | *IV* | *SP* | **LC** | **LC** | |

*Figure 59: Myotis myotis, M. oxygnathus, M. brandtii, M. mystacinus and Miniopterus schreibersii; Photo: B. Karapandža; original*

*Figure 60: Tadarida teniotis, Plecotus auritus and P. macrobullaris (left to right); Photo: B.Karapandža; original*

The Mountain lodge Devečani was inspected in detail outside and it was estimated that it has a moderate potential for bats roosts during the season of activities, and a very low potential for hibernation roosts.

## 4.9 Landscape

The whole assessment area is characterized as a landscape of significant value[41], and as such a large area of Vlasic mountain is proposed as a protected landscape including plateau Devečani.

The study area defined for the purposes of both landscape character assessment and visual assessment extends to a radius of 5 km from the outer most turbine of the Proposal Site. The study area covers a land area of approximately 78 km² (7,800 ha), and encompasses the Devečani plateau, where the southern border ends at the slopes of Paklarske stijene, beneath which there is the Lašva river valley, with Travnik and neighboring settlements, some of which are closest Ovčarevo and Paklarevo. The eastern border is towards the Vlaška gromila, with the closest mountain peak Čardakov. The northern border ends below the highest mountain peak Paljenik, at a distance of approximately 500 m from the concession area boundary. The western border extends to the Galica and northwest towards the Harambašina voda.

The topography of the area varies between the river valley at the foot of the Vlašić (503 m a.s.l.) south of the concession area, over a flattened plateau, such as Devečani plateau (1,780 m a.s.l.) which covers the concession area, and mountain peaks Paljenik (1,933 m a.s.l.) north of the concession area, Čardakov (1,805 m a.s.l.) east of the same and Vlaška gromila (1,919 m a.s.l.) east and northeast of the mentioned area. On the western part of Vlašić mountain massif there is Galica, situated between the peaks Panje (1,606 m a.s.l.) and Vis (1,611 m a.s.l.). The study area is away from Paljenik approximately 500 m of the crow flies, from Galica approximately 2 km, from Ovčarevo approximately 5 km, Paklarevo approximately 4 km, Babanovac approximately 5 km and from Turbe approximately 4.5 km.

Transition in landform and land-cover across the study area provides for a matrix of landscape types. This area is represented by the large, exposed areas of the plateau, at an altitude of 1,780 m a.s.l. to 1,800 m a.s.l., and the concession area is wholly located in the alpine and sub-alpine meadows, where grazing is very intense.

In the area outside the concession area (Galica), there are some forests of spruce and fir, very dense plants, while above the upper limit of the forests, mountain pastures are developing. Alpine and sub-alpine meadows are present in the wider area of Devečani, Oštrik and Đenetić, while in

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41 *The study area is located within the Protected landscape "Vlašić", as well as within the scope of the Spatial plan of special area Vlašić (Spatial Plan of Travnik municipality for the period 2003-2020, Natural values). According recently adopted Amendments to Spatial Plan of Travnik Municipality for the period 2003-2020, Spatial basis, moutain Vlašić area is provided as a Nature Park „Vlašić". The study area is located within the Nature Park "Vlašić".*

the southeastern part of the concession area, there are meadows type hay meadows. On the steep slope areas from 5˚-30˚ incline, the vegetation is reduced in places with very severe forms of limestone on the surface.

The study area which is currently used for sheep grazing, contains a wide variety of natural habitats, including uncultivated mountain meadows. Given that this is the area above the upper border of the forest, in this area there are no forest communities. Also, there are no water surface flows, while smaller sources are present at several locations, and in the location there is only one source, the source Devečani, located in the southern part of the concession area, above Paklarske stijene.

Forest communities are west, northwest, north and northeast of the concession area and at the considerable distance from it (the nearest forest area, to the west, are located approximately 1 km from the concession area).

The whole area is attractive for the development of mountain tourism and outdoor recreation, with a focus on cycling and hiking, for which there are good conditions, considering the features of the present landscapes (forests and meadows). The whole site has several hiking trails that lead in different directions, mainly in an east-west direction. One of them is the "cheese route". Also, shepherd huts (katuni) represent an important feature of the Vlasic mountain, with no form of settlement here, but individual shepherd facilities, which are seasonally in use, as long as snow and wind storms do not cover rich pastures of this mountain.

Based on the preliminary categorization, *the Spatial Plan of the Central Bosnia Canton 2005-2025* singled out 15 areas as particularly valuable areas of unique natural phenomena of natural heritage. In the area that is important for this project there is also the *Protected Landscape*[42] *„Vlašić*", with a surface area of 22,750 ha. *The Regional Plan of the municipality of Travnik 2003-2020* envisages placing Vlašić under the protection regime at the level of the *Protected Landscapes* "*Vlašić*", within which is the study area. Due to the significant value of the intact landscape, the diversity of flora and fauna, pasture cottages, as well as protected traditional lifestyle of the local population (livestock and famous vlašić cheese), there are plans to designate the landscape as a protected landscape by Central Bosnian Cantonal Ministry of Physical Planning, Environmental Protection, Return and Housing Affairs.

The area of protected landscape is 22,750 hectares. As part of the *Spatial Plan of Travnik municipality for the period 2003-2020*, Figure No.61, marks the approximate boundaries of the nature park in the municipality of Travnik. The exact boundaries will be determined in the preparation of documentation for the designation of the area as protected.

[42] *In Amendments to Spatial Plan of Travnik Municipality for the period 2003-2020, Spatial basis, Vlašić is intended as a Nature Park;*

Currently, on the basis of the preliminary categorization within the *Spatial Plan of Bosnia and Herzegovina for the period 1981-2000*, this area has been set aside as an area of particular importance and content of unique phenomenon of natural heritage, and has the status of *Nature Park "Vlašić"*.

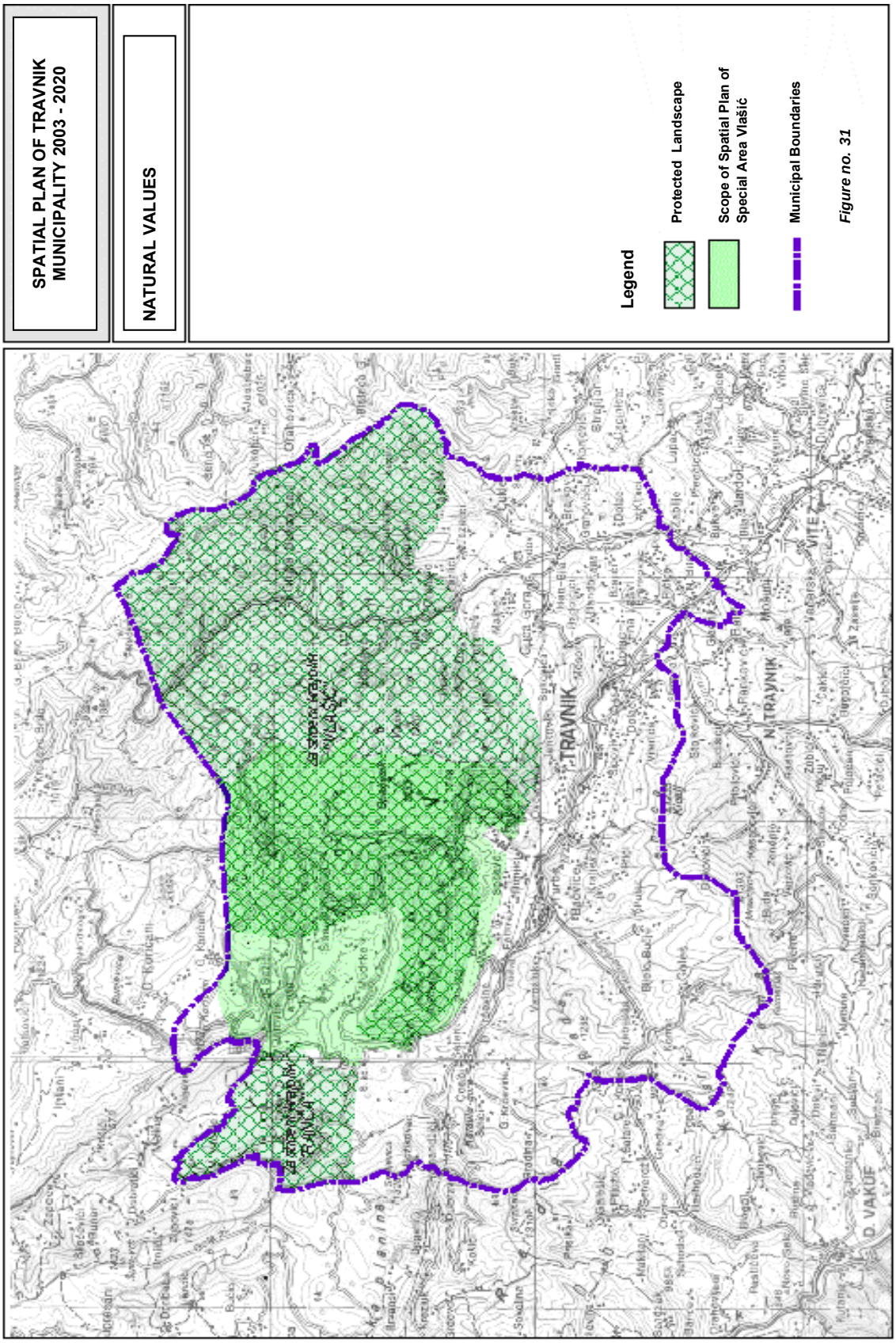


*Figure 61: The boundaries of the protected areas*

*Landscape Character Areas within the Study Area*

The Vlašić Mountain Area has the characteristics of a typical mountain landscape, and with the increase in altitude, it changes its form. On the slopes and at the foot of the Vlašić massif, some settlements were established, the typical rural landscapes, where arable land varieties of crop are prevailing, which is the main activity of local people. Such areas are located in the hilly area, where in addition to the above cultivated areas, mountain hay meadows occupy an important place.

Climbing up to higher altitudes, there is a dense forest area, covered by coniferous forests with beech. This area ends in the area above the village of Galica, where there is a transformation of forest landscape into the landscape of mountain meadows. View from Galica to Devečani plateau, in the southern part, is disturbed by Palkarske stijene, which by its very large slope dominates above the village Paklarevo. The afore mentioned village was tucked in the slopes of Vlašić Mount, more precisely Paklarske stijene, and from this settlement Devečani plateau can not be seen.

The appearance of Devečani plateau corresponds to a typical karst mountain meadow, with a number of blocks of limestone on the surface and the vast community of mountain plants, which complement the space. Mountain Lodge "Devečani" is the only facility of anthropogenic origin in this area, which is fitted into the afore mentioned landscape by its architecture and choosing wood as the material, and which does not disturb its original look. South of the mountain lodge, in one of the larger bays, there is the water spring Devečani, which gives again to this area a special character, although the water capture is done in this zone.

Going further towards the top of Vlašić mountain, following the winding gravel road, the beauty of the mountain landscape is completed by hilly terrain forms overgrown by mountain vegetation. These slopes are different gradients, and thus form a poorly viewed area, which is most prominent in the area of Vlašička gromila. In all this area, some massive limestone blocks dominate on the surface, some of which, due to intensive winds, have no developed plant cover.

Using topographic maps and site visits, eight broad areas of landscape character have been identified within a 5km radius of the study area. The conclusions of the maps are results of field survey and are given in *Table 16*.

*Table 9: Landscape Character Areas*

| ***Character Area*** | ***Location*** | ***Key Characteristics*** |
|---|---|---|
| Upland valleys | Travnik (approximately 500 m a.s.l.), Turbe (approximately 569 m a.s.l.) | Areas at elevation between 200 – 1,000 m a.s.l., mountain belt. Areas of commercial and natural forests built by deciduous trees in the valley and on the sloping sides. Upland zone under grasslands (natural and anthropogenic). Closed upland valley with steep sides, which limit the view of the surrounding landscape. Wooded valley sides and fields surrounded by hedges in the settlements. Road network is passing through the valley. |
| River valleys | Lašva river valley in the municipality of Travnik | Areas at elevation between 200 – 1,000 m a.s.l., mountain belt. Partly expanded river valley with deciduous trees and the area covered with forest land on valley sides. A small |

| *Character Area* | *Location* | *Key Characteristics* |
|---|---|---|
| | | number of public buildings, located mainly on raised part of the flood plain. Larger settlements are located in the valley. |
| Hills and steep slopes | Paklarevo (approximately 900 m a.s.l.), Ovčarevo (approximately 700 m a.s.l.) | Areas at elevation between 200 – 1,000 m a.s.l., mountain belt. Natura land uncultivated grasslands, many of them anthropogenic, with hedges on their periphery. Private arable land and orchards. Areas with natural forests. Also suitable for the livestock development. |
| Mountain valley | Babanovac (approximately 1,260 m a.s.l.) | Mountain area with altitude above 1,000 m a.s.l., a typical low mountain to 1,500 m a.s.l. The mountain area is rich in conifer forests. Very well-known ski resort with functional ski lift. Significant opportunities for the development of winter tourism. |
| Exposed upland plateau | Galica (1,487 m a.s.l.) Devečani plateau (1,780 m a.s.l.) | Mountain area with altitude above 1,000 m a.s.l., a typical medium highland to 2,500 m a.s.l. The area above the upper limit of the forest, overgrown with alpine and sub-alpine meadows on limestone. There are present grasslands of the Bosnian Fescue and Matgrass. Devečani are well known gathering place for hikers and climbers, as evidenced by the built mountain lodge. The area is used for sheep grazing. |
| Exposed mountain rocks | Paklarske stijene (approximately 1,780 m a.s.l.) | Mountain area with altitude above 1,000 meters above sea level, a typical medium highland to 2,500 m a.s.l. On the steep cliffs, made of limestone, have been developed rock and in some places scree communities. The area is very difficult to access. |
| Mountain valleys and slopes | Small area above Paklarske stijene in the zone of Devečani, east and northeast of the gravel road toward Đenetići, north of the mountain lodge "Devečani" in Oštrik area and north area of the concession area to Buhačice | Mountain area with altitude above 1,000 m a.s.l., a typical medium highland to 2,500 m a.s.l. The area above the upper limit of the forest, overgrown with alpine and sub-alpine meadows on limestone. There are grasslands of the Bosnian Fescue and Matgrass. The area is used for sheep grazing. |
| Mountain peaks | Peak Paljenik (1,933 m a.s.l.) | Mountain area with altitude above 1,000 m a.s.l., a typical medium highland to 2,500 m a.s.l. The area above the upper limit of the forest, overgrown with alpine and sub-alpine meadows on limestone, with present endemic plant communities of the Bosnian Fescue. There is a broadcasting relay station. |

Visibility within the Character Areas

Landscape features (such as forest and woodland, open grasslands, hedgerows, buildings etc.), topography and local landform all influence the extent of views within the landscape. Whether views are close range (0-5 km), medium range (5-10 km), long range (10-15 km), distant (15 km

+), enclosed and intimate, or unrestricted and panoramic depends on the interaction of landform with surface features.

The extent of visibility within each character area varies according to this relationship between landform and features and is summarized in the *Table 17* below.

*Table 10: Visibility within Differing Landscape Character Types*

| ***Character Area*** | ***Visual Appraisal and key Influencing Factors*** |
|---|---|
| Upland Valleys | Long to medium distance views, with open views providing good, longer distance views across undulating pasture, landscape towards scarp slopes. |
| River Valleys | Long to medium distance views, with closed views towards the river valley, which is visible, without the possibility of views on the river, because of coastal vegetation, and vegetation in general. |
| Hills and Scarp Slopes | Long to medium distance views, with vegetation of partially closed views, with exposed slopes and scarp slopes. |
| Mountain Valleys | Medium to short distance views, with open views providing good, longer distance views, partially restricted by forest vegetation to the west. |
| Exposed Mountain Plateau | Long to medium distance views, with open views providing good, longer distance views. Views of the highest mountain peaks of the surrounding distant mountains. Vegetation does not restrict the distance views. |
| Exposed Mountain Rocks | Long to medium distance views, with open views providing good, longer distance views. Views of the highest mountain peaks of the surrounding distant mountains. |
| Mountain Valleys and Slopes | Medium to short distance views, with open views providing good, longer distance views. |
| Mountain Peaks | Long distance views to the south, southwest and southeast, medium to the east, and short to the north, where, due to landform, the view is restricted and ends to the highest top of Vlašić, above the concession area. |

## 4.10 Cultural Heritage

Institute for Protection of Cultural Monuments and Natural Rarities[43,] has registered and protected a large number of cultural and historical monuments and the ensembles, archaeological sites-inventory. All of them are located in the area of Travnik municipality, mostly in Travnik city, approximately 4.5 km away from the study area. An overview of cultural heritage assets includes:

Archaeological sites: *Prehistoric times*, *Period of Roman rule*, *Necropolis of stećak tombstones* and *general sites,* in a larger number of settlements in the entire area of the Municipality, the largest concentration in the valleys of watercourses; *The Middle Ages (fortified towns - burgs*), in several villages in the entire area of the Municipality, mainly in the valleys of watercourses;

The Ottoman period: *Mosques*, *Bridges*, *Turbe tombs* (the most famous the Vizier's turbe, 18th and 19th century), *Mezarja/cemeteries*, *Sahat kule/Clock towers*, *Madrasahs*, *Mektebs*, *Residential buildings* and *Fountains*, mainly in Travnik;

Austro-Hungarian period: *Catholic monasteries and churches (from more periods), Orthodox churches* (from more periods), *Jewish synagogue* and *Individual facilities*, mainly in Travnik;

The historic urban ensemble of Travnik (urban whole of the city center with a higher concentration of facilities of Western European eclecticism)By the *Decision of the Commission to Preserve National Monuments*, monuments in the area of Travnik municipality were declared as national monuments. These are mostly in Travnik city, approximately 4,5 km away from the study area. These include:

The Batal's grave in Turbe near Travnik – archaeological site;

Mosque in Gornja Čaršija (Mehmed Pasha Kukavica mosque, Ali bey mosque) and the the Clock Tower – architectural ensemble in Travnik;

The Jeni (Hasan-aga) mosque – architectural ensemble in Travnik;

The remains of a Roman settlement, late antique basilica and the graves at Crkvina in Varošluk, Turbe near Travnik - the archaeological site;

The Clock Tower on Musala in Travnik– historic monument;

The Old Fort in Travnik – architectural ensemble;

The Turbes under the lime tree or Abdullah-Pasha's Turbe, Jalaluddin-Pasha's Turbe and Perishan Mustafa-Pasha's Turbe with a fountain – architectural ensemblein Travnik;

The Šarena (Sulejmanija) mosque – architectural ensemblein Travnik.

[43] *Spatial Plan of Travnik Municipality for the period 2003-2020*

There are a number of sites of cultural and historic interest in the Municaplity of Travnik, however none are located within the boundaries of the concession area. They are approximately 4.5 km away from the study area.

## 4.11 Socio-Economic Baseline

Travnik municipality is located in the central part of Bosnia and Herzegovina, in Central Bosnia Canton, and covers an area of 563 km$^2$. It is bordered by nine municipalities: in the south Bugojno, Novi Travnik and Vitez, in the east Zenica, in the north Teslić, Kotor Varoš and Dobretići, in the west Jajce and Donji Vakuf. It represents a rounded geographical space, to which the existing natural and social factors give also a tourist character. This area is intersected by significant west-east transport routs, which brings economic movement to the municipality.

The advantage of the geographical position of Travnik municipality, in particular defined the following elements: a central location in Bosnia and Herzegovina; an important position on two very important transverse invasions (Bosnia valley and the Vrbas valley) and one main longitudinal direction; to be located at the forward part of the Balkans to Central and Western Europe; and that on all four sides, builds on the directions of Balkan and European economic flows.

Travnik municipality is situated at an altitude of 517 m above sea level, in the narrow valley of the river Lašva, which is enclosed by high mountains Vlašić from the north and branches of the lower Vilenice from the south.

Within the municipality of Travnik there are 57 543 residents in 16 641 households, in 90 settlements[44], in 34 local communities.[45]

### *4.11.1 Population[46]*

*Demographics*

During the war and post-war period (1992 onwards), significant demographic changes have taken place in the municipality of Travnik. There has been a significant decline in population, and also a decline in the percentage of the total population in the territory of the Central Bosnian Canton. Within the Canton Travnik municipality dominates, because of its size relative to its neighbours Novi Travnik and Vitez.

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[44] *Census of population, households and dwellings in Bosnia and Herzegovina, 2013; Preliminary results in municipalities and populated areas in the Federation of Bosnia and Herzegovina; 195 Statistical Bulletin, Sarajevo 2013.;*

[45] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

[46] *Spatial Plan of the Central Bosnia Canton 2005. – 2025;*

Population change for the period 1981.– 1991. shows that the area of Travnik municipality experienced a growth of 10%. According the latest recent statistics, estimated change in population for the period 1991.– 1999. shows a decrease of 29%.

*Population density*

Within Travnik municipality there are 57 543 inhabitants, with the total number of households of 16 641[41]. Population density is 64.7 inhabitants/km$^2$.

According to population density, Travnik municipality is one of the most densely populated municipalities in Bosnia and Herzegovina. Population per 1 km$^2$ of the territory of the Municipality has been increasing: in 1948. it was 64.3, and in 1991. was 125.7. In relation to Bosnia and Herzegovina, the population of the municipality was always higher, and in 1991. increased by 46 percent.[47]

In the study area there are no residential or public buildings, except for the mountain lodge „Devečani". The local population, close to the study area, is settled in Paklarevo, Šišava, Ovčarevo and Galica.

Paklarevo and Ovčarevo settlements are located at the bottom of hills and steep slopes at an altitude of (Paklarevo approximately 900 m a.s.l., Ovčarevo approximately 700 m a.s.l.). Paklarevo is approximately 4 km and Ovčarevo is approximately 5 km away from the southern end of the study area. In both of settlements there are private low rise houses with related farm structures, which make up characteristics of rural areas. The planned Wind Farm Vlašić is located on the mountain plateau above the settlements, and they are partly „tucked" in Devečanski plateau, especially Paklarevo.

Galica settlement is approximately 2 km to the west of the study area, located at the exposed upland plateau, up above Srnske stijene, at an altitude of 1,487 m a.s.l. It is an small settlement with several weekend houses.

Šišava settlement is approximately 6 km to the west of the study area, located at the mountain valley, at an altitude of 1,166 m a.s.l. There are private buildings with related farm structures, with low rise houses, which make up characteristics of rural areas.

[47] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

*Labour market (employment and unemployment)*

In Central Bosnia Canton for every 100 employees there are 74 unemployed persons (42% unemployment). In the area of Travnik Municipality, 7,157 (12.43%) people are unemployed, all of professional qualifications, and 11,207 (19.47%) people are employed.[48] The number of unemployed persons is shown in *Table 18*, based on professional qualifications.

*Table 11: Unemployed persons, based on professional qualifications:*[49]

| **Total** | University degree | College education | High school education | Primary school education | Highly skilled worker | Skilled worker | Semi skilled worker | No skilled worker |
|---|---|---|---|---|---|---|---|---|
| 7 157 | 119 | 86 | 1 322 | - | 45 | 2 349 | 142 | 3 049 |

### *4.11.2 Urban areas*

Spatial distribution of settlements, in the area of Travnik municipality is uneven. There are parts within the municipality that are not inhabited or have a very small number of settlements and inhabitants. Travnik has the role of cantonal and municipal center, and is the largest urban area in Canton.

The settlements closest to the study area, are Galica approximately 2 km, Paklarevo approximately 4 km, Ovčarevo approximately 5 km and Šišava approximately 6 km. These settlements, have a prominent agricultural and livestock economy, and are relatively well connected with Travnik via the transport network.

The inhabitants of these settlements are mostly farmers, who are engaged in agriculture and cattle breeding. Not many of them are employed full time, but they are also dealing with agriculture and cattle breeding.

### *4.11.3 Economy*

The main economic activities within the Municipality include the following:

*Agricultural production* before the war ((1992-1995)) agricultural production was mainly used for meeting the needs of the area, and some products were marketed to domestic and to a lesser

[48] *Development Strategy of Travnik municipality for the period from 2011 to 2015;*
[49] *Development Strategy of Travnik Municipality for the Period from 2011 to 2015;*

extent to foreign markets. Unfortunately, during the war, agricultural production decreased and some farm buildings were damaged or destroyed.

*Forestry* is also one of the important activities in the Municipality, because the wealth of forests served as the basis for development of forest cultivation, management and exploitation. This activity is being carried out by the Forest Management Company "Lašvansko", which in its management areas includes forest areas with more neighboring municipalities, employing about 1 500 workers. In addition to the regular exploitation of forests, during the war there was a significant unplanned and unregistered logging, as well as the appearance of disease of forests, which continued after the war.

*Wood industry* takes place within the Municipality of Travnik in sawmills or factories which are located in Travnik and surrounding villages.

*Publishing and printing* is a tradional industry of the area going back to 1904. Within the town of Travnik there are modern facilities and professional staff.

*Mineral resources*are prevalent within the area of Travnik municipality (e.g. iron, brown coal, building stone). These resouces may contribute to the development of mining and other indsutries such as energy.

*Metal-processing industry* has capacities for production of gray and steel castings, castings of non-ferrous metals and metallurgical aluminum.

*Construction activities (construction of buildings)* were carried out by free-standing organizational units. Construction activities are performed by "Građevinarstvo" Travnik. Currently, the industry is represented by a number of smaller construction companies in private ownership.

*The textile industry* in Travnik municipality is limited to the processing of clothing once it has been manufactured.

*Orcharding*

The area of Travnik municipality has excellent conditions for the development of fruit growing, especially for growing plums, pears, apples and walnuts, as well as vegetable growing in river valleys.[50]

In the study area, there are no orchards.*Livestock breeding*

[50] *Development Strategy of Travnik Municipality for the Period from 2011 to 2015;*

Vast pasture areas[47], on the almost untouched mountain slopes, in the area of Travnik municipality, are highly favorable for the development of sheep breeding. Quality sheep milk is the basis for making the world famous sheep cheese in which the Travnik region is recognizable. This cheese, as indigenous type of domestic white cheese from sheep's milk, in brine, which is certainly a brand of the region, holds a special place among the indigenous dairy products.

In the Devečani plateau area, nomadic livestock breeding is dominant. Other agricultural sectors are not represented.

### *4.11.4 Tourism and Catering*

Vlašić mountain has a high potential for tourism . Mountain tourism is being promoted in the region under the marketing slogan "*365 active days on Vlašić*". However, it is recognised by the authorities that there is a need to develop the necessary infrastructure for winter activities, which includes skiing, mountain hiking on mountain tracks/footpaths, research and caving tours, mountain biking, riding, paragliding, photo-safari, etc.

Travnik municipality has the potential to develop tourism which is recognised through the establishment of protected areas for both natural (*protected landscape/nature park "Vlašić" protected landscape "Ranča", Plava voda*) and cultural heritage sites (e.g. *The Vizier's tomb in Travnik, the old town of Travnik, Šarena (Sulejmanija) mosque , birthplace of Ivo Andrić*).

The area of Devečani plateau has high-mountain hiking routes (signposted), in addition to a meeting place for hikers in the mountain lodge "Devečani". Rural tourism also exists in the area. For example there is a marked trail called "Road of the cheese." At the northeastern part of the concession area, on the border, there is a religious cross, periodically visited by locals and tourists.

### *4.11.5 Infrastructure[51]*

*Road Transport*

Road transport is detailed described within the *Section 4.1*.

*Railway Transport*

[51] *Spatial Plan of Travnik municipality for the period 2003 – 2020*

There is no railway within the Municipality. The nearest train station of Travnik is Lašva and it is the train station of the railway Sarajevo-Šamac. Distance of the town of Travnik from the Lašva train station is 95 kilometers.

### *4.11.6 Water supply and waste water*

*Water supply*

Travnik municipality is supplied with drinking water from the springs Plava voda 200 l/s, Bašbunar 45 l/s, Goleš 28 l/s, Runjići 5 l/s and Trebišnjica 16 l/s. A total of 294 l/s is captured. The water supply network is constructed in pipes Ø 50-400 mm from different materials. Water supply for 20 000 residents is realized through 5 reservoirs (Kupilo, Kalibunar, Skok, Runjići and Zulići). Analysis of drinking water quality from the city water facilities is performed by the Institute of Public Health of Central Bosnia Canton. In rural areas, water supply is done using rural water supply and control of water quality is generally not performed or it is very rare.[52] Holders of utilities, in the area of Travnik municipality, are public utility companies JKP «Bašbunar», JKP «Trebešnjica» and SRC «Vlašić», whose activity, among other things, is also water supply.

The supply of water to population with in the Municipality of Travnik is not sufficient,, especially in dry periods. The required amount of drinking water for Travnik, which can meet the needs of the city and its industry in the planning period, is possible to be provided from existing water spring Plava voda, which gives the minimum of about 700 l/s of water, and the water spring Bašbunar.

Travnik is included in the concept of the regional water supply of the Central Bosnia area, together with Novi Travnik, Vitez, Busovača, Zenica and Kakanj. Besides these water sources, there is also a plan for the use of surface reservoirs „Jasenica" and „Gluha Bukvica".[53] By building these reservoirs, about 1,800 l/s of drinking water is supplied, which with 500 l/s of the water source "Plava voda" and 350 l/s of water intake on the Krušćica river, gives the available amount of water sufficient for the regional water supply. At all of the above water sources are required significant works on the organization of the protection zones and the construction of other water supply facilities (pumping stations, reservoirs, main water supply lines, distribution network with measuring devices).

In some parts of Travnik municipality, there are relatively high karst plateaus, such as the slopes of Vlašić, Rostovo, the left bank of Ugar and others. In the central part of the Babanovac plateau (Šišava), where there is a variety of development including a weekend resort, hotels, restaurants,

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52 *LEAP Travnik – Local Environmental Action Plan 2010 – 2015;*

53 *Spatial Plan of Travnik municipality 2003 – 2020;*

guesthouses and other infrastructure of sports and recreation center SRC "Vlašić", water supply is done from the source capture about 1.5 km downstream of the Ugar river spring. This captured water source is the only one bigger and also the most important water source per yield on Vlašić plateau. According to the *Water supply study of Vlašić plateau, ("Projekt" Sarajevo, July 2000.*), the minimum capacity of the water source captured is 25 l/s.

The existing water supply system includes Babanovac, Šišava, and settlements in Mudríke (Halilovići, Odžak, Mehići, Čogići-right of the road to Babanovac, and Maglići and Golići-left of the road to Babanovac). Water supply is also resolved for settlements Čogići, Odžak, Halilovići and Mehići.

In the *Water supply study of Vlašić plateau,* during a field reconnaissance of the area, there are some other smaller water sources, but their yield, except Šantić water source, does not exceed the capacity greater than 0.15 – 0.70 l/s. The wellheads, except the existing capture, are not included in the water supply system of settlements and are used for watering livestock.

In the concession area, directly influenced by the project, there is a water supply network of the Public Broadcasting Service of Bosnia and Herzegovina (JRT servis BiH) for water supply of broadcasting transmitter "Vlašić" and the mountain lodge "Devečani".

Facilities of the water supply network that are located within the study area and include:

Devečani water spring with capture, pumping station and trough for watering livestock;

discharge pipeline from „Devečani" water spring to RTV repeater „Vlašić", in a length of 1,800 m;

two reservoirs with capacity V=150 $m^3$ at location Opaljenik;

a reservoir with capacity V=5 $m^3$ and pipeline in a length of approximately 200 m, which supplies with water the mountain lodge „Devečani".

The route of the pipelines, reservoirs and pumping station are visible in the field.

Near Devečani water spring there is a small spring which is captured with a water fountain and trough, the water from this spring is used for drinking by people (cattlemen).

There is no data on water quality of the Devečani spring. Analysis of water quality of the water supply network is conducted by the Institute for Public Health of the Sarajevo Canton (samples were taken from the water tank). Test results of physical-chemical and microbiological parameters of the water quality are shown in *Table 19 and Table 20*.

*Table 12: The measurement results of physical-chemical parameters of water quality from the Devečani water supply network[54]*

| Test parameters | Unit of measure | Test results | Reference value | Test methods |
|---|---|---|---|---|
| Colour | PtCo scale | **0** | # | *US EPA 110.2 (TM V03)* |
| Odour | - | **no** | # | *BAS EN 1420-1 (TM V04)* |
| Taste | - | **no** | # | *BAS EN 1420-1 (TM V04)* |
| Turbidity (for surface water) | St. NTU | **-** | max 1,0 | *US EPA 180.1 (TM 104)* |
| Turbidity (for other types of water) | St. NTU | **0,4** | # | *US EPA 180.1 (TM 104)* |
| Electro conductivity | µS/cm at 20˚C | **353** | 2500 | *BAS EN 27888 (TM 101)* |
| pH | pH unit | **8,3 (t 20,2°C)** | 6,5≤pH≥9,5 | *BAS ISO 10523 (TM 102)* |
| Consumption of $KMnO_4$ | mg/l $O_2$ | **1,8** | do 5,0 | *BAS EN ISO 8467 (TM V11)* |
| Ammonia ($NH_4$) | mg/l | **0,1** | 0,5 | *US EPA 350.2 (TM V13)* |
| Chlorides (Cl) | mg/l | **<1,5** | 250 | *BAS ISO 9297 (TM 103)* |
| Nitrates ($NO_3$) | mg/l | **<1,8** | 50 | *US EPA 4500-$NO_3$ (TM V15)* |
| Nitrites ($NO_2$) | mg/l | **<0,007** | 0,5 | *US EPA 354,1 (TM V14)* |
| Iron (Fe) | µg/l | | 200 | *BAS EN ISO 15586 (TM V25)* |
| Aluminium (Al) | µg/l | | 200 | *BAS EN ISO 15586 (TM V25)* |

*# Acceptable for consumers and without abnormal changes*

*Table 20: Measurement results of microbiological water quality parameters from the Devečani water supply network[55]*

| Test parameters | Unit of measure | Test results | Reference value | Test methods |
|---|---|---|---|---|
| The number of coliform germs in 100 ml of water | cfu/ml | **not present** | b | *MF BAS EN ISO 9308-1* |
| The total number of viable germs, 22±1 °C, 48 h | cfu/ml | **0** | 100 | The number of germs on nutrient agar, Pour plate method |

[54] *A report on the physical and chemical testing of water, Institute of Public Health of Canton Sarajevo, May 2013.;*

[55] *Report on the microbiological examination of water, Institute of Public Health of Canton Sarajevo, May 2013.;*

| | | | | |
|---|---|---|---|---|
| The total number of viable germs, 37±1 °C, 48 h | cfu/ml | **0** | 20 | The number of germs on nutrient agar, Pour plate method |
| Escherichia coli at 37±1 °C, 24 h | cfu/100 ml | **not present** | [b] | *MF BAS EN ISO 9308-1* |
| Enterococcus spp at 37±1 °C, 48 h | cfu/100 ml | **not present** | [b] | *MF BAS EN ISO 7899-1* |

[b] *Should not be present*

Test results of physical-chemical and microbiological parameters show that the water quality by measurement indicators corresponds to the requirements of *the Rulebook on* Drinking Water Safety *(Official Gazette of BiH, no. 40/10, 43/10, 30/12).*

*Waste water*

The pollutants that affect water quality in the municipality of Travnik, can be divided into concentrated (settlements distributed over the catchment areas of water courses or as a product of economic activity of the population) and diffuse (all sources of pollution, which are emitted over a wide area and, in this way, negatively affect the quality of surface and ground water). The dominant source of contamination of watercourses in the municipality of Travnik, are waste water from households and waste water of industry and other economic activities. In the municipality of Travnik, emissions of waste water pollution into the Lašva river is high. The intensity of contamination from municipal waste water is approximately 27 877 equivalent inhabitants[56], while the amount of contamination from industry is unknown.

Not a single industrial plant, which is operating and producing significant amounts of contaminated water, treats its waste water before discharging it. There is no record on the type of pollutants, or total amount of contaminated water, which is produced and released into the watercourses. Waste water of existing industrial facilities, car wash and public institutions, are discharged, without treatment, into streams or directly into the Lašva river. In addition to these pollutants, it is also important to mention the pollution caused by built roads, extending along these watercourses (through the washing of roads due to rainfall and intake of oils and fats in the riverbeds, indirectly through increased intensity of traffic and the entry of lead and sulfur, through accidental pollution, through traffic accidents involving vehicles carrying polluting substances). In places where canal water is discharged into watercourses, contamination of the watercourses is extremely high.

*Sewage system and waste water disposal*

[56] *Spatial Plan of Travnik municipality for the period of 2003– 2020;*

The sewerage system is managed by the same utilities companies that manage water supply system. Travnik has a constructed sewage system, without the main collector and equipment for water treatment. The sewerage network was built in the urban area of Travnik municipality and partly in the area of Turbe and local communities Polje-Slimena, Ilovača, and Dolac and Dolac on Lašva. In the city there is a mixed sewer system. The pipes are made of concrete and PVC, and discharges of sewerage network in the river were made in city areas.[57]

Smaller and rural settlements in the entire area of Travnik municipality, do not have a sewage system. In these areas there is only partial coverage of sewage systems and discharge is sometimes directly into watercourses. One part of the population discharges its waste water mostly in septic tanks, which are not properly constructed. A significant part of the population in suburban areas and villages does not have any provision for domestic sewage.

Industrial plants discharge their waste water, mostly without treatment or with an insufficient degree of purification, directly into watercourses. Travnik municipality does not have a single waste water treatment works.

At the Vlašić plateau, sewage system and waste water and storm water treatment, in rural and weekend settlements, do not exist, except for the part on the SRC in Babanovac. In the present situation, waste water from households, tourism, catering and other facilities of small businessis collected in septic tanks, or directly discharged into natural gullies and streams.

The existing sewage system is of mixed type, built for the reception of sewage and storm water in the area of Babanovac and Dolina panjeva. In the lowest downstream point of sewage collector, a waste water treatment works is planned. Waste and storm water are currently discharged into the gully, without purification.

Facilities that are in the study area (broadcasting transmitter and a mountain lodge „Devečani“) discharge their waste water into the septic tank.

*Spatial Plan of Travnik municipality for the period 2003 - 2020*, the annex to the plan "*Spatial Plan of Vlašić*" *(Zoning Plan)*, provide a plan of repairs of the existing one, as well as the plan to build a new sewerage system and equipment for waste water treatment.

### *4.11.7 Disposal of solid waste and waste management*

The activities of collection, removal and disposal of municipal waste for about 57,543 residents in the municipality of Travnik, are performed by public utilities companies JPK "Bašbunar", JPK "Trebešnjica" and Sports and Recreational Center "Vlašić". 100% of the total area of Travnik municipality is covered by service of collection, removal and disposal of waste. Waste removal

[57] *LEAP Travnik – Local Environmental Action Plan 2010 – 2015;*

covers the following settlements in the municipality of Travnik: the city with 4 Local communities (LC), LC Turbe, LC Nova Bila, LC Pokrajčići, LC Vitovlje, LC Mudrike, LC Šišava, partly LC Karaula, settlements Guča Gora, Krpeljići, partly Mehurići, settlements Slimena, Dolac, Ciglana, Polje, Grahovik, Guvna, Vakuf, G.Dolac and Ilovača, and the area of tourist settlement Babanovac, Vlašić.[58]

Average daily quantities of collected and disposed solid waste in the municipality of Travnik are 60-70 $m^3$/day, and the quantities at the annual level amount to about 570 t (plan for 2010.).

*Medical waste* is treated at the device "Sintion", which has Public Institution Hospital Travnik, where infectious waste is processed in municipal waste and after treatment, the waste is transported to the regional landfill.

*Specific waste*, such as electronic waste, used oil, etc., are not treated, because there is no the appropriate technology for the treatment of this type of waste.

*Construction waste management* is not adequately resolved, but the Municipality is actively working to find an appropriate location for this type of waste.

In the municipality of Travnik, existing landfill "Ovčarevo" is being rehabilitated in accordance with legal regulations, and new landfill was agreed in the *Agreement on accession to the project of solid waste management and the use of Regional landfill Moščanica in Zenica*, concluded between the nine municipalities, in November 2006., and from September 2008., was also started disposal of municipal waste at the same.

In the municipality of Travnik (the area of 30 local communities), there are 182 illegal landfills. At 167 locations of illegal dumps, in which an assessment is made, there is a total of 14,246 $m^3$ of waste. However, it should be noted that at 15 illegal dumps, where it was not possible to estimate the amount of waste, there is at least 10,000 $m^3$ of waste of various origin.

### *4.11.8 The Power Grid[58]*

The existing HV network, within Travnik municipality (data of "Elektroprijenos BiH" Operational area Sarajevo) includes TL 220 kV Kakanj - Prijedor (part of the transmission line), TL 110 kV Zenica

[58] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

1 - Travnik 1 (part of the transmission line), TL 110 kV Travnik 1 - Travnik 2, TL 110 kV Travnik 2 - Jajce 2, SS 110/35/10 kV Travnik 1, SS 110/20/10 kV Travnik 2.

In Travnik municipality there is no planned construction of new transmission facilities, except expansion and modernization of existing facilities.

In the area of Vlašić the energy demand is predicted to increase, in particular because of the predicted increase in tourism (*Spatial Plan of Travnik municipality for the period 2003 – 2020)*. A review is therefore required of current power supply (safety and reliability). In pre-war plans of power supply of Turbe and the area of Vlašić, the construction of new substations of 110/x kV Turbe was planned, and it has been recommended within the Travnik Spatial Plan that it is necessary to consider its construction now to meet increasing demands.

Through the concession area passes over an underground high-voltage cable, on the stretch Broadcasting relay (RTV relay) - mountain lodge "Devečani" crossing the WF Vlašić site. Also, in the upper left corner of the concession area is 10 kV overhead cable, which branch of the electrical network in Turbe, leads to RTV relay on Paljenik. RTV relay the north, outside the concession area.

### *4.11.9 Telecommunications network[58]*

The telecommunication system in Travnik municipality consists of a system of fixed and mobile telephony. The main supplier for both services, for the area of Travnik, is BH Telecom, HT d.d., Mostar and HT Eronet. Internet network is also established, where the main internet provider is BH Telecom. The average density of Travnik municipality is 29 telephone lines per 100 inhabitants. The average of Western European countries amounts to more than 50 connections per 100 inhabitants.

Within the concession area, under the existing local road, which leads to RTV relay on Paljenik, is the underground optical cable from BH Telecom. North of the concession area, close to the same, is the plot, the property of BH Telecom, where they have planned construction of the tower and building for their purposes.

*TV and radio stations*

The area of Travnik municipality is covered by the signal of the public broadcasting (radio and television) system, RTV Travnik and TNT Radio.

Within the concession area, there are no installation, no facilities of this system. The nearest object of this system, is the broadcasting relay on Paljenik, north, approximately 250 m above the concession zone.

### 4.11.10 *Religious buildings*

In the inner city area of Travnik, there are 15 (fifteen) mosques, 4 (four) roman catholic churches, 2 (two) orthodox churches and 1 (one) jewish temple.

In the concession area there are no religious buildings.

### *4.11.11 Cemeteries/graves*

In the area of Travnik municipality, there are martyr cemeteries/graves, muslim cemeteries/ graves. Every village has cemeteries/graves that are still being used.

In the concession area there are no cemeteries/graves.

### *4.11.12 Access to education, health and other services*

*The education system*[58]

The education system in Bosnia and Herzegovina, and therefore the area of Travnik municipality, consists of three levels: primary education, which is compulsory, secondary education, which is not compulsory and higher education. In the area of Travnik municipality, educational institutions are state-owned. There are twelve elementary schools, and six high schools.

In the concession area there are no schools or other educational institutions.

*Health Care*[59]

Health care, in the municipality of Travnik, was organized through the activity of medical institutions in the public and private sector. In Travnik there is also the Public Health Institute of the Central Bosnia Canton.

In the concession area there are no health care facilities.

*Social Security*[60]

[58] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

[59] *Development Strategy of Travnik municipality for the period from 2011 to 2015;*

[60] *Development Strategy of Travnik municipality for the period from 2011 to 2015;*

Social security and care in the area of Travnik municipality is carried out by centers for social work and care, which are at the municipal level, as is also the case in other parts of Bosnia and Herzegovina (BiH).

In the concession area there are no facilities of social security.

*Sports and Recreation*[61]

Within Travnik municipality, there is the *Cultural and Economic sports center* "*Pirota*", which is not yet fully completed, but will includea football field with covered stands, handball roofed playground, and large areas of office space.

There is a Hunting Club "Vlašić" in Travnik. The hunting ground boundaries match up with the boundaries of the Travnik Municipality. The hunting area is in the concession area of the Wind FarmVlašić. From hunting and commercial buildings in the area of hunting grounds, neither facility is in the concession area.

Within the concession area there is the existing mountain lodge (ML) "Devečani", property of the Mountaineering Association (MA)"Vlašić" Travnik. MA "Vlašić" manages and operates it. The building is supplied with water and electricity. The mountain lodge "Devečani" is used mainly by MA members, but it can be used by the public by appointment (mostly on weekends or public holidays). ML "Devečani" is located near the existing road and directly from the gravel road an access to the mountain lodge "Devečani" is enabled. The same can be reached by hiking, mountain climbing and biking as well.

[61] *Spatial Plan of Travnik municipality for the period 2003 – 2020;*

# 5. ASSESSMENT OF POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROJECT

## 5.1 Introduction

Having set out the environmental baseline in Chapter 4, this chapter identifies the potential environmental effects that may result from the construction, operation and decommissioning of the proposed WF Vlasic. Assessment methodology set out below has been used to determine impact significance. Unless otherwise stated, effects from construction are considered to be direct.

It is important to note that the level of significance assigned to the identified impacts within this chapter is **with** mitigation measures that are described in Chapter 6.

## 5.2 Impact Assessment methodology

The ESIA has been carried out using an overarching framework which is set out below:

### *5.2.1 Identification of receptors*

The term "receptor" is used to describe features of the environment and may comprise resources such as water resources, habitats and species which are valued by society for their intrinsic worth and/or their social or economic contribution; and social groups such as individuals and communities that may be affected by the Project.

The importance of a receptor is determined by the consideration of a range of criteria depending on the topic under consideration, including: the economic, social and cultural value of the receptor, locally, nationally and internationally; any local, national or international designations; the rarity of the receiving environment; and the benefits or services provided.

Receptor sensitivity is determined by the consideration of a receptors' ability to resist or adapt to changes and its resilience to change. *Table 21* below describes categories of importance and/or sensitivity that have been applied in this ESIA.

*Table 21: Receptor Importance and Sensitivity*

| ***Importance/ Sensitivity of receptor*** | **Example of Importance of receptors** | **Example of Sensitivity of receptors** |
|---|---|---|
| Very High | An attribute with a high quality and rarity on an international, regional or national scale with little or no potential for substitution. | Sensitive area or receptor with little resilience to imposed stresses |

| | | |
|---|---|---|
| High | An attribute with a high quality and rarity on a local scale with little or no potential for local substitution, or with a medium quality or rarity on a regional or national scale with limited potential for substitution. | |
| Medium | An attribute with a medium quality and rarity on a local scale with limited potential for substitution, or an attribute of low quality and rarity on a regional or national scale. | The receiving environment or receptor has a moderate natural resilience to imposed stresses. |
| Low | An attribute of low quality and rarity on a local scale with potential for substitution locally. | The receiving environment or receptor has a high natural resilience to imposed stresses. |

### *5.2.2 Identification and Assessment of Potential Impacts*

Potential environmental and social impacts are identified and then it is assessed whether these impacts may or may not consequently have a potential significant effect on sensitive receptors, where:

- The term "impact" will be used to describe an effect that results in a significant change to a sensitive receptor;
- The term "effect" is used when describing the consequence of a change arising from the Project on a sensitive receptor.

### *5.2.3 Impact Magnitude/severity*

The impact magnitude or severity is determined based on whether the impact is direct or indirect, it's geographical extent, the duration of change and the likelihood of it occurring is then identified as negligible, low, medium or high, which is explained and justified using modelling results or professional judgement.

These parameters are define as:

***Type**:*

- Direct impacts are those which arise directly from activities that form an integral part of the Project (e.g. new infrastructure) and is within the control of the developer;
- indirect impacts which arise from activities not explicitly forming part of the Project but as a "knock on effect" of it, that may not be within the control of the developer (e.g. changes to water availability due to increased influx of people);

***Duration**:*

- short-term (days to weeks);
- medium-term (weeks to months); or
- long term (months to years);

***Extent**:*

- localised; or
- regional;
- national/cross boarder

***Likelihood**:*

- highly unlikely to occur;
- unlikely to occur;
- likely to occur; or
- certain to occur

### *5.2.4 Determining the Significance of Effects*

Significance of effect reflects the relationship between two factors:

- The magnitude (or severity) of impact (whether the impact is direct or indirect, its geographic extent, the duration of change and its likelihood);
- The sensitivity, importance or value of the affected receptor.

The significance of effect is determined by considering the importance and sensitivity of the receptor in combination with the magnitude of the impact. Predicted significance of effects is classified according to whether they are considered to be Major, Moderate, Minor or Negligible; and Beneficial, Adverse or Neutral. *Table 22* below sets out the relationship between factors in determining significance of effects.

*Table 22: Predicting significance of effects*

| | | **Magnitude of impact** | | | |
|---|---|---|---|---|---|
| | | **High** | **Medium** | **Low** | **Negligible** |
| **Sensitivity or importance of receptor** | **Very High** | Major | Major | Moderate | Minor |
| | **High** | Major | Moderate | Minor | Negligible |
| | **Medium** | Moderate | Minor | Minor | Negligible |
| | **Low** | Minor | Minor | Negligible | Negligible |

These significance criteria are general ones which have been applied to the ESIA where appropriate. In addition, the assessments included have been defined by professional judgement

that has been based on comparison with topic-specific legislation, regulations or standards; comparison with experience on other similar projects and consultation with stakeholders.

In some cases a different topic assessment methodology or modelling has been used which is based on recognised and/or required Standards. Impacts will be quantified where possible and the method of qualification will be clearly explained if significance cannot be quantified.

### *5.2.5 Mitigation measures*

During the iterative design process of the wind farm, environmental constraints that have been identified have been considered and the design/layout of the wind farm adapted to mitigate the potential effects caused by these constraints. This is deemed 'design mitigation' and it integral to the project. The layout and design of WF Vlasic has been determined by such design mitigation and therefore the wind farm layout described in Chapter 2 represents the outcome of design mitigation. Sometimes however, it is not possible to modify the design of the wind farm in order to avoid or mitigate any identified impacts. In these cases it may be possible to implement other types of mitigation measures that will reduce the magnitude of the environmental and/or social effect. Mitigation measures for identified effects are outlined in Chapter 6 and these have been taken into account during the assessment.

### *5.2.7 Assessment of Cumulative effects*

Assessment of cumulative effects considers the effects of other past, present or reasonably foreseeable projects/developments which are close to the proposed WF Vlasic. When the impacts from these developments are considered in combination with WF Vlasic, the resulting impact may be more significant that if the impacts were considered separately.

Within the study area there are no known developments that currently exist or are likely to be approved that would have a cumulative effect with the proposed WF Vlasic. Cumulative effects are therefore not considered any further.

## 5.3 Construction Phase Impacts

### *5.3.1 Hydrological Characteristics*

During construction, the most significant impacts on surface and ground water will result from activities around the excavation of soil for the foundation pits of pillars of wind turbines, and excavation during the construction of access roads for equipment and vehicles to be used for construction works, transportation of materials and equipment, and installation of wind turbines and ancillary equipment.

Adverse impacts on water quality during construction of the wind farm may be due to inadequate collection and disposal of waste on the site, then due to the storage of petroleum products for the needs of mechanization on the study area without taking measures to protect the environment during storage, as well as the uncontrolled spill of machine oil or fuel into the soil, and then into the groundwater. Standard site management practices would avoid this type of impact (e.g. through the implementation of a Construction Environmental Management Plan (CEMP). In the immediate vicinity of the study area, there are two karst springs of lower abundance, Devečani and Ormanj, which are directly threatened by any change in the catchment area due to the uncontrolled discharge of water and sanitary water during construction of the wind farm Vlašić.

Excavations for the foundations of the turbines and access roads and the removal of topsoil could have a direct and lasting impact on the ground in the form of increased erosion and sedimentation, or alluvium, which over time causes a torrent, and which would have an additional negative impact on groundwater quality due to high water permeability of the field.

### *5.3.2 Geology and Soils*

On the basis of background documentation prepared by wind farm designers and on the experience of other wind farm designers, there is no impact. According this, there are no impact on seismic conditions.

As set out in the baseline section (*Section 4.6*) soil within the study area has the characteristics of VI and VII rating categories[62]. Based on existing laws, this type of area can be used for construction.

Given the fact that there is no arable land of high rating category at the site and since the cover consists of mountain pastures of the VI and VII rating categories, construction of the proposed WF Vlasic will not have harmful effects on the land and agricultural activities in this area. Land take for wind farm/access tracks and soil/gravel that will be brought to the site is detailed described in *Chapter 2*.

During construction there is a potential risk of of spillage of various oils and lubricants into the ground, which in these shallow and porous soils can lead to degradation of soil quality. However, standard environmental management will be integrated into construction practices and it is considered that the risk is low and therefore the likely effect of neglibile significance.

Potential impacts on the land at the given location of the construction of WF Vlašić would comprise the following:

[62] *Poor quality agricultural land*

- permanent impact on the land will be related to the excavation of pits for laying the foundations for each wind turbine (pillar) and setting up substations and transmitters;
- temporary impact on the land will be related primarily to the organization of service roads between the individual wind turbines (pillars).
- Accidental spillage of fuel and various oils (lubricants), leading to ground pollution effects.

*Erosion*

In view of the planned activity in study area, accelerated erosion can be expected as a considerable part of the area that will be affected by the construction. This should be particularly taken into account because the loss of soil on these geological substrates is almost irrecoverable. In addition to the fact that the formation of soil on limestone takes a long time, erosion represents the permanent loss of the most fertile part of the soil (as decribed in *Chapter 4, Section 4.6.3*). This impact is of *medium significance*.

### *5.3.3 Flora – construction impacts*

Assessment of effects are considered based on the different floral habitats and communities that have been identified within the study area.

*Subalpine and alpine pasture*

The proposed WF Vlasic is located within an area of sub alpine and alpine pastures, which are rated as habitats of great importance. Placing wind turbines, as well as the construction of access roads within this area will remove and/or damage large areas of this habitat. Quantification of the area that will be lost is currently not know and this would need to be achieved throuh a further study. Despite the lack of quntification it is considered that this loss would result in a negative, long term, significant impact.

*Subalpine and alpine meadows*

These communities will be put under pressure, given that the entire Concession area is is covered with this type of vegetation. Among the most threatened plant communities stands out *Seslerio - Gentianetum dinaricae*, with a dominant species *Genitiana dinarica G.Beck*, listed on the Red List of the F BiH under the symbol "vulnerable species" This impact is of *high significance*.

*General floral communities*

A total of 13 plant species of different status and the degree of vulnerability were recorded in the concession area. In addition to the type of vegetation that is specific and in accordance with the

terms of habitat, the area is planned as a „protected landscape"/"nature park", as well as a potential *Natura 2000* site. These habitats are very important and are considered to be *very sensitive*. Therefore, the impact on plant communities (alpine and subalpine pasture) during construction is considered to be negative, long term and significant. A negative impact is also expected on the endemic community *Festucetum bosniacae*, sharp grass fescue (*Festuca bosniaca*), although it is not considered to be significant.

Another negative effect relates to the potential pollution of plant habitats as a result of poor management and/or spills of oils, lubricants and fuel necessary for the operation of construction machines, as well as the establishment of zones where their decanting would be performed.

*Forests of spruce, fir and subalpine spruce*

Construction within the Concession Area will not lead to any impact on forest communities of fir, spruce and sub-alpine spruce as the wind farm itself is above the upper limit of the forest and the transmission line route avoids the forest areas. The construction of the access roads will require clearance of a small area of forest for areas required for expansion of curves. This will be approximately 0.40 m , which would not require clearing of dense forest or cutting of a large number of trees. It is therefore expected that there will be no significant impact on forest habitats.

### *5.3.4 Impact on birds*

26 priority bird species[63,64] were identified within the study area as requiring monitoring. This monitoring established that there is a low proportion of flights within the critical altitude zone. The trajectory of these flights, as well as the observed behavior of the target species, indicate a low level of predicted impacts within the concession area, during construction. Before the start of construction, it will be checked whole concession area to determine the presence of any ground nesting birds. It is determinated the position of nests within concession area only for *Northern Wheatear (Oenanthae oenanthae)*. This is not kind of target birds.

During construction birds can be disturbed and/or may result in their temporary withdrawal from their habitat. This disturbance to birds resulting from habitat loss (for feeding and breeding), noise and vibration levels, are considered minimal. The nearest construction activities are planned in the area over Paklarske stijene, which is between 200 m to 500 m, from potential nesting areas for the species Common Buzzard (*Buteo buteo*), Golden Eagle (*Aquila chrysaetos*), Common Kestrel (*Falco tinnunculus*) and Alpine Chough (*Pyrrhocorax graculus*)[2]. This distance is considered sufficient to offer protection to these species from disturbance. However, due to the high conservation status

[63] *„Birds & Bats Baseline Condition – Monitoring - Twelve Month Report"* prepared by *M&M Consulting;*

[64] *26 species out of total are categorized as target (priority) species according to their national and international importance and conservation and protection status, risk of their collision with wind turbine blades and/or of devastation of their habitats during construction and operation of wind farm;*

of these species it is considered that any disturbace of these species will be of moderate, medium-term, significance

### *5.3.5 Impact on bats*

Although it could not be confirmed in the study, bat roosts of the 20 bat *species listed in Section 4.8.4* are potentially located in the crevices of rocks, which are present thoughout the whole Concession area.

Noise and vibration from construction activity can result in disturbance to bats. Other construction activity that results in habitat loss can also disturb bats due to loss of roosts and feeding grounds. Lights that are used during night time construction also affects bats. This is because bats are nocturnal species and are disturbed by lighting. This could result in spatial avoidance (i.e. bats avoid certain roosts and or migration routes) that may affect bat populations. In particular, lighting can significantly affect the species within the genus *Plecotus*, through a disorder in eating and migration[2]. So, we can say that the sensitivity is high. Since these effects are temporary, limited to the construction phase, it is anticipated that the impact, in this case, would be *low*.

### *5.3.6 Impacts on terrestrial fauna*

*Mammals (Mamalia)*

Mammals could be disturbed during construction due to an increase noise and vibration, loss of habitat and habitat fragmentation.Given that the impact is of a temporary nature, it is anticipated that the significance of the impact, in this case, would be *minor*.

*Reptiles*

The impact on reptiles will result from disturbance, especially during the feeding period, but also hibernation, which will occur as a result of increasing levels of noise and vibration. Impact is of the limited period. and due to the fact that there are no protected reptile species effected, the significance of the impact is considered *negligible*.

### *5.3.7 Landscape (visual impact)*

Potential impacts arising during the construction phase on landscape and visual amenity are less significant than those of the operational phase, predominately due to the shorter timescale of the construction phase of works. As such, a qualitative assessment has been undertaken, focusing on the general aspects of landscape change and potential visual amenity during the construction phase. It is predicted to last for nineteen months at the most. The assessment has been based on the technical description of the Proposal provided in *Chapter 2*. Impacts have been assessed in

accordance with the criteria provided in Landscape and visual *assessment methodology* (see *Appendix 14.9*). No individual viewpoint analysis has been undertaken for the construction phase assessment.

The main visual impacts during the construction period (other than the appearance of the turbines, which are considered in the operational phase of the wind farm) are likely to be caused by the erection and operation of the cranes, as these are likely to be visible from longer distances than other activities such as the construction of access tracks. The cranes will be most prominent from the site itself and areas immediately surrounding the Proposal Site, such as Galica on the west, Paljenik on the north, Vlaška gromila to the northeast, Čardakov to the east etc. They will also be visible from the settlements along the main road M5, such as Turbe and surrounding settlements. Travelling the main road in the area from Travnik to Turbe, in both directions, views from these settlements are likely to be particulary obscured by a combination of topography and vegetation.

Given the altitude and the weather conditions prevailing at Vlašić in winter, it is not expected that during this period it will be possible to execute the works, as well as to maintain the installed cranes. The works will be temporary of limited duration and impacts will be limited to the construction phase program.

Moving further away from the Proposal Site, the cranes and other construction activity will predominately be obscured from view by topography and vegetation and likely to be limited to isolated high points such as Paljenik to the north, Galica and Srnske stijene to the west, Čardakov to the east, and Vlaška gromila to the northeast. Though construction activity including views of the cranes may be visible, they will not be prominent features within the view and impacts will not be significant.

### *5.3.8 Cultural Heritage*

There are no registered archaeological or cultural heritage sites within the Project area. There are therefore not likely to be any significant effects.

Due to the location of the proposed WF Vlasic on a mountain landscape, it is considered that there is also unlikely to be any unknown archaeology discovered during construction works.

### *5.3.9 Socio-Economic Impacts*

*Land Use*

Pasture is the dominant land use in the Travnik Municipality composing 10.2% (5,396 ha) of total land area. The total amount of land which will be occupied during construction is approx. 18.67 ha, most of which is pasture land (for sheep grazing). This represents 4.1% of the Project site which is 450 ha. Approx. 6.87 ha (over 37%) will only be temporarily occupied and available again for sheep grazing use after construction is completed.

Construction is expected to last 19 months, however, an average plot of land needed for the construction of the WTGs will be unavailable for sheep grazing only for a period of 2 to 3 months.

The total land which will be unavailable for a short period during construction is only a small portion of pasture land in the area. This impact is therefore assessed to be *minor adverse*.

*Existing roads*

Some of the land that will be acquired for the project is needed for widening the existing road network without access tracks, (approx. 1 ha). The roads will be expanded generally on the sharp curves to relieve them. Before construction, the road network will be upgraded and then used for the transport of materials, equipment, workers, etc. which will increase the amount of traffic in the construction area. During the upgrading of access tracks, as well as a result of increased traffic, particularly the presence of heavy vehicles some of the local residents may have temporary difficulties accessing their plots of land (settlements Podkraj, Đelilovac, Seferi, Mudrike and Šišava). This impact is assessed as *low adverse*, it may occur only occasionally, under certain circumstances.

*Employment and Procurement Opportunities*

Creation of employment opportunities both directly and indirectly associated with the development is expected.

*Direct employment*: The workforce needed during the construction phase of the Project will be sourced locally (primarily from the Travnik Municipality, but also from nearby communities, i.e. Dolac na Lašvi, Vitez), nationally (from other parts of Bosnia and Herzegovina) and internationally, through third party construction firms. Due to the technical nature of the Project and the low skill set in local communities, it is likely that skilled and semi-skilled labour will be sourced nationally and internationally. EP BiH will select contractors through an open tender. They will hire their existing workforce and will hire additional staff if needed. Typically, in BiH, construction firms employ unskilled labour from the local communities, primarily to reduce costs associated with travel and accommodation.

The construction phase will last 19 months, however not all workers will be employed all the time. The frequency at which workers will be employed and the duration of their engagement could not be estimated at the time of developing the ESIA Study and will depend on the contractor's organization of work.

It is expected that approximately 20% will be local labour (unskilled and some semi-skilled), 50% national labour and 30% international labour. The numbers of local workers may be greater, as opposed to people coming from other parts of Bosnia and Herzegovina, if individuals with the appropriate skills and experience can be found in the nearby communities. The estimated population of Travnik Municipality is 57 543 (*Section 4.12.1*) and therefore this translates to a

generation of employment for 0.17% of the local population. Employment of locals will give a significant effect on those who are employed however this will be a small portion of the total population and is therefore not a signficant effect.

The employment of individuals from local communities will however be beneficial as it is expected to lead to improved relationships between the Project and local communities, improved local skill set which may be valuable for future projects and reduced influx of labour into the project area and associated negative impacts. This impact has been assessed as *minor beneficial*.

*Indirect employment:* The creation of indirect employment opportunities is associated with:

- the project's supply chain (goods and services);
- spending of project employees in local communities.

Turbine components will be imported and delivered to the site via the port of Ploče. It is highly likely that materials needed for civil works (i.e. cement, clay), as well as the materials needed for infrastructure improvements (i.e. for the upgrading of access tracks) will be procured locally, in Travnik City and the Travnik Municipality, as they are available in these areas. These materials will be procured by the selected construction company.

Employment of non-locals, as well as the increase of incomes of local employees, may also bring in some minor benefits for local communities, associated with increased spending in the project area. Local communities surrounding the Project site have small shops, bars and restaurants, which may benefit from this. Indirect employment is likely to provide more opportunities for women, as opposed to direct employment which will most likely involve more men.

There is no available data from which to estimate levels of indirect employment in BiH and the impacts will depend on the nature of the local economy, the availability of required goods and services in the Project area and ways in which employees choose to spend their earnings.

However, taking into account the import of turbine components, the technical nature of procurement requirements, the 19 mounths construction timeframe and the number of employment opportunities, impacts related to indirect employment are assessed as being of *minor beneficial significance*.

It is assumed that the appointed construction contractors will abide by the BiH Law on Labour and other relevant legislation, which is in agreement with EIB's labour related requirements. Similarly, it is assumed that all suppliers will have to comply with the same legislation.

*Employment related expectations among the local population:* The development and implementation of projects in undeveloped areas can sometimes lead to increased expectations among the local population in relation to employment opportunities. During the ESIA Study scoping phase it was concluded that there is some increased expectation in the local communities that the Project will result in widespread employment opportunities.

During subsequent meetings held with local communities in the ESIA development phase, it was established that such expectations are still present, however to a much lesser extend and mostly confined to individuals. This is probably the result of further meetings and contacts between EP BiH and the local communities, where more information has been provided in terms of expected levels of employment opportunities. It is expected that continued engagement with local communities and provision of transparent information regarding employment will minimize unrealistic expectations even further. This impact has been assessed as being of *low adverse significance*.

*Impacts on Livelihoods*

In relation to EP BiHs land acquisition activities, the following categories of people may have their livelihoods affected during construction:

- persons who are using the land plots which have been or will be acquired for the project, but who are not owners of land, and whose sheep grazing may be affected by construction;
- persons who are using the land plots which will be crossed during the transport and installation of WTGs in their future locations or other land which may be disrupted during construction, whose sheep grazing may be affected.

The existence of individuals using the land without the knowledge of the owners is possible as all land is used for seasonal sheep grazing by livestock breeding nomads.

Construction plan includes moving cranes directly from plot to plot, not via any roadways. This will inevitably cause damage through compaction of the soil and constrain soil use. The impact for an average land plot is expected to last less than one month. EP BiH will compensate all loss and damages in accordance with the *Law on Spatial Planning and Land Use of the Federation of Bosnia and Herzegovina* and the principles set out in the Livelihood Restoration Framework. In addition, the implementation of the Transport Management Plan, reinstatement of all affected land and provision of information to owners who will be affected, should assist in managing impacts on livelihoods. This impact is assessed as being *low to moderate adverse*, as it is presently impossible to determine the number of people who will be affected.

Reduction in land available for sheep grazing is not expected to have a significant impact on livelihoods of those using the land. Private land plots will be compensated. Due to the small scale of land take (2.9 ha) and the availability of land for sheep grazing in the area, impacts on livelihoods are assessed as *low adverse*.

Increased incomes generated through the above, together with those generated through direct and indirect employment may have a positive effect on livelihoods in the local area. Approximately 80 local households who will acquire more land, together with approximately 20 local households whose members will be employed by the project, will have increased incomes and consequently

improved standard of living. In relation to the size of local communities 100 households is a small percentage and although this may be significant for the households in question, it is not significant to the population as a whole. Some increased spending of these households together with non-local employees in the local area could further positively benefit the local economies, although this is not expected to have a significant effect. This impact is assessed as *low beneficial*.

Transport and increased traffic are not expected to have significant impacts on livelihoods. Difficulties in accessing land described above may only be occasional and may impact only individuals. In relation to transport of materials to and from the Project site, the D8, D9, E73, M17, A1, M5, R413 and R413a on which transport will be carried out from the port of Ploče through the settlements and cities Metković, Mostar, Konjic, Sarajevo, Vitez and Travnik, are a part of the main regional transport network and traffic volumes are moderate frequented by heavy goods vehicles. Any businesses along this route are not expected to suffer income losses, as a result of project related increased traffic. Only residential houses were observed on the road network and prefered transport route and no impacts on livelihoods are expected. EP BiH will consult with the representatives of the Travnik Municipality and will organize public meeting to talk to all potentially affected people. At present, this impact is assessed as *negligible with potential to rise to low adverse* if any businesses along transport routes are identified.

As a result of increased demand for land by EP BiH, other investors in the region, as well as landowners who will receive compensation for their land and purchase new land, it is to expect that the prices of land in the area will increase. Ultimately, the impact is beneficial for people selling their land, while it can be considered adverse for those buying it. This impact is assessed as *negligible*.

*Impacts on Community Health, Safety and Security*

This section focuses on community health, safety and security impacts associated with the influx of labour and the increase in traffic and heavy vehicles.

The introduction of temporary construction employment opportunities is sometimes associated with an increase in vulnerability and susceptibility of local communities to various negative social actions. The project is relatively small and an estimated 20 individuals will be employed from local communities as unskilled labour or as drivers, security personnel, etc. Apart from the local labour, approx. 50 employees will be national labour employed on semi-skilled or skilled jobs, who will most likely be from larger settlements i.e. Travnik, Vitez, Dolac na Lašvi. Due to the relatively short distances involved, these workers will probably commute to the Project site every day. There will also be approx. 30 international staff and they will be housed in apartments in the Travnik City and commute to the site every day. The presence of workers will inevitably cause some disturbances in the Project area, however these are expected to be minor and as a result, the impact on local communities in relation to negative social actions is assessed as *low adverse*.

Transport and increased traffic can lead to more possibilities for accidents for the local population as well as to a reduced quality of life as a result of noise and air pollution.

*Impacts on Infrastructure (not roads)*

The Project is unlikely to place any additional demands on local infrastructure during construction, as utility infrastructure connections are not available on the Project site. Water will be provided from tanks or possibly a groundwater well, electricity will be provided through a generator and sanitary containers will be installed on the site.

*Tourism*

It is possible that tourists who visit the area will not wish to see wind farm development and be deterred from visiting the area. This would lead to a reduced economic input from tourism into the local economy. However, equally, the presence of a wind farm may attract some people to visit the area and therefore counteract the negative effect that it may have for some people. It is therefore considered that overall there will be a negligible effect on tourism.

### *5.3.10 Health and Safety*

Key construction health and safety and public nuissance issues for consideration associated with the proposed project are as follows:

- working at height and in confined spaces;
- working with large scale structures and plant;
- traffic (see also *Transport Assessment* );
- issues associated unauthorised access and vandalism;
- ground excavation hazards;
- potential for electrocution;
- usege of hazardous substances.

Among the issues described above, two are particularly associated with injury and death in relation to proposed construction project, and they are:

- falls from height;
- electrocution.

Although the activities described above may be classified as high risk with a significant potential for incident, incidents are preventable through the implementation of appropriate management systems and the adherence to the management system requirements by the work force.

If the appropriate Health and Safety management measures are implemented, the health and safety risk during construction has been assessed as being of *low* significance.

A health and safety plan would be prepared during the construction phase.

### *5.3.11 Water/Drainage*

Impact on water/drainage is detailed described within the *Section 5.3.3*.

### *5.3.12 Traffic and Transport*

The main transportation impacts will occur during the construction stage. The impacts will be caused either by an increase in traffic levels or by physical alterations required to facilitate the passage of abnormal loads.

*Traffic Generation*

Traffic will be generated by each of the activities given in Table 3 below. Data are based on transport assessment (Technical assistance for Vlašić Wind Farm – BiH, Second Interim Report,Transport Study, November 2015.). For each activity, an estimate is given of the total number of journeys anticipated and the maximum number of journeys that may conceivably be made in one day. A journey is considered to be a round trip, where a vehicle travels from its origin to the site then back to its origin. The figures given in *Table 34* are estimates; there will be days when the activity generates no traffic and days when an activity generates the maximum number of journeys stated.

The construction period will be approximately 19 months. The worst case for traffic management will be a shorter time frame so for this section the construction period is assumed to be 12 months, starting in January. It is anticipated works will commence in 2017. Site working hours during construction would be Monday to Saturday 6 am to 8 pm, other than during turbine erection and commissioning when the site will work 7 days a week.

*Table 23: Traffic Movements during Construction Phase*

| Phase | Purpose | Vehicle | Total journeys | Max journeys possible per day | Period of Delivery (Total 12 months) |
|---|---|---|---|---|---|
| Site Set-Up | Portacabin delivery | Low loader | 4 | 4 | 1 month |
| | Skip delivery | Low loader | 3 | 3 | 1 month |
| | Generator delivery | Low loader | 1 | 1 | 1 month |
| | Water and fuel tank delivery | Low loader | 1 | 1 | 1 month |
| Road and hardstandings | Stone for site roads | Tipper trucks | 4 | 40 | 6 months |

| Phase | Purpose | Vehicle | Total journeys | Max journeys possible per day | Period of Delivery (Total 12 months) |
|---|---|---|---|---|---|
| | Stone for crane hardstanding | Tipper trucks | 3 | 40 | 6 months |
| | Stone for construction compound | Tipper trucks | 1 | 40 | 6 months |
| | Stone for control building and substation compounds | Tipper trucks | 1 | 40 | 6 months |
| | Stone for turning heads | Tipper trucks | 4,705 | 40 | 6 months |
| | Stone for lay down area | Tipper trucks | 2,465 | 40 | 6 months |
| | Stone for rotor assembly | Tipper trucks | 175 | 40 | 6 months |
| | Stone for pathways | Tipper trucks | 245 | 21 | 1 months |
| Foundation construction | Excavator delivery | Low loader | 2 | 2 | 1 month |
| | Misc works | Backhoe loader | 2 | 2 | 1 month |
| | Turbine concrete delivery | Mixer trucks | 1,250 | 50 | 4 months |
| | Met mast concrete delivery | Mixer trucks | 18 | 18 | 4 months |
| | Transformer concrete delivery | Mixer trucks | 98 | 98 | 4 months |
| | Communications mast delivery | Mixer trucks | 3 | 3 | 6 months |
| | Steel delivery | Flat bed | 35 | 32 | 4 months |
| | Foundation bolts or steel insert delivery | Flat bed | 25 | 21 | 1 month |
| | Place foundation bolt cage or steel insert | 30 t to 50 t crane | 1 | 1 | 1 month |
| Turbine erection | Tool container delivery | Low loader | 2 | 2 | 3 months |

| Phase | Purpose | Vehicle | Total journeys | Max journeys possible per day | Period of Delivery (Total 12 months) |
|---|---|---|---|---|---|
| | Tower section delivery | Extendible trailer | 75 | 6 | 1 month |
| | Blade delivery | Extendible trailer | 75 | 6 | 1 month |
| | Nacelle delivery | Low loader | 25 | 2 | 1 month |
| | Met mast | Low loader | 1 | 1 | 1 month |
| | Hub and spinner | Low loader | 25 | 2 | 1 month |
| | Turbine erection | 1 000 t crane | 1 | 1 | 1 month |
| | Turbine erection | 150 t to 200 t crane | 1 | 1 | 1 month |
| Cable Installation | Cable delivery | Flat bed or Hiab | 10 | 2 | 1 month |
| | Excavator delivery | Low loader | 1 | 1 | 1 month |
| | Cable laying | Telescopic handler | 1 | 1 | 1 month |
| Substation | Concrete delivery | Mixer trucks | 23 | 18 | 1 month |
| | Brick delivery | Flat bed | 3 | 3 | 1 month |
| | Switchgear | Flat bed | 2 | 2 | 1 month |
| | Misc electrical equipment | Flat bed | 2 | 2 | 1 month |
| Reinstatement | Removal of temporary hardstanding stone | Tipper trucks | 1,370 | 40 | 2 months |
| | Removal of temporary compound stone | Tipper trucks | 175 | 40 | 2 months |
| | Removal of temporary lay down area stone | Tipper trucks | 583 | 40 | 2 months |
| | Removal of temporary turning head stone | Tipper trucks | 250 | 40 | 2 months |
| | Removal of rotor assembly area stone | Tipper trucks | 207 | 40 | 2 months |
| Miscellaneous | Vans, cars | | 1,580 | 5 | 2 months |
| | Telescopic handler | | 2 | 2 | 2 months |

| Phase | Purpose | Vehicle | Total journeys | Max journeys possible per day | Period of Delivery (Total 12 months) |
|---|---|---|---|---|---|
| | Skip lorry | | 124 | 2 | 2 months |
| | Small tanker | | 124 | 2 | 2 months |
| | Light goods van | | 248 | 4 | 2 months |
| **Total number of round trips** | | | **13,952** | | |

The greatest number of journeys per day would be generated between March and May, as several key activities are planned for this period. Experience has shown that most traffic is generated on days when turbine or transformer foundations are poured. Each turbine foundation would require concrete from 50 mixer trucks, as well as additional associated HGVs. As there are 25 proposed turbines, these busy days would occur 25 times. The single busiest day would be when the foundations for the transformer are poured. This activity would require 98 concrete mixer lorries and up to 53 associated HGV deliveries. This impact has been assessed as being of *medium* significance.

*Physical impact*

Movement of the turbine components as abnormal loads to the site would have a significant impact if not properly managed. The potential impact on the physical layout of the highway, main and regional roads along the proposed access route was identified using swept path analysis. Vehicle Tracking software was used to model the movement of an extended transport vehicle, and profiles of vehicles are designed so that they represent transport vehicles for the transport of blades and towers, suitable for transporting components of a typical turbine, which is expected to be by the plan. Blades and towers are the longest and widest indivisible loads, which give a worst case scenario. Review of transport vehicle size is presented in *Figure 62.*[65]

[65] *Technical assistance for Vlašić Wind Farm – BiH, Second Interim Report,Transport Study, November 2015.;*

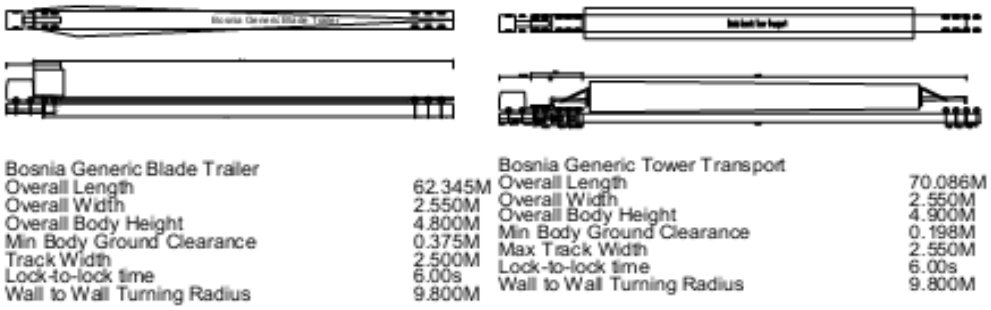


*Figure62: Review of size of transport vehicle for blade and towers*

Along the preferred transport route areas have been identified that would require physical alteration in order to allow transport of abnormal load of turbine components.[7]

The impact of the construction traffic on the local road network has been derived from the proportional change in vehicular flows on the local road network compared to the existing. The traffic is to carry out at night, in the time between 23:00 and 05:00 the next day.

The generated traffic anticipated per day during the construction stage has been estimated and compared to the existing daily traffic flows along the main access route to the site. The impact of abnormal load vehicles has been assessed as a desk-based exercise using swept path analysis to identify areas of overrun and oversail. This has been used to consider whether there would be any required physical modifications to the main road to accommodate the abnormal loads. The desk-based exercise has then been verified with a trial run.

Traffic count data for various locations along the highway M5 was obtained from the PC Directorate of Roads of F B&H (JP DC BiH) for Annual Average Daily Flow (AADF) data. This gives the total daily average number of motor vehicles passing the count points in both directions in 2014. The nearest count point to the concession area is on the highway M5, at the section Turbe – Nević Polje, and is 14, 731 vehicles/day. There is no count point at the section Turbe – Travnik at all, and approximate AADF is 8, 000 vehicles/day. The background traffic flows along this route are unlikely to change materially prior to commencement of the construction of the proposed wind farm.

Traffic count data for various locations along the regional roads R413 and R413a was obtained from the Cantonal Directorate for Roads of Central Bosnia (CB) Canton and Municipality of Travnik, the Service for Common and Municipal Affaires. At the section Turbe – Skender Vakuf (until the

entity boundary), AADF for R413 is 2, 048 vehicles/day. At the section Vitovlje – Babanovac AADF for R413a is 640 vehicles/day.[66]

According to the information of the PC Directorate of Roads of F B&H (JP DC B&H), generally there is no discernible impact and has been assessed as being of *low* significance.

### *5.3.13 Noise*

*Construction Activities*

During construction piling will be required for the construction of the turbine foundations, which will generate noise impacts at locations closer than 1,500 m from the turbine locations.

Other construction activity that is likely to generate noise includes that generated from construction traffic and from works required to upgrade the roads used for access in order to make them suitable for abnormal loads.

It is considered that such works would be localised and short term, and will generate noise of minor significance.

### *5.3.14 Air Quality*

Construction activities have the potential to affect air quality mainly due to the dust created by activities during completion of ground works and construction. In addition, construction plant and vehicles can affect air quality as a result of exhaust emissions.

Re-suspension of dust through activities on the site or the wind can cause a nuisance and affect human health and vegetation. Favourable conditions for dust generation are dry weather combined with high winds. Continual or severe concerns are most likely near to dust sources, usually within 100 metres. The perception of nuisance is subjective and highly variable, although crop cover with dust may lead to a reduction in crop yields and since farming is small scale, this may be locally significant if it occurs.

There are a wide range of dust control measures that are commonly used on construction sites. The measures should be incorporated into a *Construction Environmental Management Plan (EMP*) and will include:

- water-spraying of roads, surfaces prior to being worked, and material stockpiles to minimise dust raising, as required;

66 *Analysis of traffic load on regional roads of Central Bosnia Canton in 2012.;*

- sheeting vehicles carrying dusty materials to prevent materials being blown from the vehicles whilst travelling;
- enforcing speed limits for vehicles on unmade surfaces to minimise dust emissions and dispersion; and
- employing suitable measures to ensure that vehicles leaving the site do not entrain dust onto public roads.

With the above measures employed, any emissions will be of a temporary nature and due to the remote location of the construction site it is unlikely to give rise to any nuisance.

Air emissions will be released from the exhausts of the construction plant which may lead to reduced air qualitywhere plant pass or operate in the vicinity of occupational residences and if the number of vehicles is significant. The transport assessment details the proposed transport route options. However, since the vehicle routings pass through residential areas on main roads, there will be no long term idling in the vicinity of residential receptors. In additionthe actual total number of vehicles is relatively low. Therefore, it is not to expected to result in a significant reduction in air quality.

On site, construction plant, including diesel generators, will generate emissions. However, due to the scale of the operations these will not be significant. In order to ensure that emissions from all vehicles and plant are as low as possible, all vehicles shall be in a good state of repair.

There will be no on site burning of any material, therefore there will be no such emissions as a result of construction activities.

In the event that the aforementioned measures are implemented, the impact of air emissions will be *negligible*, potentially limited short term dust and/or diesel and oil fume. There is no to expect health effects as a result of the emissions.

## 5.4 Operational Phase Impacts

### *5.4.1 Hydrological Characteristics*

During the operation of the proposed WF Vlasic, it is not anticipated that there will be any impacts on hydrology.

### *5.4.2 Geology and Soils*

During the operation of the proposed WF Vlasic, it is not anticipated that there will be any impacts on geology and soils.

### *5.4.3 Flora*

No significant impacts are predicted to occur on floral communities during operation of the wind farm.

### *5.4.4 Impact on birds*

During Wind Farm operation birds are exposed to potential strike risk with turbine blades. The assessment concludes that, depending on the species, significance of the impact is in the range of *negligible to medium high*. The greatest negative impact on birds is expected in the area of Paklarske rocks and cliffs, because of their highest activity in this area.

Scope, height and direction of their flight indicate a potentially *low* negative impact on the majority of registered species. In general, the most vulnerable are birds of prey (*Falconiformes*, *Accipitriformes*), among which 20 species out of 26 priority species[67] belong to them. Certain impacts (collision with turbine blades) of operation of wind turbines can be assumed for certain species of birds of prey, which are usually observed at critical heights (zone of blades coverage, which are 32 to 150 m above the ground). Among these species are:

- Common Buzzard (*Buteo buteo*);
- Golden Eagle (*Aquila chrysaetos*); and
- Short-toed Eagle (*Circaetus gallicus*).

Almost all recorded overflights belonged to the Golden Eagle and Common Buzzard. For this reason, these two species are considered potentially threatened by the wind farm operation, due to the nature of their flights (near the nest, nutrition, frequent overflights and active use of the plateau). Therefore, the impact on this group of birds is considered to be of *moderate-major* significance.

[67] *26 species out of total are categorized as target (priority) species according to their national and international importance and conservation and protection status, risk of their collision with wind turbine blades and/or of devastation of their habitats during construction and operation of wind farm;*

Other target species, as well as other species (see *Appendix 1*) were rarely recorded during flight in the critical zone. Target species included:

- Common Kestrel (Falco tinnunculus);
- Eurasian Skylark (Alauda arvensis); and
- Alpine Chough (Pyrrhocorax graculus).

The low proportion of flights in the *critical altitude zone*, the trajectory of these flights, as well as the observed behavior of the target species, indicate a low level of expected collision with turbine blades, within the Concession Area.

Behavior patterns of Eurasian Skylark (*Alauda arvensis*) exclude a risk for this species because of flight altitude, location and nutrition, as well as nesting. Some of the priority species are mainly limited to flights at high altitudes and therefore are not exposed to strike risk. These include:

- Common Crane (*Grus grus*);
- European bee-eater (*Merops apiaster*);
- Osprey (*Pandion haliaetus*); and
- Griffon Vulture (*Gyps fulvus*)

Some species fly lower within the potential height of strike risk and the impact is assessed as a low significant. These include:

- Harrier (Circus sp.);
- Lesser Kestrel (Falco naumanni;
- Redfooted Falcon (Falco vespertinus); and
- Eurasian Hobby (Falco subbuteo).

Some of the identified species were strictly focused on cliffs oriented towards the south. Species remaining in these cliff zones are not expected to be affected by the wind farm. These included:

- Alpine Chough (Pyrrhocorax graculus);
- Northern Goshawk (Accipiter gentilis); and
- Eurasian Sparrowhawk (Accipiter nisus).

Non-target species were recorded wtihin the study zone, mainly *outside the critical altitude zones*. This included:

- Swallow (Hirundinidae);
- Flocks of crows (Corvidae);
- Finch (Fringillidae); and
- Other songbirds.

Despite the significant presence of these species, there is expected to be a negligible impact on these species during wind farm operation.

*5.4.5 Impact on bats*

Bats can be injured as a result of changes in air pressure, which is associated with the rotation of turbine blades. In doing so, there is no direct contact between the bats and the blades themselves, but the barotrauma causes internal bleeding, leading to death. It is believed that barotrauma occurs when they come into contact with eddy current of air, where, due to the operation of wind turbine blades, a field of low pressure is created.

Although it is considered that there is a high risk of a collision with the blades of wind turbines, there are certain bat species, which are more vulnerable to such phenomena. For example, the genus *Pipistrellus, Nyctalus* and *Vespertilio*, which, according to estimates, are the bats with the highest probability of the occurrence of a collision. Usually these are species/groups with a high number of overflights and significant activity (occasionally in the season) in the concession area. These species flight paths going across the wind farm site.

Bats within this genus are very active and represent a group in the southern part of the concession area, along the edge of steep cliffs of Paklarske cliffs. Therefore, in these zones (at distance from cca 250 m to the closest turbine), it is possible that there will be an occasional increase in mortality due to baraotrauma. It is expected that the mortality rate would be proportional to the population activity, with less predictability for migratory population.

The proposed WF Vlašić is positioned away from the forest areas which have the highest bat activity (the nearest turbine is located approximately 500m away). Turbines are also positioned away from watering holes , thereby avoiding affecting bats in these areas. Foraging routs (forests) are on the distance approximately 700 m from the concession area.

Overall the predicted effect on bats is considered to be of *moderate- major* significance.

*5.4.6 Impacts on terrestrial fauna*

*Mammals (Mamalia)*

During the Wind Farm operation, impacts on mammals are reflected in a partial change in the habitat, caused primarily by increased noise levels, as a result of operation of wind turbines. However, it is expected that these species will be able to adapt to the new conditions in the habitat. Mammalian habitats will not be fenced off and therefore species will have free movement across the site, as they currently do. It is anticipated that any effect on these species would be *negligible*.

*5.4.7 Landscape (visual impact)*

To assist in the selection of viewpoints and to aid the assessment of visual impacts within the study area a Zone of Theoretical Visibility (ZTV) was produced to establish where all, or part of the site and proposed turbines, are likely to be visible from. A ZTV is a map of where and how many wind turbines will theoretically be visible from all parts of the study area. It is used for the visual

impact assessment because the turbines will be the most visible element of the proposed wind farm development, particularly during the operational period.

To aid the assessment of the potential visual impacts of the development, eighteen representative viewpointswere selected. This allowed for comparisons to be made between the existing view and that with the development in placeAppropriate viewpoint locations were determined following site visits. The selected locations were: Srnske stijene, Galica, Paklarevo, Ovčarevo, Turbe, Travnik, Paklarske stijene, Paljenik and Babanovac.

The eighteen viewpoints selected are within areas known as *View Areas (see Appendix 14.5)*. Through a combination of desktop and fieldwork analysis nine *View Areas* were identified, based upon topographic character areas, extent of visibility, settlements, road, footpath, cycling networks, tourist attractions, plus other important landscape features or designations, such as Special Landscape Areas. The existing and predicted views (including cumulative impacts) from viewpoints and the wider landscape within these View Areas, as a result of the proposed wind farm, are described in the following text.

Each viewpoint represents a „typical" view of the development found within the View Area and it should be noted that the viewpoints chosen have been selected to illustrate the presence of the wind farm in the landscape rather than to show the screening effect of landform and landscape features.

All viewpoints are publicly accessible, however it should be noted that areas of potential visibility as indicated by the ZTV may be constrained for example by hedgerows, trees and other local obstacles that can obscure clear views to the Proposal Site and restrict panoramic views. Taking these factors into account, the area was thoroughly explored to find the most suitable, safely accessible location for the photograph to be taken from. For the purposes of this assessment, the topographic map scale of 1: 25 000 was used. The software Google Earth „free" has also been used along with the programs Adobe Photoshop and Corel PP.

The predicted view in relation to the number of proposed turbines that can be seen from each viewpoint location is described in terms of the turbine's components that are visible and are classified as:

- *Blade type level* –when only the whole or part of one or more turbine blade is visible within the view;
- *Nacelle*–when only the nacelle (being the large structure at the top of the tower housing the gearbox and other generating equipment) and whole or part of one or more turbine blade is visible within the view;
- *Tower* – when the whole or part of one or more turbine blade, nacelle and whole or part of the turbine's tower is visible within the view.

In considering the visual impact on each View Area, one or more representative viewpoints within the View Area has been selected and assessed in detail. The conclusions of the viewpoint assessment relates to the individual viewpoint alone. However conclusions are also drawn on the visual impact on the overall View Area.

**View Area A: Urban areas of Travnik city and Turbe settlement**[68]

Landscape Character Area: Urban areas with changed landscape of anthropogenic type.

Type and Sensitivity of Receptor: The urban center of the area, the town of Travnik, and a smaller urban center, Turbe, located in a valley, with the smaller settlements in between, extending east-west, along the M5 main road, which follows the river Lašva, south and southwest of the concession area. The Wind Farm is, from this area, partly visible, and the sensitivity of the receptor, accordingly, is low. From other locations within the wider view area, the dominant type of receptor would be workers on farms and drivers passing by, and the sensitivity of these receptors would be low.

**Assessment of Selected Viewpoint 1 (Travnik city)**

Predicted view: The impact of the proposed wind farm from the viewpoint 1 is illustrated by Google Earth photo shown in *Figure 63,* which illustrates that of 25 turbines, only 5 are visible, namely nacelles with turbine blades.

Magnitude of Impact: Given that Travnik is located in a valley, and that Paklarske rocks rise above it, the wind farm at the Devečani plateau will be less visible from the city center. Therefore, the magnitude of impact is low.

Significance of Impact: Receptors from this viewpoint are considered to be low sensitive. Given the above reasons, the significance of impact of this wind farm is estimated as minor-negligible.

[68] *See Appendix 19.4 Synthesis map of the current state of the environment;*

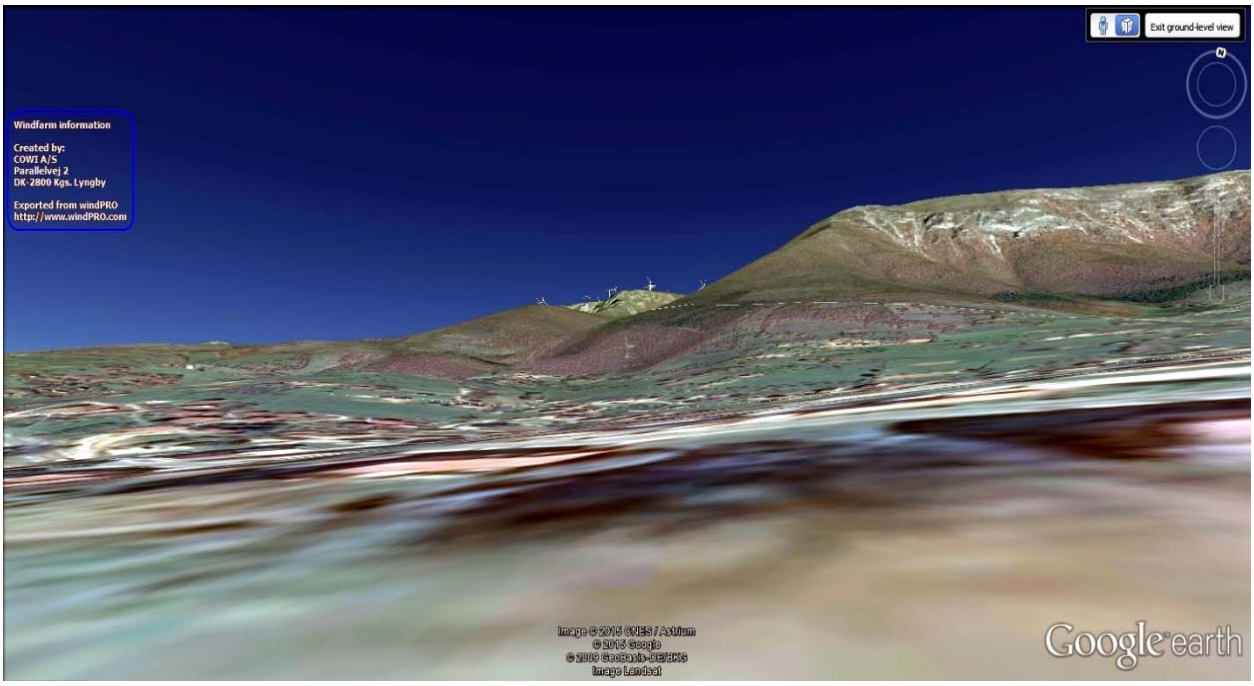


*Figure 63: Viewpoint 1 (Travnik city)*

**Assessment of Selected Viewpoint 2 (Turbe settlement)**

Predicted view: The impact of the proposed wind farm from the viewpoint 2 is illustrated by Google Earth photo shown in *Figure 64,* which illustrates that 13 of 25 turbine are visible. Two of these turbines only have the blades visible.

Magnitude of Impact: Although Turbe is located in a valley, and Srnske rocks raise above it, the wind farm at Devečani plateau will be visible from the city center. Therefore, the magnitude of impact is medium.

Significance of Impact: Receptors from this viewpoint are considered to be low sensitive. Given the above reasons, the significance of impact of this wind farm is assessed as moderate.

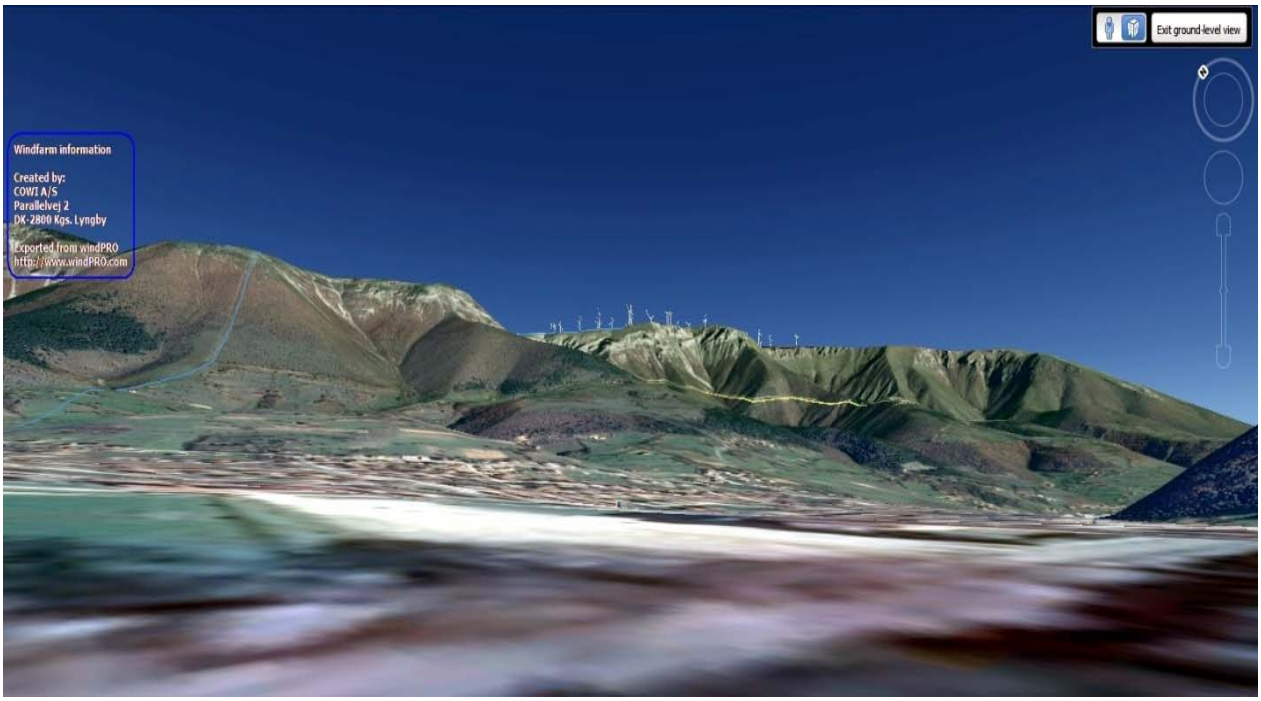


*Figure 64: Viewpoint 2 (Turbe settlement)*

**View Area B: Rural areas on the stretch Travnik city - Turbe settlement**

Landscape Character Area: Rural areas of highland valleys

Type and Sensitivity of Receptor: Smaller settlements, located between urban centers of the area of Travnik and Turbe, located in a valley, along the M5 main road, which follows the river Lašva, south and southwest of the concession area. The Wind Farm is, from this area, partly visible, and the sensitivity of the receptor, accordingly, is low. From other locations within the wider view area, the dominant type of receptor would be workers on farms and drivers passing by, and the sensitivity of these receptors would be moderate.

**Assessment of Selected Viewpoint 3 (Bilići settlement - Travnik)**

Predicted View: The impact of the Wind Farm from the viewpoint 3 is illustrated by Google Earth photo shown in *Figure 65,* showing that 13 of of 25 turbines will be visible. For 7 of these turbines only the nacelle and turbine blades would be visible.

Magnitude of Impacts: Given that the settlement is located in a highland valley, and that Paklarske rocks rise above it, the wind farm at the Devečani plateau would be visible from this viewpoint. Therefore, the magnitude of impact is medium.

Significance of Impacts: Receptors from this viewpoint are considered medium sensitive. Given the above reasons, the significance of impacts of this wind farm is assessed as moderate.

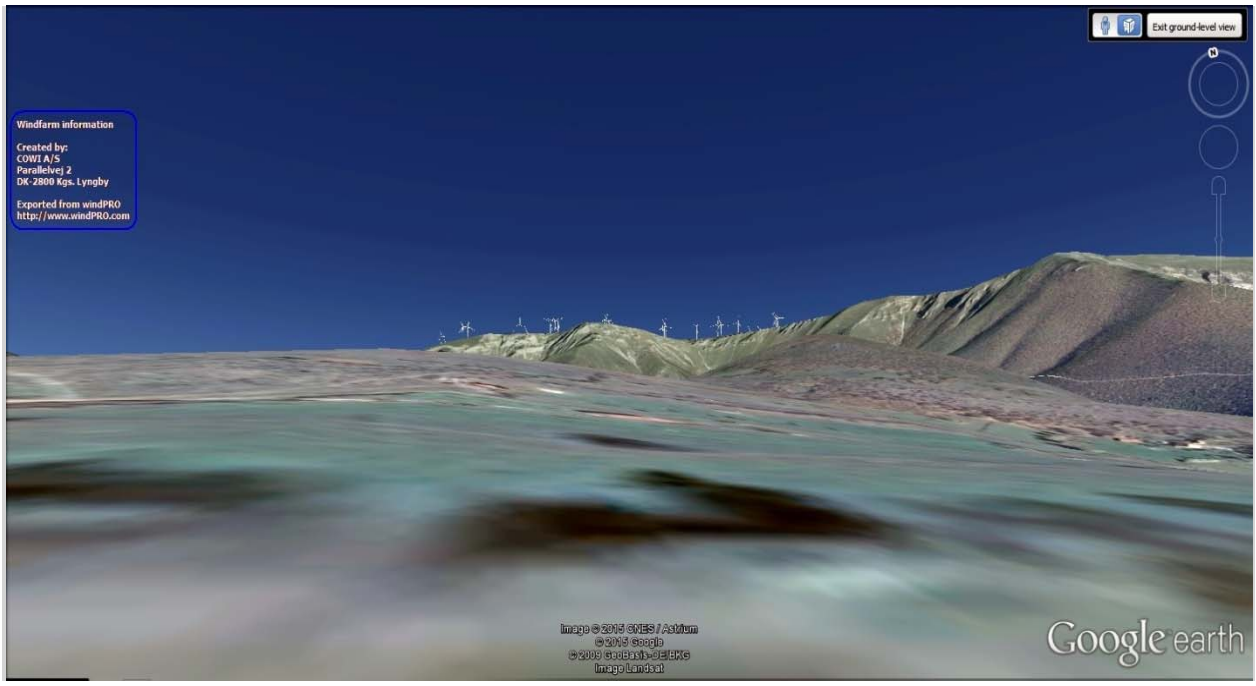


*Figure 65: Viewpoint 3 (Bilići settlement - Travnik)*

**Assessment of Selected Viewpoint 4 (Zlokići settlement - Travnik)**

Predicted View: The impact of the Wind Farm from the viewpoint 4 is illustrated by Google Earth photo shown in *Figure 66,* showing that 14 of 25 turbines are visible.

Magnitude of Impacts: Although the settlement is located in a highland valley, approximately 6.5 km south of the Concession Area, the Wind Farm on the Devečani plateau, above Paklarske stijene, would be visible from this viewpoint. Therefore, the magnitude of impacts is medium.

Significance of Impacts: Receptors from this viewpoint are considered medium sensitive. Given the above reasons, the significance of impacts of this wind farm is assessed as moderate.

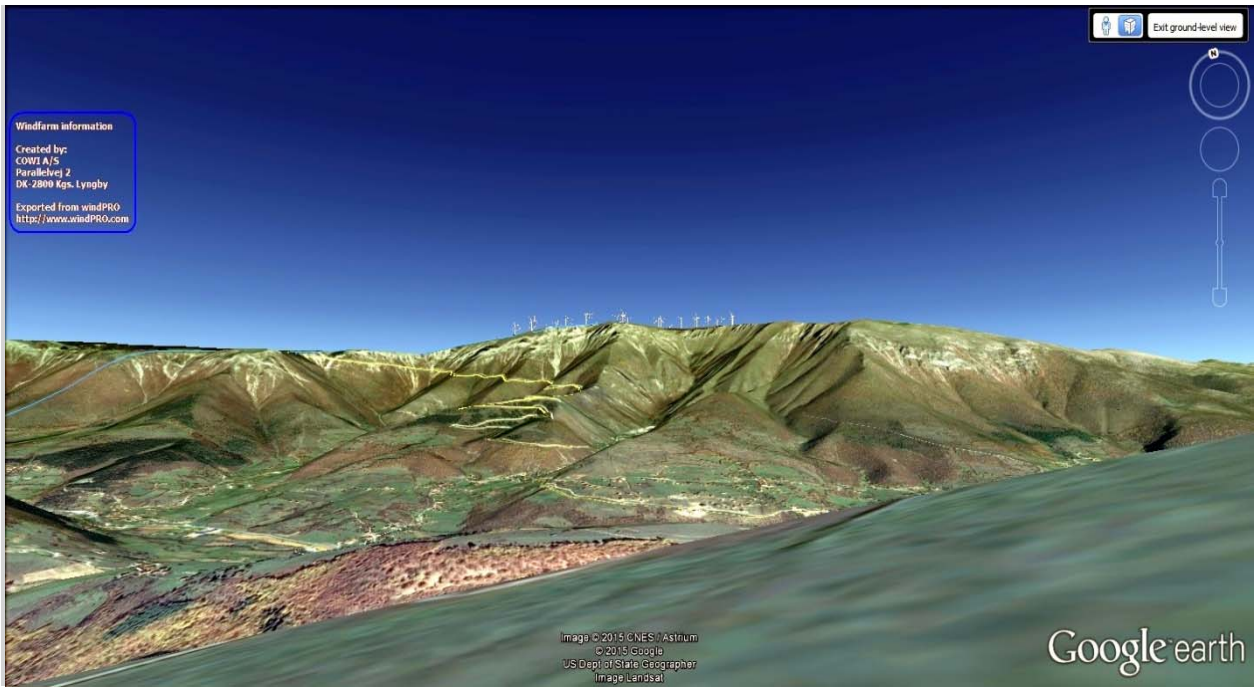


*Figure 66: Viewpoint 4 (Zlokići settlement - Travnik)*

**Assessment of Selected Viewpoint 5 (Potkraj settlement - Turbe)**

Predicted View: The impact of the Wind Farm from the viewpoint 5 is illustrated by Google Earth photo shown in *Figure 67,* showing that none of 25 turbines would be visible.

Significance of Impacts: As none of the WF Vlasic is visible there will be no impact.

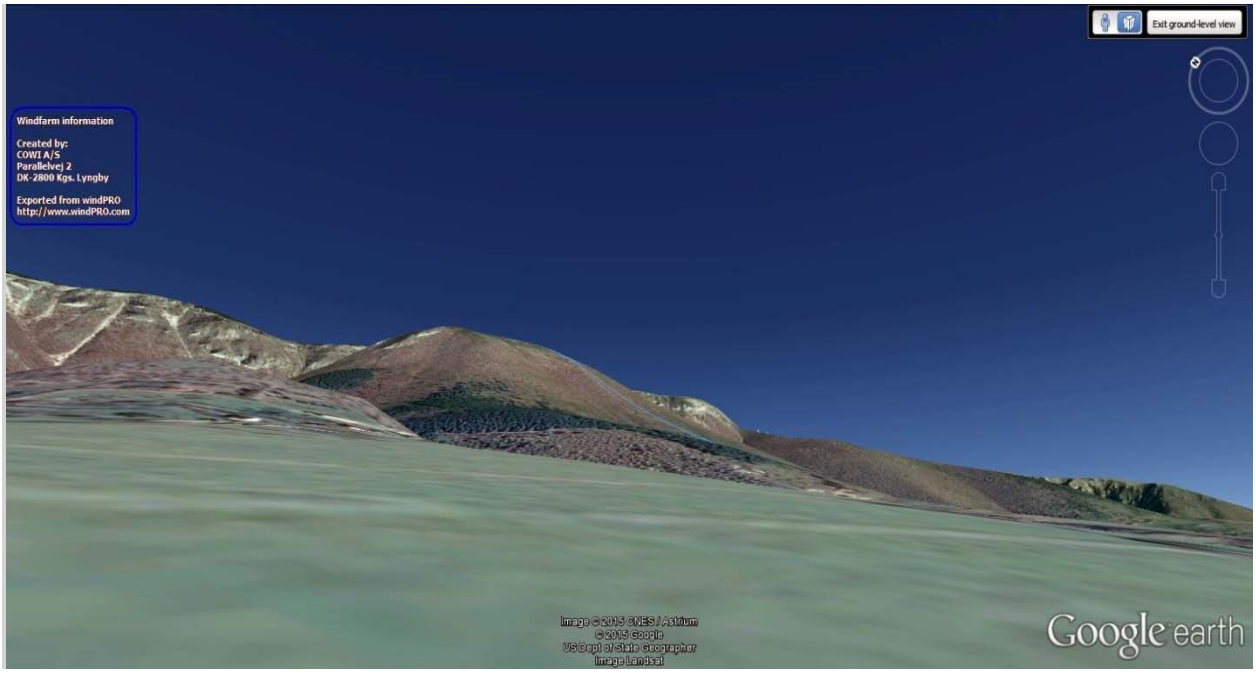


*Figure 67: Viewpoint 5 (Potkraj settlement - Travnik)*

**Assessment of Selected Viewpoint 6 (Vlahovići settlement - Turbe)**

Predicted View: The impact of the Wind Farm from the viewpoint 6 is illustrated by Google Earth photo shown in *Figure 68,* showing that 15 of 25 turbines are visible. Four of these turbines would only have the blades are visible.

Magnitude of Impacts: Although the settlement is located in a highland valley, approximately 6 km southwest of the concession area, the Wind Farm at the Devečani plateau, above Paklarske stijene, would be visible from this viewpoint. Therefore, the magnitude of impacts is medium.

Significance of Impacts: Receptors from this viewpoint are considered medium sensitive. Given the above reasons, the significance of impacts of this wind farm is assessed as moderate.

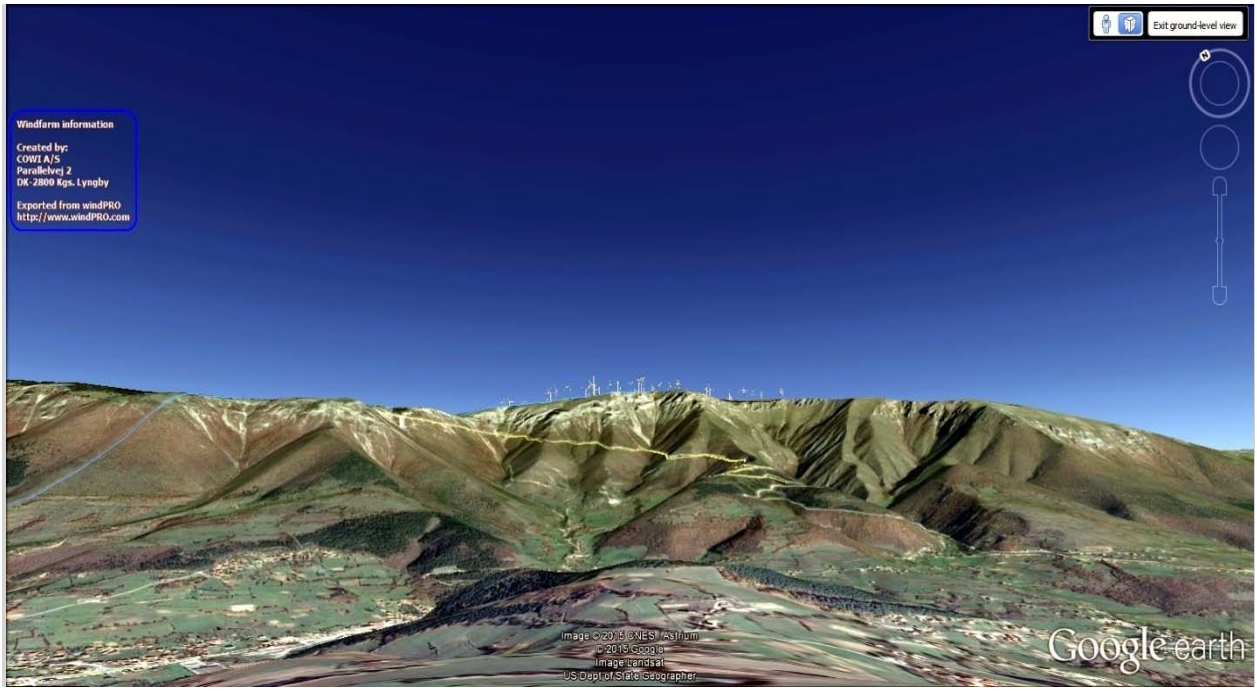


*Figure 68: Viewpoint 6 (Vlahovići settlement - Travnik)*

**View Area C: The Lašva river valley**

Landscape Character Area: The River Valley

Type and Sensitivity of Receptor: Lašva river valley gives character to this landscape. There are low rise private and public buildings. The M5 main road mostly follows the watercourse. Due to the configuration of the terrain and the present riparian vegetation, the view on Devečani plateau is limited, and the wind farm will be visible to a lesser extent from this view area.

The sensitivity of receptors, in accordance with this, is low. From other locations within the wider view area, the dominant type of receptor would be workers on farms and drivers passing by, and the sensitivity of these receptors would be medium.

**Assessment of Selected Viewpoint 7 (The Lašva riverside below Marijanovića Brijeg settlement)**

Predicted View: The impact of the Wind Farm from the viewpoint 7 is illustrated by Google Earth photo shown in *Figure 69,* showing that 11 of 25 turbines would be visible, namely turbine blades only.

Magnitude of Impacts: Given that the viewpoint is located in the river valley, and that Paklarske rocks raises above it, the Wind Farm at the Devečani plateau would be visible from this viewpoint. Therefore, the magnitude of impacts is medium.

Significance of Impacts: Receptors from this viewpoint are considered medium sensitive. Given the above reasons, the significance of impacts of this wind farm is assessed as minor.

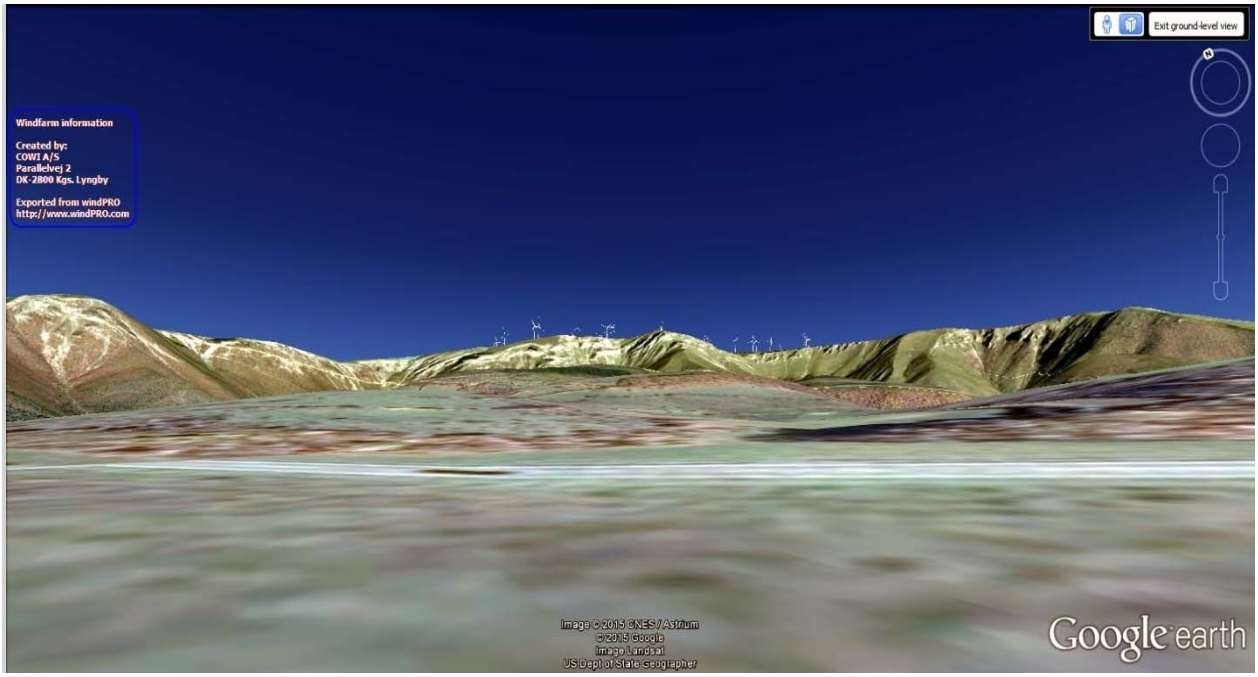


*Figure 69: Viewpoint 7 (The Lašva riverside below Marijanovića Brijeg settlement)*

**View Area D: The hills and oblique slopes**

Landscape Character Area: Rural areas with partially altered landscape of anthropogenic type.

Type and Sensitivity of Receptor: Smaller settlements, located below Paklarske rocks, south of the concession area. The Wind Farm is, from this area, visible to a lesser extent, and the sensitivity of the receptor, accordingly, is low. From other locations within the wider view area, the dominant type of receptor would be workers on farms, and the sensitivity of these receptors would be medium.

**Assessment of Selected Viewpoint 8 (Paklarevo settlement)**

Predicted View: The impact of the Wind Farm from the viewpoint 8 is illustrated by Google Earth photo shown in *Figure 70,* showing that 11 of 25 turbines would be visible, namely turbine blades only.

Magnitude of Impacts: Given that the viewpoint is partly "tucked" in Devečani plateau i.e. Paklarske rocks, from this viewpoint, the planned wind farm would be visible however to a lesser extent. Therefore, the magnitude of impacts is low.

Significance of Impacts: Receptors from this viewpoint are considered medium sensitive. Given the above reasons, the significance of impacts of this wind farm is assessed as moderate.

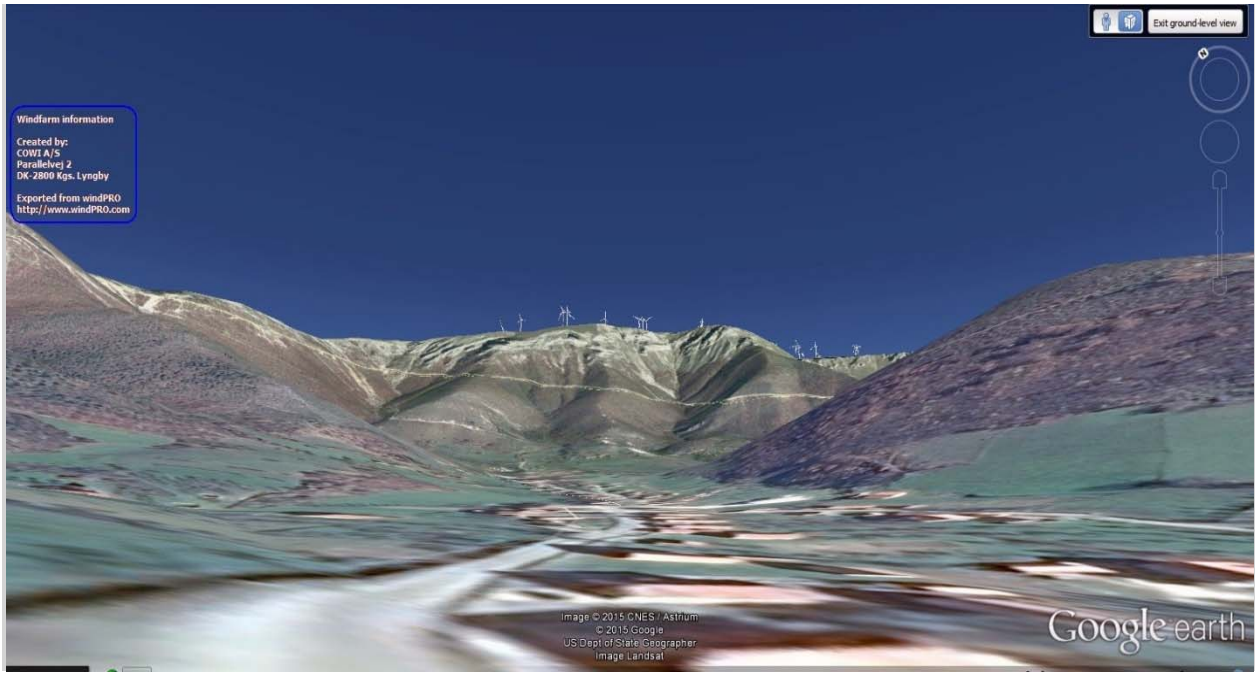


*Figure 70: Viewpoint 8 (Paklarevo settlement)*

**Assessment of Selected Viewpoint 9 (Ovčarevo settlement)**

Predicted View: The impact of the Wind Farm from the viewpoint 8 is illustrated by Google Earth photo shown in *Figure 71,* showing that 7 of 25 turbine would be visible, namely turbine blades only.

Magnitude of Impacts: Given that the viewpoint is partly "tucked" in Devečani plateau i.e. Paklarske rocks, from this viewpoint, the planned wind farm would be visible however to a lesser extent. Therefore, the magnitude of impacts is low.

Significance of Impacts: Receptors from this viewpoint are considered medium sensitive. Given the above reasons, the significance of impacts of this wind farm is assessed as minor.

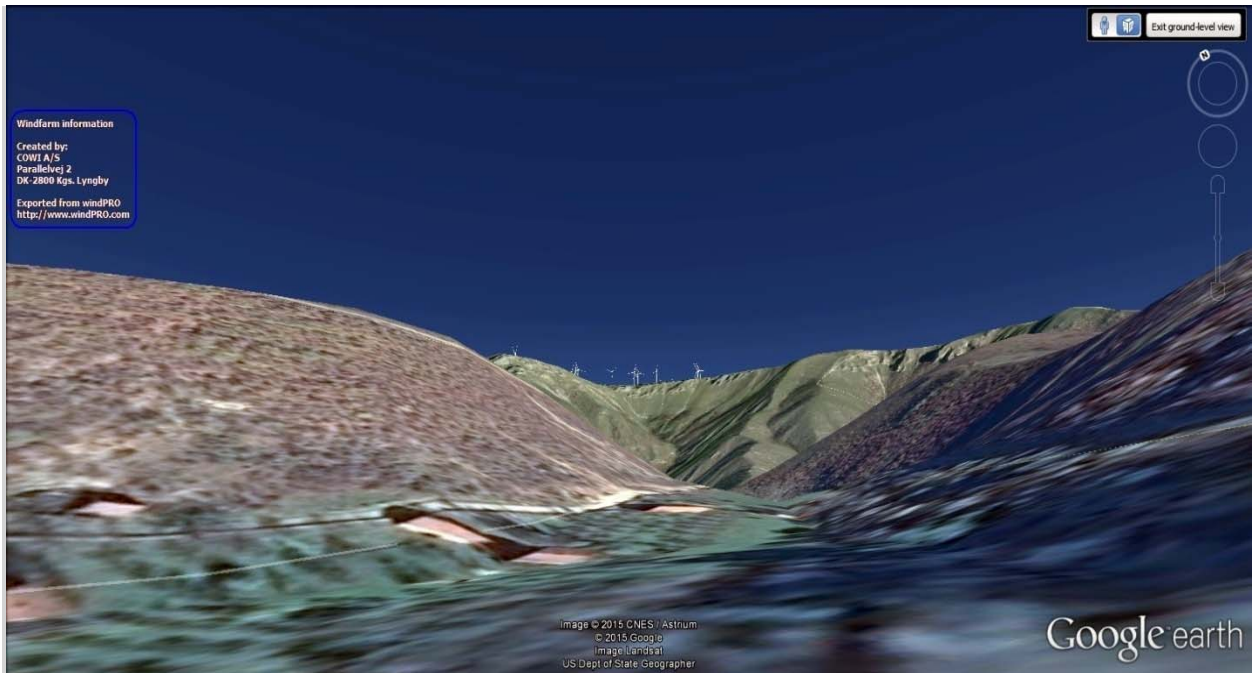


*Figure 71: Viewpoint 9 (Ovčarevo settlement)*

**View Area E: Mountain valleys (Babanovac)**

Landscape Character Area: Tourist - Recreation Center Babanovac

Type and Sensitivity of Receptor: Tourist-recreation center, located about 4.5 km northwest of the concession area. The Wind Farm, from this area, is not visible, and the sensitivity of receptors, accordingly, is low. From other locations within the wider view area, the dominant type of receptor would be visitors of the recreation center and workers on farms, and the sensitivity of these receptors would be medium.

**Assessment of Selected Viewpoint 10 (Babanovac)**

Predicted View: The impact of the Wind Farm from the viewpoint 10 is illustrated by Google Earth photo shown in *Figure 72,* showing that none of the 25 turbines is clearly visible.

Magnitude of Impacts: Due to the configuration of the site, as well as that the viewpoint is about 4.5 km far away from Devečani plateau, and that it is covered with dense coniferous forest, the Wind Farm on Devečani plateau, from this viewpoint, would not be clearly visible. Therefore, magnitude of impacts is negligible.

Significance of Impacts: Receptors from this viewpoint are considered medium sensitive. Given the above reasons, the significance of impacts of this Wind Farm is estimated as minor-negligible.

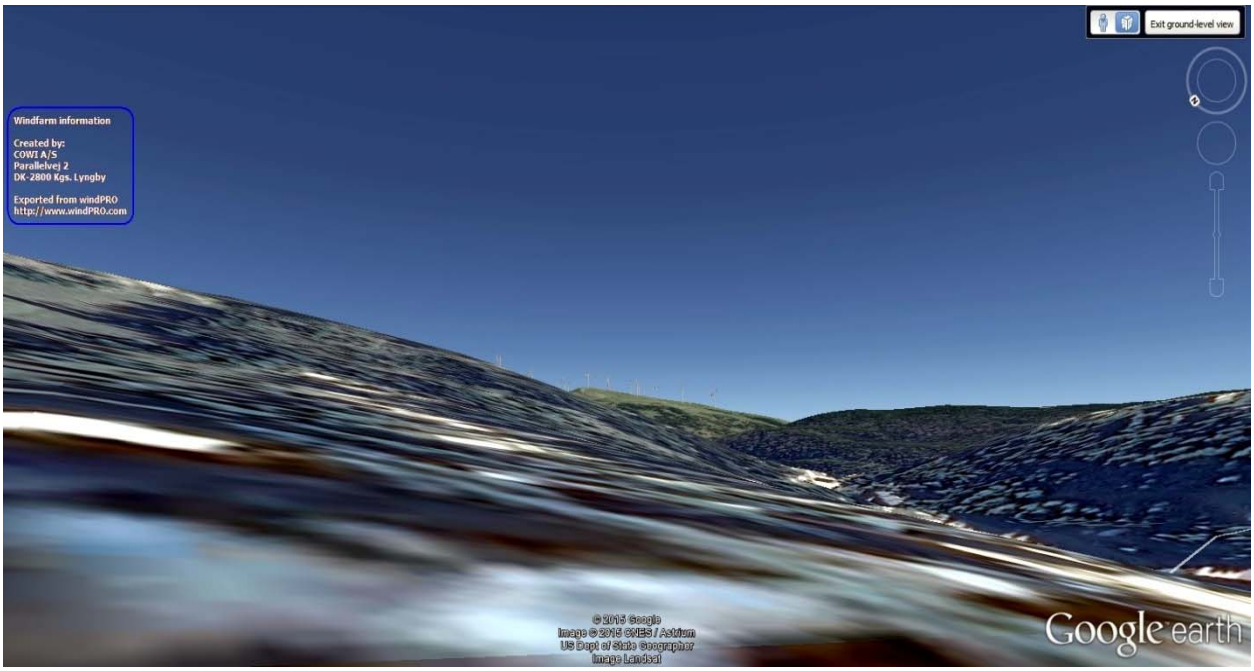


*Figure 72: Viewpoint 10 (Babanovac)*

**View Area F: Exposed mountain plateau**

Landscape Character Area: The mountain plateau with dense coniferous forest

Type and Sensitivity of Receptor: The area with prominent conifer forests and subalpine meadows, and some hay meadows. The Wind Farm, from this area, would be visible, and the sensitivity of receptors, accordingly, is high. From other locations within the wider view area, the dominant type of receptors would be the owners of cottages, recreational hikers, visitors and workers on farms, and the sensitivity of these receptors would be medium.

**Assessment of Selected Viewpoint 11 (Galica 1,457 m a.s.l)**

Predicted View: The impact of the Wind Farm from the viewpoint 11 is illustrated by Google Earth photo shown in *Figure 73,* showing that 17 of 25 turbines would be visible. Seven of these would only have turbine blades visible.

Magnitude of Impacts: Due to the configuration of the site, and that the viewpoint is about 2 km away from Devečani plateau, and the viewpoint is located on the plateau of Galica, the wind farm on Devečani plateau would be fully visible. Therefore, the magnitude of impacts is medium.

Significance of Impacts: Receptors from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of the wind farm is estimated as high-moderate.

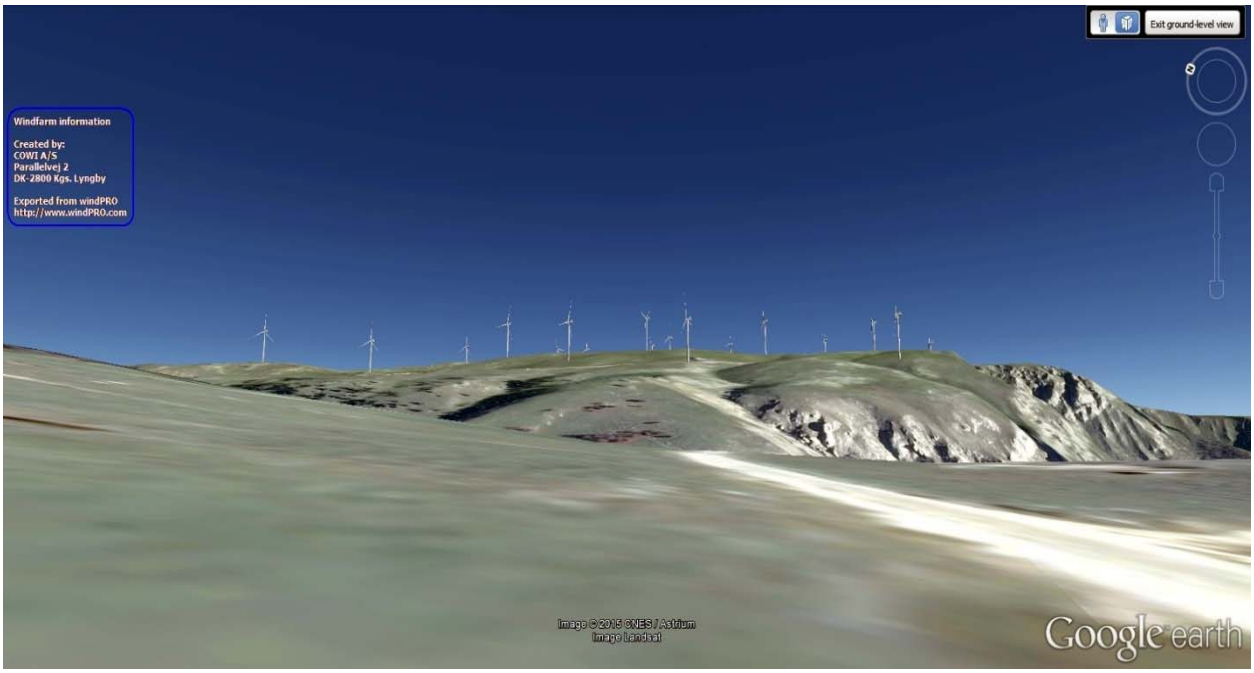


*Figure 73: Viewpoint 11 (Galica)*

**Assessment of Selected Viewpoint 12 (Devečani plateau 1,780 m a.s.l)**

Predicted View: The impact of the Wind Farm from the viewpoint 12 is illustrated by Google Earth photo shown in *Figure 74,* showing that all of 25 turbines would be visible.

Magnitude of Impacts: Due to the configuration of the site, and that the viewpoint is located within the concession area, at a distance of approximately 500 meters from the nearest turbines, the Wind Farm would be fully visible. Therefore, the magnitude of impacts is high.

Significance of Impacts: Receptors (tourists, nomads, visitors of the mountain lodge „Devečani") from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of this wind farm is estimated as high.


*Figure 74: Viewpoint 12 (Devečani plateau)*

**View Area G: Exposed mountain rocks**

Landscape Character Area: Exposed mountain rocks under low vegetation

Type and Sensitivity of Receptor: The area with developed rock and scree communities. The location is suitable for nesting of birds of prey (recorded nesting of one pair of the Golden Eagles). The wind farm is located on a plateau above. The area is largely inaccessible

**Assessment of Selected Viewpoint 13 (Paklarske stijene 1,780 m a.s.l)**

Predicted View: The area with developed rock and scree communities, south, southeast and southwest exposure. Here there is a cave called Ledenica. The area gives a sense of monumentality and drama. The impact of the wind farm from the viewpoint 13 is illustrated by Google Earth photo shown in *Figure 75,* showing that 12 of 25 turbines would be visible. Of these, 5 turbines would only have the turbine blades visible.

Magnitude of Impacts: Due to the fact that the planned Wind Farm is located on a plateau above and the fact that the area is largely inaccessible. However, due to the rotation of the turbines and the noise emissions, it may come to disruption of nesting of birds registered in the area. Given that the location of the wind farm is above the subject area, and the fact that it is a steep slope of large inclination, view of the same would be very limited and direct, due to the terrain configuration. From the above, it is concluded that the magnitude of impacts would be high.

Significance of Impacts: Receptors from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of this wind farm is estimated as high.


*Figure 75: Viewpoint 13 (Paklarske stijene)*

**Assessment of Selected Viewpoint 14 (Srnske stijene 1,434 m a.s.l)**

Predicted View: The area with developed rock and scree communities, south, southeast and southwest exposure. The area gives a sense of monumentality and drama. The impact of the Wind Farm from the viewpoint 14 is illustrated by Google Earth photo shown in *Figure 76,* showing that 17 of 25 turbines would be visible, 4 of which would only have the blades visible.

Magnitude of Impacts: Although the proposed Wind Farm is located on a plateau eastward and the area is largely inaccessible, the construction of turbines will result in a physical impact on the landscape. From the above, it is concluded that the magnitude of impacts would be high. Given that the location of the wind farm is south-east of the subject area, and the fact that it is a steep slope of large inclination, the view of the turbiens would be direct.

Significance of Impacts: Receptors from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of this wind farm is estimated as high.

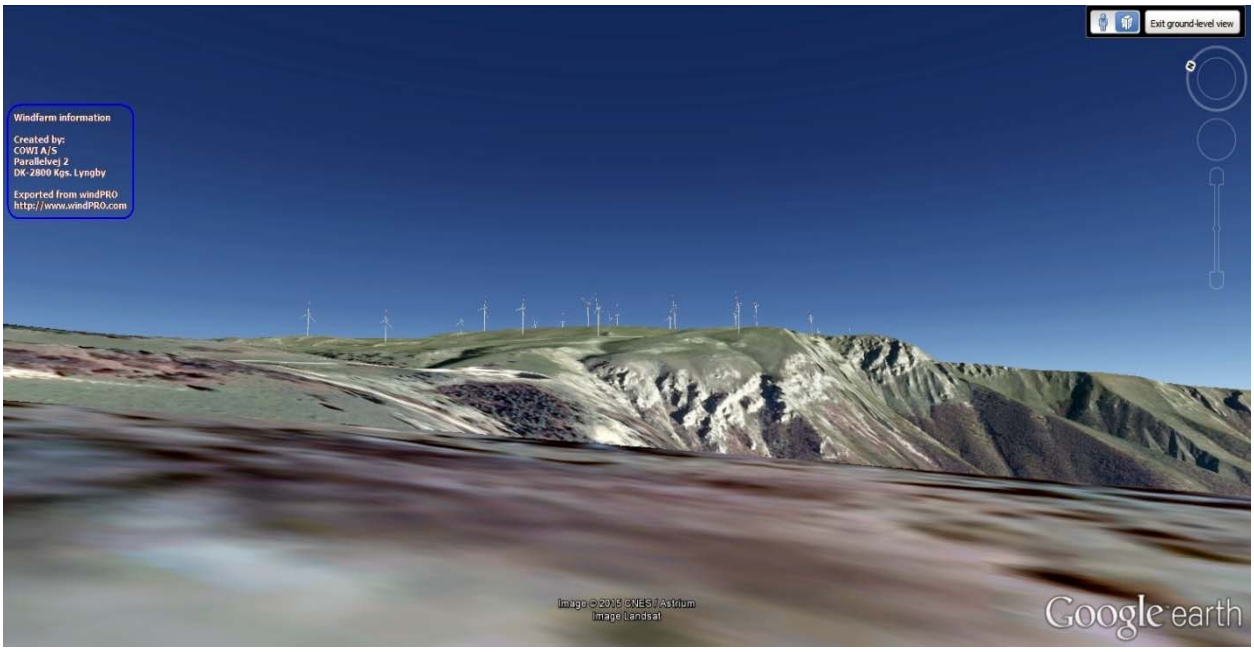


*Figure 76: Viewpoint 14 (Srnske stijene)*

**View Area H: Mountain valleys and slopes**

Landscape Character Area: Mountain valleys and slopes above Paklarske stijene in the area of Devečani, east and northeast of the gravel road towards Đenetići, north of the mountain lodge „Devečani" in the area of Oštrike, as well as the north area of the concession zone towards Buhačice.

Type and Sensitivity of Receptor: The Wind Farm is located on a plateau, mainly surrounded by these landscape character areas, with prominent subalpine and alpine pastures. Below this area there is the upper limit of the forest. There is a small number of shepherd's huts (katuni). The area has a number of hiking and biking trails, intended for recreation. Through the same there is a local gravel road. From other locations within the wider view area, the dominant type of receptors would be the owners of shepherd's huts, recreational hikers, visitors and cattle breeders, and the sensitivity of these receptors would be high. The area is considered an area of outstanding quality and of local importance. It is also proposed to make the area part of the Natura 2000 network, in which case it will be classified as an area of national importance. Due to the preservation of the mountain landscape, sub-alpine and alpine pastures in this part, and the planned declaration of "Protected Landscape"/"Nature Park", the landscape of the area is considered a landscape of outstanding quality.

**Assessment of Selected Viewpoint 15 (Oštrike)**

Predicted View: The area is characterized by slight slopes under subalpine and alpine pastures. The impact of the wind farm from the viewpoint 15 shows that all 25 turbines will be visible, given

that the viewpoint is located within the wind farm, and selected view angle, shown in the illustration of Google Earth photo in *Figure 77,* shows 4 turbines that are visible.

Magnitude of Impacts: Created impacts can be seen throughout of few existing shepherd's huts (katuni). The greatest pressure on existing habitats is by herders, since the area is known for the sheep grazing and production of Vlašić cheese. Due to the configuration of the terrain, and that the viewpoint is located within the Concession Area, within close proximity to the turbines, the Wind Farm would be fully visible. Therefore, the magnitude of impacts is high.

Significance of Impacts: Receptors from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of this wind farm is estimated as major.

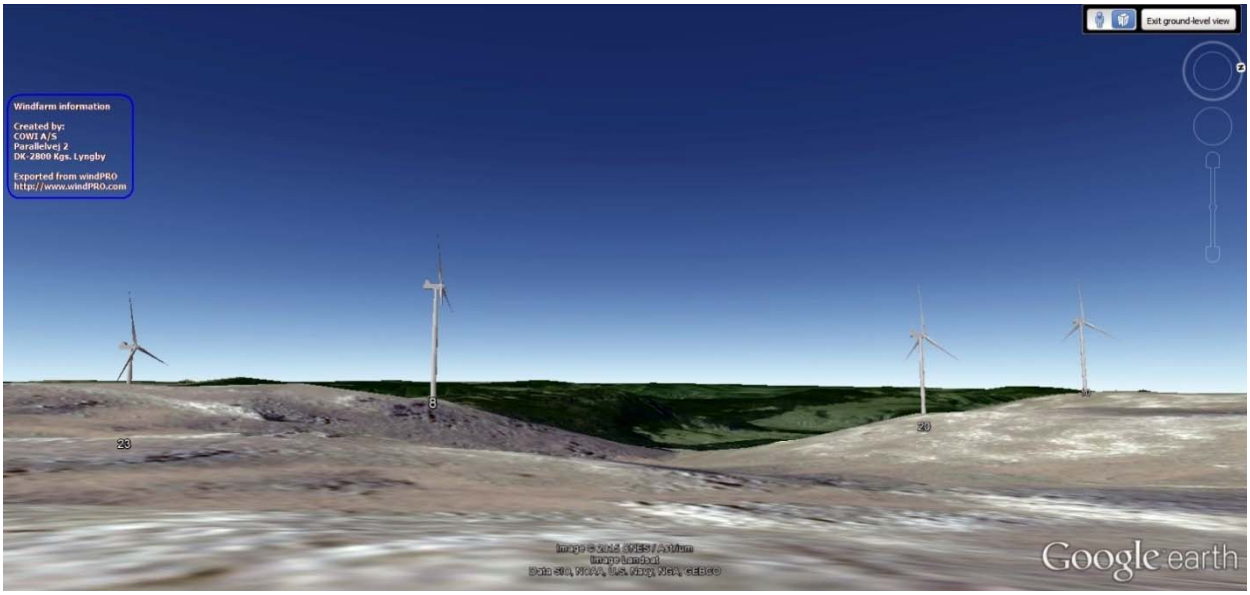


*Figure 77: Viewpoint 15 (Oštrike)*

**View Area I: Mountain peaks**

Landscape Character Area: The highest peaks of the Vlašić Mountain.

Type and Sensitivity of Receptor: The Wind Farm is located on a plateau at the foot of the mountain peaks. The area is with prominent subalpine and alpine pastures, under which there is the upper limit of the forest. There is a small number of shepherd's huts (katuni) at the foot of the same, as well as the broadcasting transmitter at the top of Paljenik. The area has several hiking trails, intended for recreation and a local gravel road. From other locations within the wider view area, the dominant type of receptor would be owners of shepherd's huts, employees of the braodcasting transmitter, recreational hikers, visitors and cattle breeders, and sensitivity of these receptors would be high. The area is considered an area of outstanding quality and of local importance. It is also proposed to make the area part of the Natura 2000 network, in which case it will be classified as an area of national importance. Due to the preservation of the mountain landscape, sub-alpine and alpine pastures in this part, and the planned declaration of "Protected

Landscape"/"Nature Park", the landscape of the area is considered as a landscape of outstanding quality.

**Assessment of Selected Viewpoint 16 (Paljenik 1,933 m a.s.l)**

Predicted View: The area with slight slopes under sub-alpine and alpine pastures, and significant presence of predominantly bare stone surfaces. The dominant element is a RTV broadcasting transmitter. The impact of the Wind Farm from the viewpoint 16 is illustrated by Google Earth photo shown in *Figure 78,* showing that all 25 turbines would be visible.

Magnitude of Impacts: Location of the Wind Farm is on Devečani plateau, located approximately 500 m south of the viewpoint. Due to the terrain configuration and surfaces under the subalpine and alpine pastures, there will be significant changes in experience of the landscape itself. Therefore, the magnitude of impacts is high.

Significance of Impacts: Receptors from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of this wind farm is estimated as major.


*Figure 78: Viewpoint 16 (Paljenik)*

**Assessment of Selected Viewpoint 17 (Vlaška Gromila 1,919 m a.s.l)**

Predicted View: The area with slight slopes under subalpine and alpine pastures, and a significant presence of predominantly bare stone surfaces. The impact of the Wind Farm from the viewpoint 17 is illustrated by the Google Earth photo shown in *Figure 79,* showing that all 25 turbines would be visible.

Magnitude of Impacts: Location of the Wind Farm is on Devečani plateau, located approximately 1.5m southwest of the viewpoint. Due to the terrain configuration and surfaces under the

subalpine and alpine pastures, there will be significant changes in the experience of the landscape itself. Therefore, the magnitude of impacts is high.

Significance of Impacts: Receptors from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of this wind farm is estimated as major.

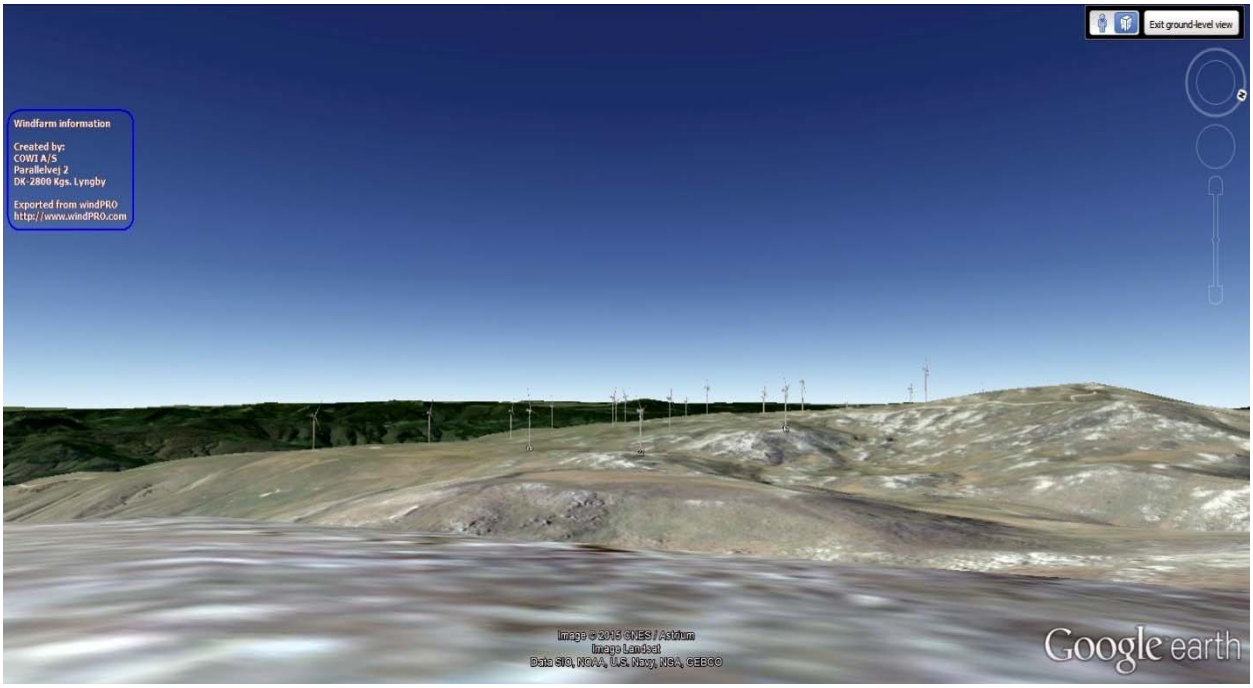


*Figure 79: Viewpoint 17 (Vlaška Gromila)*

**Assessment of Selected Viewpoint 18 (Čardakov 1,805 m a.s.l)**

Predicted View: The area with slight slopes under subalpine and alpine pastures, and a significant presence of predominantly bare stone surfaces. The impact of the Wind Farm from the viewpoint 18 is illustrated by the Google Earth photo shown in *Figure 80,* showing that all 25 turbines would be visible.

Magnitude of Impacts: Location of the Wind Farm is on Devečani plateau, located approximately 100m west of the viewpoint. Due to the terrain configuration and surfaces under the subalpine and alpine pastures, there will be significant changes in experience of the landscape itself. Therefore, the magnitude of impacts is high.

Significance of Impacts: Receptors from this viewpoint are considered highly sensitive. Given the above reasons, the significance of impacts of this wind farm is estimated as major.

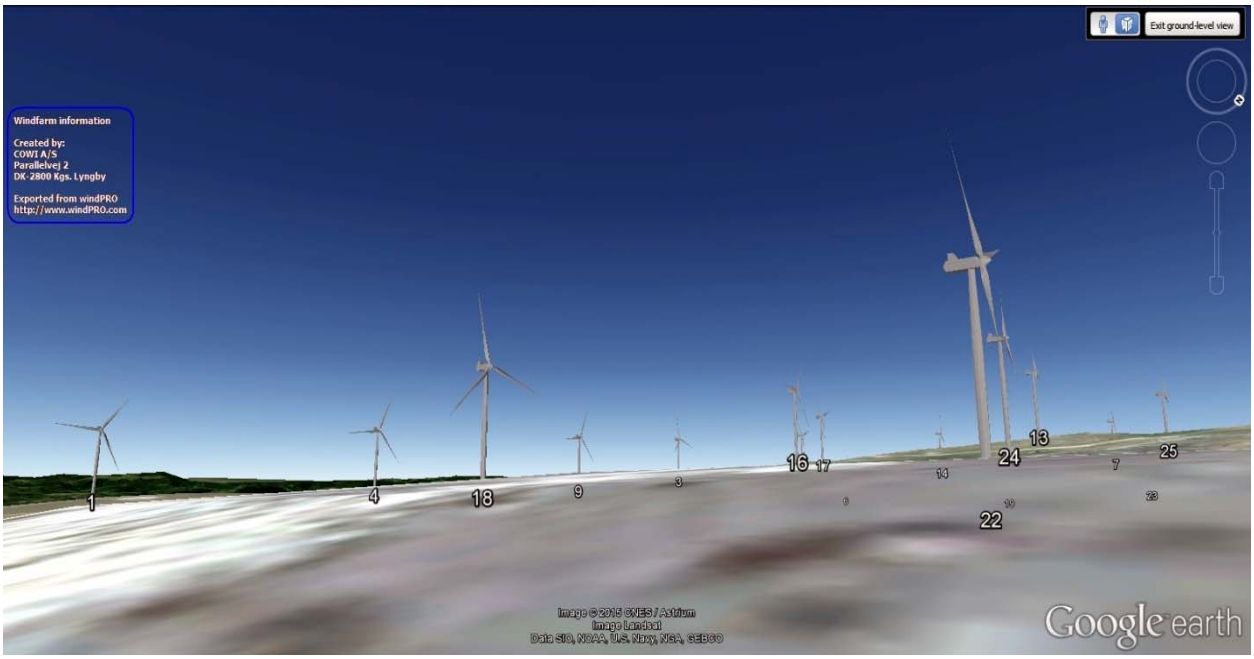


*Figure 80: Viewpoint 18 (Čardakov)*

*Summary of Visual Impact Assessment*

A total number of eighteen (18) viewpoints with eight (8) View Areas were assessed, and a summary of the results is set out in *Table 24*.

*Table 24: Summary of Visual Impact Assessment*[69]

| View Area | Viewpoint number (individually) | Approx distance from nearest turbine (km) | Sensitivity of receptors (individually) | Magnitude of Impact (individually) | Significance of impact (individually) | Sensitivity of receptors (View Area) | Magnitude of impact (View Area) | Significance of impact (View Area) |
|---|---|---|---|---|---|---|---|---|
| **A** | **1** | 4.50 | Low | Low | Minor-Negligible | Low | Negligible | Minor-Negligible |
| | **2** | 4.50 | Low | Medium | Moderate | | | |
| **B** | **3** | 4 | Medium | Medium | Moderate | Medium | Negligible | Minor-Negligible |
| | **4** | 6.50 | Medium | Medium | Moderate | | | |
| | **5** | 5.50 | No impact | No impact | No impact | | | |
| | **6** | 6.50 | Medium | Medium | Moderate | | | |
| **C** | **7** | 4.50 | Medium | Medium | Minor | Medium | Low | Minor |
| **D** | **8** | 4 | Medium | Low | Moderate | Medium | Low | Minor |
| | **9** | 5 | Medium | Low | Minor | | | |
| **E** | **10** | 5 | High | Negligible | Minor-Negligible | Medium | Medium | Minor-Negligible |
| **F** | **11** | 2 | High | Medium | High-Moderate | Medium | High | Major |
| | **12** | 0.25 | High | High | High | | | |
| **G** | **13** | 0.30 | High | High | High | High | High | Major |
| | **14** | 3 | High | High | High | | | |
| **H** | **15** | 0.20 | High | High | Major | High | High | Major |
| **I** | **16** | 0.50 | High | High | Major | High | High | Major |
| | **17** | 1.50 | High | High | Major | | | |
| | **18** | 0.25 | High | High | Major | | | |

[69] *Each viewpoint represents a „typical" view of the development found within the View Area and it should be noted that the viewpoints chosen have been selected to illustrate the presence of the wind farm in the landscape rather than to show the screening effect of landform and landscape features.*

### *5.4.8 Cultural Heritage*

During the operation of the proposed WF Vlasic, it is not anticipated that there will be any impacts on cultural heritage.

### *5.4.9 Socio-Economic Impacts*

*Land use*

Approximately 6.87 ha of land that will have been occupied during the construction period will become available for sheep grazing again during operation of the wind farm. 11.8 ha will remain unavailable during the operation of the wind farm and will be assigned as construction land. This includes land occupied by the WTGs, the OHLs, the substation and management complex and access roads. Of the whole Project site which is 450 ha, this represents 2.6%. As discussed in earlier sections, pasture is the one of dominant land use in the Travnik Municipality composing 5,396 ha (10.2%) of total land area. This means that 0.2% of pasture land in the municipality will be lost. Compensation for privately owned lost land has to be provide as described under construction impacts. This impact is assessed as *low adverse*.

A part of the land on which WTGs are constructed will be subject to some use restrictions. Owners who sign lease contracts with EP BiH for the use of land on which WTGs will be constructed will not be permitted to carry out any activity on the land which may hinder the work of the WTGs. However, land that was acquired for the WTGs is of $6^{th}$ and $7^{th}$ class quality and is used for sheep grazing. As sheep will be able to continute grazing the site during operation and the area of loss is relatively small, it is considered that impact on sheep grazing would be negligible.

*Employment and Procurement Opportunities*

*Direct employment:* The life of the project is expected to be at least 25 years and during that time a small work force will be needed. EP BiH estimate that up to 15 individuals (a few local and international, but mostly national) will be employed during operations. This will give long term stability to the full time employees and will have a significant effect on their lives. However, within the local communities and even more at the national level, this number is very low and the impact has been assessed as *low beneficial*.

*Indirect employment:* Indirect employment may occur as a result of increased spending of those employed by EP BiH, however since this number is so low, this is also assessed as a negligible *positive* impact. The procurement of local goods and services is also likely to be minimal and have a *negligible* effect on local economies.

*Revenue Generation for the Local Government/Community*

According to *Law on the concession of the Central Bosnian Canton,* 60% of the concession fee that must be paid by EP BiH must be distributed to Travnik Municipality. This Concession fee is paid annually.

The benefits from the financial contribution to the Municipality will benefit residents of the Travnik Municipality as it will allow the Municipality to make some investments and contribute to the delivery of certain services to citizens. However, it is not known how much the fee will be and therefore this impact has been assessed as *low*. The financial contribution needs to be well managed and benefits made clear to residents of the Municipality in order to ensure that tensions between the Project and local communities do not arise.

The pressence of an operational wind farm may be accompanied by increased tourism in the area due to the fact that WF Vlasic would be one of the first wind farms to be constructed in BiH. It is therefore possible that visitors may be encouraged to visit the area to see it. An existing tourist settlement in the area is "Babanovac", is located about 4 km northwest from the proposed project location, administratively belonging to the Travnik Municipality. The settlement consists mainly of weekend houses and has some tourist infrastructure i.e. restaurants, hotels, ski jumps etc. which may represent a potential for further development. It is difficult to assess whether the wind farm alone will be enough of a stimulus to trigger tourism in the area further contributing to local economic development and therefore the impact has been assessed as *low beneficial*.

The presence of EP BiH in Travnik Municipality, may attract foreign and domestic investments in the municipality and the wider area, fostering local economic development. This impact is assessed as *low beneficial with potential to grow to moderate*.

*Impacts on Infrastructure*

There will be no impacts on community infrastructure.

### *5.4.10 Health and Safety*

This section details the direct potential health and safety impacts associated with the operation of the wind farm. Issues such as health impacts associated with electromagnetic waves are described below. The operational activities of a wind farm and associated power lines carries with it several key health and safety risks to the workers employed on the project as well as members of the public. Key issues for consideration associated with the proposed project are as follows:

- working at height;
- potential for electrocution;
- frosting and ice shed;
- blade shear or breakage;
- turbine collapse;
- lightning strike and fire;
- issues associated unauthorised access and vandalism.

The issues above may be grouped into those which may primarily carry a physical risk to workers, those which carry a physical risk to members of the public but also possibly workers and those which may impact other stakeholders.

*Worker Health and Safety*

Of the issues described above, two are particularly associated with injury and death in relation to the proposed workers during the operational phases of the project, they are:

- working at height; and
- potential for electrocution.

Due to the nature of the activities undertaken, it is clear that the potential risks associated with working at height are relatively significant.

However, incidents are preventable through the implementation of appropriate management systems and the adherence to the management system requirements by the work force. It is to be expected that permanent, operational staff , including the wind farm management, will be familiar with appropriate safety measures for such projects. Furthermore, all personnel undertaking hazardous work should be certified to do so and implementation of specific international requirements for working at height and working in areas where there is risk of electrocution. In the event that the appropriate measures are implemented, the residual risk is classified as *low***.**

*Public Health and Safety*

Issues which may impact on public health and safety, but which also may impact worker health and safety are associated with:

- frosting and ice shed;
- blade shear or breakage;
- turbine collapse;
- lightning strike and fire; and
- issues associated unauthorised access and vandalism.

*Frosting and Ice Shed:* The risk of frosting/ice build-up leading to ice throw and potential injury is considered to be low for the following reasons:

- according to Best Avaible Technics (BAT) assessment and the climatological data presented in *Section 4– Baseline Environment,* the wind farm is situated in a particularly cold region where there is significant on-going risk of ice build-up.
- the turbines will be equipped with sensors as part of their design to detected imbalances on the turbine blades, which among other causes, will indicate ice build-up leading to shut down of the turbines and therefore prevent ice throw;

- during cold periods, it is highly unlikely that the land for sheep grazing will be occupied;
- There are footpaths that cross the site;
- the residential dwelling is approximately 2 km from the nearest turbine, and ice throw over that distance is highly unlikely;
- workers attending the site during cold conditions will be aware of potential hazards associated with ice build-up on the turbine structures and in the event of a potential risk, should not undertake any tasks associated with the turbine structures.

Based on the above information it is considered that the potential risk of ice throw from ice build-up on the turbine blades leading to injury or damage is of *negligible* significance.

A further risk associated with ice build-up is falling ice directly from turbine structures. There is a potential for injury or death caused by falling ice as from all large scale structures where snow/ice have built up. With adequate saftey managment, the risk of accident should also be *negligible*.

*Blade Shear or Breakage:* Blade shear or breakage is a relatively rare occurrence and injury as a result of blade shear or breakage is rarer still. As with ice shed, it is unlikely that persons will be in the vicinity of the wind farm during conditions which may lead to blade shear/breakage and the distance from the nearest residential property will minimise any risk. Based on the above mentioned information it is to determine that the potential risk of blade shear or breakage leading to injury or property damage is *negligible*.

*Turbine Collapse:* Occurrences of turbine collapse are extremely rare. As with ice shed and blade shear or breakage, it is unlikely that persons will be in the vicinity of the wind farm during conditions which may lead to turbine collapse and the distance from the nearest residential property will eliminate any risk. Based on this it is considered that the potential risk of turbine collapse leading to injury or property damage is *negligible*.

*Lightning Strike and Fire:* Due to the nature of the structure, lightning strike is an inevitability. However, damage caused to turbines by lightning damage is often attributed to design issues associated with inadequate direct-strike protection, insufficient earthing (grounding) and/or other insufficient protection. In such cases breakup of the turbine structure could potentially result in injury or damage to property. However, it is expected that the proposed design will be state of the art and incorporate all possible modern methods to eliminate damage caused by lightning strike. Further, for the reasons listed above, it is unlikely that persons or property will be impacted in an event where damage is caused to the turbine by lightning strike. Based on the above mentioned information it is considered that the potential risk of lightning strike leading to damage to the turbine structure and causing injury or property damage is *negligible*.

Fire associated with wind turbine structures is extremely rare, the few public reports of such occurrences may be classified as 'freak events' and compared to other power generation structures the risks associated with wind power are extremely small. Due to the nature of the design, there is a very small amount of readily combustible materials associated with wind turbine

structures. There are no incidents where turbine fires have led to injury or property damage. Therefore, the risk of turbine collapse leading to injury or property damage is *negligible*. Fire may also be associated with the transformer station, and previous reported incidents are more dramatic than those associated with wind turbine structures. However, the transformer will be located away from persons and public property and will be designed with a fire protection system. Therefore, the risk of a transformer fire leading to injury or property damage is *negligible*.

*Unauthorised Access and Vandalism*: Unauthorised access and vandalism are a problem with all remotely managed technical equipment. The turbines will be designed to as to prevent unauthorised access, but there will be no enclosing fencing around the turbine array. The transformer station and management compound will be fenced and locked so as to prevent access. Further, there will be an onsite security presence in order to deter any unauthorised access and/or vandalism. As sa result, it is considered that the risk of injury is *negligible*.

### *5.4.11 Water/drainage*

After setting up wind turbine and commissioning the wind farm, possible incidental contamination of groundwater can be expected in wind generator overhaul, and in the case of inadequate waste disposal. During the operation of wind farm, a lot of hydraulic oil is necessary for the rotation of the rotor, which if not managed correctly may leak into the environment, and into groundwater.

In the immediate vicinity of the study area, there are two karst springs of lower abundance, Devečani and Ormanj, which are directly threatened by any change in the catchment area.

Extraordinary events on the location of the project can be followed by uncontrolled spillage of biodegradable oil during operation of the wind farm, due to fire, due to extreme weather conditions etc. Whilst the likelihood of such an event is low, should it occur the significance of the impact is considered to be *moderate*.

### *5.4.12 Traffic and Transport*

*Traffic Movements*

After construction, traffic associated with a wind farm would be minimal. Site traffic would be limited to small maintenance vehicles carrying crews of two people undertaking general maintenance work and repair. Typically four maintenance visits would be carried out per month. There is therefore no traffic effect predicted for the operational phase.

*Driver Distraction*

Driver distraction has not been raised as a concern by the highways authorities or any other body during the scoping and preparation of the ESIA Study, but is considered here for completeness.

The minimum distance between the M5 and the proposed wind farm would be approximately 4.5 km. The closest turbine would be approximately 5-10 m, from the local road but this road is without much traffic (a few cars per hour), so driver distraction is not considered to be an issue.

Further discussion of the visual effects of turbines on local road networks is provided in *Chapter 4.9. Landscape*.

### *5.4.13 Noise*

The area that is adjacent to the concession area is intended to be used for tourism and recreational purposes, and accordingly the allowed noise level is prescribed for the day 50 dBA, for the night 40 dBA, and a limit peak level L1 65 dBA.

As the noise from wind turbines is of impulse character perceived by listener, to the modeled values is also necessary to add the correction coefficients of +5 dB for the modeled $L_{eq}$ level and +10 dB for the modeled $L_{Amax}$.

These corrections to the cumulative noise level are made for a type of noise sources, and the impact on people in relation to the level of interference that may cause. It is believed that the noise of impulse character has a greater impact on people and 5 dBA is added on the measured levels, so that they could be compared with the limit values, and be comparable with respect to other sources.

As a value of exceeded permissible levels is taken a limit value prescribed by Law in force in the F BiH as the most severe value in relation to the EU recommendations, since by the above recommendations is left to member states to regulate individually this domain. The value taken as the maximum permissible level is $L_{eq}$ = 40 dBA and L1 = 65 dBA, which is the maximum permissible level for the night, and we believe that the Wind Farm would have the greatest impact on the noise level at night when the permitted level is lower, and the impacts of other sources of noise are minimized.

The mountain lodge „Devečani" is located in the concession area. Based on the noise level calculation that is expected to be at the site of the mountain lodge „Devečani", it can be concluded that the noise level will exceed the permitted level stated in the *Table 28* for the night level, as well as for the day. Considering the noise effect on the area of the mountain lodge, we may conclude that the potential construction of the wind farm will have an impact on this area that exceeds the permitted, according to the applicable Law on noise protection of the F BiH.

At the site of the mountain lodge „Devečani", the estimated noise level from generators of the Vlašić wind farm will be 38.2 dBA.

In the area of the mountain lodge „Devečani", the maximum cumulative calculated noise level is estmated at $L_{eq}$ = 38.6 dBA and L1 = 50 dBA. Due to the continuous operation of the wind farm, and the lack of other sources of noise, it is considered that day and night noise level will not vary.

In addition to the above, and pursuant to the Law on Noise Protection, it is necessary to add correction factors to the calculated noise level, namely +5 dBA for $L_{eq}$ and +10 dBA for L1.

After adding the correction factors, and in order to compare with the Law, the estimated noise level is $L_{eq}$ = 43.6 dBA and L1 = 60 dBA.

At the mountain lodge „Devečani", the predicted increase in noise is7.4 dBA. This exceeds IFC guidelines which state that noise levels cannot be increased by more than 3 dBA.

The use of mountain lodge „Devečani" is limited to certain periods of the year including periods of good weather when conditions are not generally appropriate for the operation of a wind farm i.e. reduced wind). In periods when the mountain lodge is in use, it is therefore anticipated that noise generated from the wind turbines will be minimal.

The noise assessment has only taken into account external noise levels and therefore has not taken account of internal noise levels and mitigation provided by the building itself, e.g. walls and windows. As the lodge is in the mountains it is assumed that windows are likely to be only rarely opened (or alternatively there is other means of ventilation within the building) which will likely further reduce the noise exposure of people visiting the lodge. Whilst this has not been quantified, it is predicted that this will reduce the noise at the lodge such that it does not exceed IFC guideline limits. Monitoring of noise effects at the lodge are recommended during operation in order to identify whether any further mitigation is required.

With regards to noise effects it can be concluded that:

- The location of the Wind Farm is relatively favorable in terms of noise impact on vulnerable zones nearby the concession area;
- propagation of turbine noise in the direction of potentially impacted areas is minimized due to the prevailing wind on the site which carries noise away from these areas;
- It is predicted that none of the idenitified noise receptors will experience any significant noise effects as a result of the operation of the proposed WF Vlasic. This is with the exception of the mountain lodge „Devečani", where the estimated external noise level exceeds that permitted. It is considered that the building itself would mitigate this noise so that internal noise levels would not exceed allowable limits. However, this has not been confirmed and monitoring of noise levels within the lodge are recommended;

### *5.4.14 Shadow flicker*

Analysis of shadow flicker effect of wind turbine blades is made for the entire area of the Wind Farm for the selected wind turbines with a rotor of the outer diameter of 114 m, hub height of 93 m and with capacity of 2.5 MW.

According to data on geographical location of the Wind Farm and the angles that the sun closes at certain times of the year, it is considered that the shadow flicker effect for certain wind turbines on the site may occur upto1,065 m from the base of the turbine.

The base analysis was performed for two characteristic periods of the year, i.e. summer and winter solstice. The winter solstice is the the most unfavorable time of year for the negative effect of shadow flicker made by wind turbine blades, since at that time the sun is at the lowest angle to the horizon, and the shadows increase and are retained for longer periods of time. The period of the summer solstice was taken into consideration, since in this period one can expect the emergence of shadows that could adversely affect the more densely populated areas in the direction of settlements Turbe and Podkraj.

When the sun reaches a certain angle, shadows get shorter, and this effect is not taken into account, since there are no populated areas in the direct vicinity of the Wind Farm. The effects on the mountain lodge are considered later in the assessment.

*Sunrise – the winter solstice*

During the winter solstice, the shadow of wind turbines that are located on the west side of the Wind Farm could have a negative impact on the populated area of Šišava. In the analysis of shadows and geographic characteristics of the terrain, it was found that during the sunrise (7:10 to 7:40) the shadow is in the direction of Šišava settlement. The distance of the most unfavorable wind turbine (in terms of casting shadow) to an inhabited area is approximately 5,600m. Favorable geographic features or hill located in front of the Šišava settlement cover the possible shadows until 8:10 am and it is not expected that the shadows of wind turbines adversely affect the settlement. It is also necessary to note that the distance of 5,600 m is quite large, and that greatly reduces the shadow flicker effect, and it can be considered that in this period there will be no negative impact on the populated area.


*Figure 81: Sunrise – the winter solstice*

*Sunset – the winter solstice*

During sunset in the winter solstice period in the direction of shadows made by wind turbine blades, the terrain is tilted slightly upward, and there are no inhabited areas, as shown in *Figure 82*. In this period, negative impacts are not expected on the populated areas.

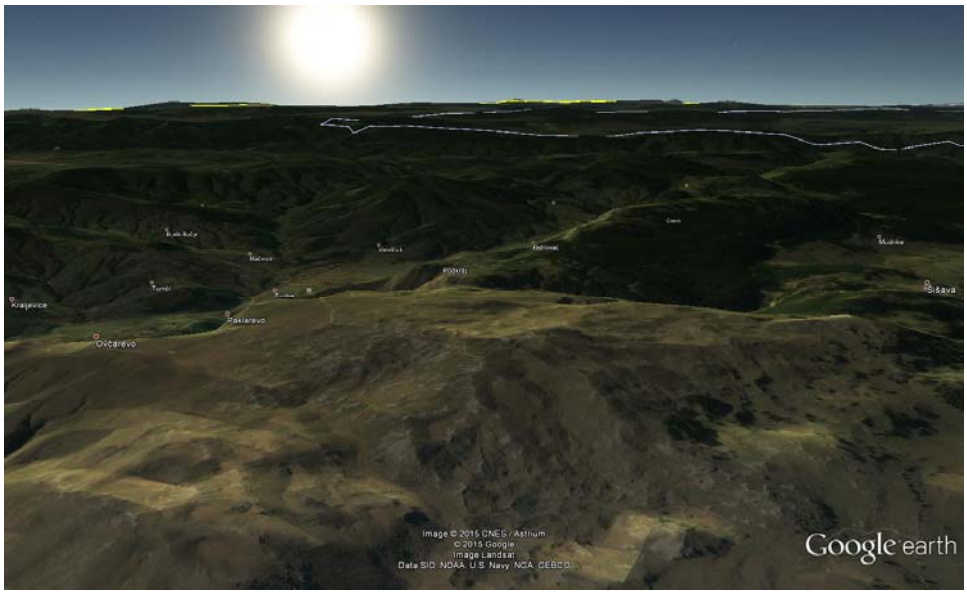


*Figure 82: Sunset – the winter solstice*

*Sunrise – the summer solstice*

During the summer solstice, the shadow of wind turbines which are located in the north-west side of the Wind Farm could have a negative impact on the inhabited area on the stretch of settlements Turbe - Podkraj. In the analysis of shadows and geographic characteristics of the terrain, it was found that during the sunrise (4:30 to 5:00) the shadow is in the direction of populated area Turbe - Podkraj. Distance of the most unfavorable wind turbine to inhabited area is approximately 6,200 m. Already after 5.45 h the shadow of wind turbine will be shortened to a level that stops the negative effect on the populated area. Distance from 6,200 m represents the distance at which the impact of shadow flicker made by wind turbine blades is minimized, and the shadow flicker effects are greatly reduced, and one can be considered that in this period there will be no negative impacts on the populated area.


*Figure 83: Sunrise – the summer solstice*

*Sunset – the summer solstice*

During sunset in the summer solstice in the direction of shadows made by wind turbine blades, the terrain is tilted slightly upward, and there are no inhabited areas, as shown in *Figure 84*. In this period, negative impacts are not expected on the populated areas.

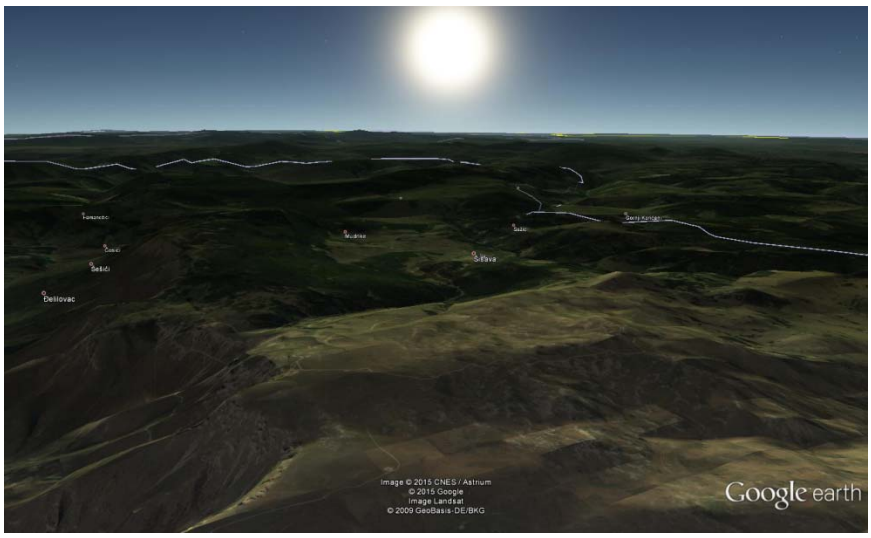


*Figure 84: Sunset – the summer solstice*

*Modeling of shadow for WF Vlašić and comparison with legislation*

Modeling of shadow flicker is performed in software Wind farm, GIS mapping. When selecting analysis of the proposed solution, choice was made based on worst-case scenarios, or cloudiness was not taking into account.

In the analysis of the proposed solution and their impact on the environment, the modeling of shadows and flickering was carried out on the surrounding settlements. Modelling the impact of shadows is carried out for all wind turbines.

The following figure shows the extended negative impact of shadows and flickering on the environment. As shown in the attached model of shadow propagation, there are no negative impacts on nearby villages.

There are no main roads in the zones affected by shadows, and therefore no analysis of impacts on roads has been done.

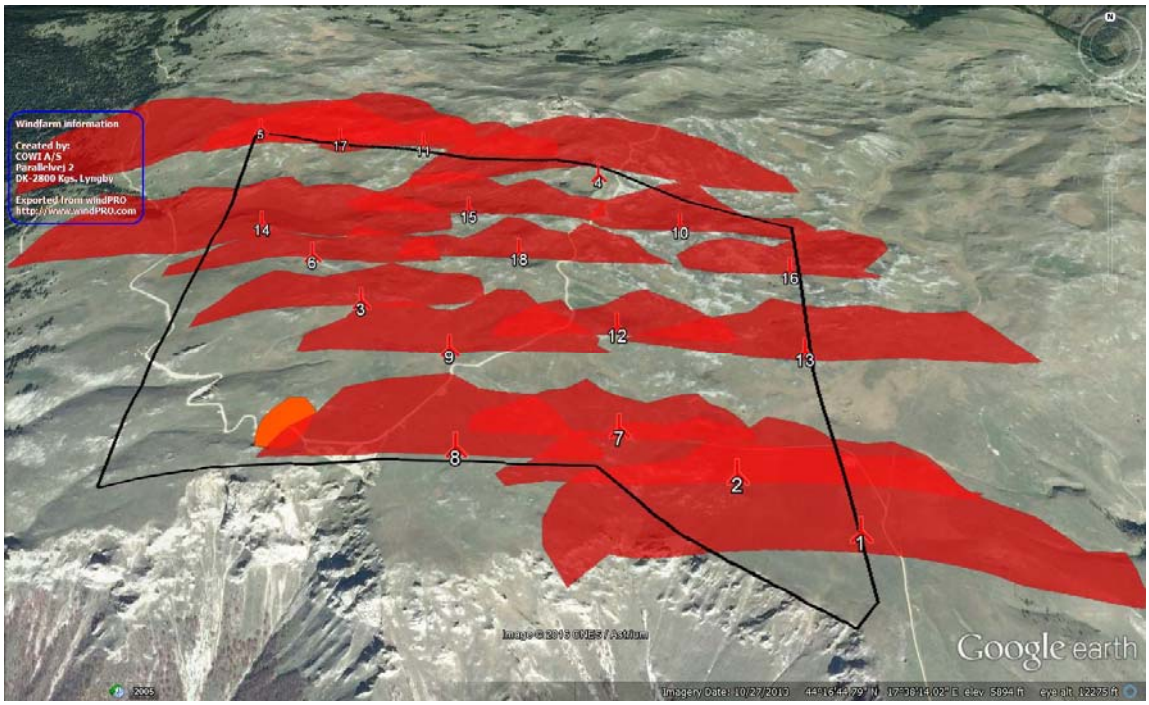


*Figure 85: Graphic view of negative shadow flicker impact on the Vlašić Wind Farm*

The appearance of shadow flicker caused by wind farm operation is shown in *Figure 85*. Based on the modeling results it can be concluded that the negative effects of the shadows will not be in the zone around the wind farm. However, the Mountain lodge „Devečani", may come under the influence of shadow flicker. The impact on the mountain lodge „Devečani" is given in the following *Figure 86*.


*Figure 86: Graphic view of negative shadow flicker impact on the area of the mountain lodge „Devečani"(in purple circle)*

As seen in *Figure 86* the effect of shadows also extends partially to the area of the mountain lodge. The effect of shadows on the mountain lodge „Devečani" is expected only from wind turbine 8. As the shadow flicker impact on the mountain lodge is of limited nature, it is expected only in a certain period of the year. Periods of days when the shadow is expected in the zone of the mountain lodge is a period of sunrise, or from sunrise for 10 to 30 minutes. After this, the shadow shortens.

Periods of the year when we expect the impact of shadows on the mountain lodge are from 24/05 to 07/06 and 05/07 to 19/07. Total duration of potential shadow flicker impact annually is estimated at 28 days. The average duration of shadows in this period is 20 minutes per day, and it is estimated that the maximum total duration of shadow flicker on the mountain lodge is 560 minutes, or 9 hours and 20 minutes per year.

In this calculation, we did not take into account days of cloudiness and periods of the wind farm operation in this time of the yearBased on the results of calculations it can be concluded that there is a potential impact of shadow flicker on the mountain lodge, but it is of a very limited nature.

*Conclusion*

There will be no significant shadow flicker effect from the proposed WF Vlasic on any inhabitated villages/towns surrounding the site. However, effects from shadow flicker will be experienced at the mountian lodge ' Devečani' for approximately 28 days of the year. It is predicted that the average exposure would be 20 minutes per day with a maximum total duration of shadow flicker

of 560 minutes or 9 hours and 20 minutes. The maximum daily impact of shadows is estimated at 30 minutes, namely on 01/06 and 12/07.

Since in the Federation of Bosnia and Herzegovina there is no legislation for this issue, and the practice of the EU is that each Member State should regulate this issue, in this analysis, the regulations of Germany have been followed, which stipulate the following limits:

- a maximum of 30 hours per year in the worst case;
- a maximum of 30 minutes per day in the case of the worst day;
- a maximum of 8 hours per year experiencing shadow flicker.

Based on the above, it can be concluded that there will be a minor negative effect of shadow flicker at the mountain lodge. However, as the mountain lodge is not in continuous use, periods of cloudiness have not been considered within our analysis, and the fact that turbines are unlikly to be operational in all the potential 560 minutes of shadow flicker, it is considered that the effect from shadow flicker on the mountain lodge is negligible.

### *5.4.15 Electric and Magnetic Fields*

Alternative current generates electrical and magnetic fields, collectively known as an 'electromagnetic field' (EMF). Electric fields are produced by voltage and increase in strength as the voltage increases. Magnetic fields result from the flow of electric current and increase in strength as the current increases. Electricity transmission lines are well known sources of electromagnetic fields (EMF), but any electrical equipment is capable of generating an electromagnetic field. Sources associated with the the wind turbines themselves and the transformers.

*Electromagnetic Interference*

- *Aviation Radar and Radio Communications*

Wind farms may have an impact on aviation radar and radio communication systems when the wind farm is situated particularly close to an airport. The proposed WF Vlašić is located approximatly 90 km from Sarajevo airport. Due to the distance between the wind farm and the nearest potential receptors of disruption, it is considered that there will be *no impact* on aviation radar and radio communication systems.

- *Television and Telecommunication Systems*

It is expected that the appropriate measures to minimise disruption to television and telecommunication systems, such as the BAT, will be implemented. Further, any interference that occurs and is shown to be as a result of the wind farm, appropriate measures (such as installation

of an additional television mast) will be implemented. There may be some short term impacts to television and or telecommunication systems as a result of the wind farm, however there is unlikely to be any long term impact, as the developer will be required to address any issues associated with impacts on television and telecommunications. In the long term there is to expect *no negative impact* associated with this issue.

## 5.5 Decommissioning phase impacts

This section describes the predicted impacts for the decommissioning phase of the wind farm which will take place at the end of the wind farm life, which is usually about 25 years. Decommissioning mirrors many of the activities that take place during construction and therefore many of the impacts are similar between these two phases. It is not possible to predict what the future baseline will be, therefore impacts are based on the current baseline.

### *5.5.1 Hydrological Characteristics*

During the decommissioning of the proposed WF Vlasic, it is not anticipated that there will be any impacts on hydrology.

### *5.5.2 Geology and Soils*

During the decommissioning of the proposed WF Vlasic, it is not anticipated that there will be any impacts on geology and soils.

### *5.5.3 Ecological impacts*

Wind Farm decommissioning may lead to potential disruption of habitats and protected speciesalthough such impacts should be limited to the current location and already established routes, which were used in the construction phase of the Wind Farm. Significance of this impact is assessed as *low-medium*.

### *5.5.4 Landscape (visual impact)*

The impacts on the landscape and visual resource of the Proposal Site and surrounding area during the decommissioning phase will be similar in nature to the construction phase. This phase was previously described, and characterized by the presence of large plants and elements of ground disturbance. However, it is likely that the magnitude of the impact would be slightly reduced due to a shorter duration of works and retention of some underground features in situ. Once the decommissioning activities have been completed, the landscape will return to a state comparable to the conditions that currently exist on the Proposal Site. Therefore impacts on landscape character and visual amenity as a result of the decommissioning work are predicted to be *not significant*.

### *5.5.5 Cultural Heritage*

During the decommissioning of the proposed WF Vlasic, it is not anticipated that there will be any impacts on cultural heritage.

### *5.5.6 Socio-Economic Impacts*

Generally speaking the socio economic impacts from decommissioning activities will be similar to those during the construction phase, apart from the considerably reduced impact on land use. In summary, impacts to land use, impacts on livelihoods and employment and procurement opportunities, include the following:

*Land Use*

The total amount of land which will be permanently lost for sheep grazing is approx. 11.2 ha. This impact is assessed as *negligible*.

*Employment and Procurement Opportunities*

The dismantling of the turbines, disposal of materials and reinstatement of land will generate some direct and indirect employment opportunities and a part of those opportunities will be available for local people. These impacts should be addressed continuously as discussed in the construction phase. This impact is assessed as *low beneficial*. In addition operational staff will loose their employment. This is considered to be of negligible sigificance due to the low number of staff who will be employed during operation.

Owners of land and/or their descendants will have the possibility to regain full ownership of land after the decommissioning of WTGs, for a certain fee which will be determined by the Travnik Municipality. They will be obliged to bear the transaction costs themselves. Whilst this could be considered as having a *low beneficial* effect, it is not known what their economic status will be in 25 years time and whether they would be able to afford to buy the land back. It is therefore not possible to predict whether there will be a benefical effect.

### *5.5.7 Health and Safety*

In general, the health and safety risks to workers and the community from decommissioning activities will be similar to those during the construction phase, as outlined above. The project will be designed to reduce potential risks during its decommissioning. This is typically done by ensuring that a design risk register is kept and maintained through the design process, allowing potential risks that can arise during decommissioning to be identified and addressed in the design process.

For example, the use of hazardous materials in construction that could lead to health and safety risks during decommissioning will be avoided wherever possible.

Upon closure of the site, inspections will be undertaken to ensure that contamination of the ground has not taken place during the operational phase, and that measures put in place during the design and construction phases have been successful in protection ground, surface water and groundwater at the site.

It will be important that documentation is maintained during the operational phase that shows that any incidents or accidents have been managed and cleaned up to ensure that no significant contamination has been caused that could lead to health and safety risks during decommissioning.

### *5.5.8 Water/Drainage*

The potential impacts of decommissioning are similar to those of construction and can be mitigated by the adoption of similar appropriate precautions.

### *5.5.9 Traffic and Transport*

Traffic and transport impacts during the decommissioning phase are likely to be very similar to the construction phase. As with the construction phase, appropriate management and mitigation measures should be implemented to prevent disruption or nuisance. If appropriate management and mitigation measures are implemented as detailed in the construction, then the residual impact should be *low*, rising to moderate if appropriate management and mitigation measures are not implemented. At the end of the 20 year consent period, the wind farm will be decommissioned, or a new planning permission would be required. All items of plant, including the turbines and associated infrastructure, would be dismantled and removed from site. The number of vehicle movements required would be substantially fewer than the number required during construction. The long vehicles needed to transport the turbine blades would not be required as these would be cut up on site prior to removal.

### *5.5.10 Noise*

*Decommissioning Activities*

Decommissioning activities are expected to generate similar noise levels as the construction activities, and similar noise significance levels would apply. The majority of plant expected to be used for decommissioning would be of sufficiently low noise levels not to significantly affect the nearby noise sensitive receptors. Some adverse noise impacts may be expected if the concrete foundations for the turbines are broken out and removed, with impacts being potentially greater at locations closer than 1,500 m.

*Decommissioning Traffic*

Similarly to the construction activities, there would be a number of vehicle movements associated with the decommissioning of each turbine, and dependent on the routes that the vehicles take to get to the site, there may be increases in noise arising from increased traffic.

Properties near the road between the west of the site and the regional roads R413 and R413a through Turbe, Potkraj, Đelilovac and Šišava have the greatest potential for increases in noise due to decommissioning traffic.

Properties within a few metres of a road with increased traffic flows may also be affected by an increase in ground borne vibration, particularly from heavy vehicles when there are irregularities in the road surface.

### *5.5.11 Air quality*

The potential impacts of decommissioning are similar to those of construction and can be mitigated by the adoption of similar appropriate precautions

# 6. MITIGATION MEASURES

Mitigation measures aim to avoid, reduce or offset adverse impacts of the proposed development of WF Vlasic. Where potential impacts have been identified during the ESIA, mitigation measures have been identified and these are set out in the sections below. A distinction is made between design mitigation and general mitigation.

## 6.1 Design Mitigation

Mitigation measures that are integrated into the design with the aim of avoiding or reducing the impacts of the project on the environment are termed 'design mitigation'. During the development of the ESIA environmental and social constraints were identified and fed into the design of the WF Vlasic such that the design went through several iterations before the final design was chosen.

### *6.1.1 Ecology*

*Plant communities*

Locations north of the mountain lodge „Devečani", within a radius of approximately 400 m, will be excluded from construction activities, because of the many species of Dinaric gentian (*Gentiana dinarica L.)*;

*Birds*

Buffer zones around sensitive bird areas areas, such as the edge of Paklarske stijene, woods and valleys on the west side of the concession area have been respected. Although the size of these buffer zones for individual bird species are usually defined by relevant international standards, in the case of WF Vlasic wind turbines and associated infrastructure will not be installedto the north and northeast of the Concession area. This is based on the findings from site surveys, in particular radar surveys that identified key bird habitat. It is considered that a buffer zone of 200 m from the edges of Paklarske stijene to the nearest wind turbine would be sufficient to reduce the adverse impact on 3 species:Yellow-billed Cough *(Pyrrhocorax graculus),* Common Kestrel (*Falco tinnuculus)* and Eurasian Scylark (*Alauda anversis)*.

During construction of turbines, ensure that the location thereof is located 750 meters from the nests of the Golden Eagle (*Aquila chrysaetos*).

*Bats*

During design of the turbine layout it was also necessary to consider areas important to bat foraging and avoid locating turbines within these zones. It was identified that an important bat foraging areas included locations around the water source Devečani, where there is potentially large activity of bats due to the presence of water. A buffer zone of 200m has been placed from this areas.

A buffer zone of 200m has also been included around the valley in the northwest, due to the fact that in these locations there is very prominent bat activity, in particular by one species; *Myotis mystacinus*.

### *6.1.2 Landscape and visual*

During the design phase, impacts on the landscape and to the visual amenity were taken into consideration and turbine layout modified to minimise landscape and visual effects as much as possibe. In order to achieve this the natural topography of the land was taken into consideration and models used to position turbines in the most appropriate arrangement such that natural screening was possible.

### *6.1.3 Land Use*

The design has taken account of individual land plots and has located turbines as close to the edge of plots wherever possible such that land use is optimised and spread more evenly between different land plots..

### *6.1.4 Traffic and Transport*

Various mitigation measures have been included in the design to reduce the anticipated traffic generated from the construction works. On-site borrow pits will be established where possible to provide stone for the construction of on-site access tracks. This will avoid the need to source stone from off-site suppliers, thereby reducing the number of HGV movements to and from the site. Spoil will be re-used rather than removed from site, thereby avoiding the need for additional HGV trips.

## 6.2 Construction Phase Mitigation

This section identifies mitigation measures for the construction phase of the proposed WF Vlasic.

### *6.2.1 Soils*

In order to mitigate against soil erosion it is necessary to minimise the length of time that cleared land areas are left without vegetation cover. The layer of soil with vegetation cover (turf) will be separated and kept separated from the rest of the land that will be used for the final rehabilitation of re -leveled area.

Drainage will be provided around turbine foundations and cable trenching in order to prevent soil erosion.

The construction site will be inspected regularly to check for any site contamination e.g. from leakage of fuel or oil from the equipment and machines. Liquid waste (fuel, oil) as well as other types of waste collected in all phases of the project will be disposed and sanctioned in accordance

with the regulations for the given type of waste. Storage space for machinery and equipment will be concreted and equipped with the appropriate equipment for the control of fuel and oil leakage. In the event of oil, grease or fuel leakage, contaminated soil will be removed and treated as hazardous waste.

### *6.2.2 Ecology*

*Plant Communities*

Measures designed to reduce negative impacts on plant communities include the following:

- Vegetation removal should be carried out in the period of plant dormancy, i.e. outside of the growing season. It is recommended that vegetation clearance should be undertaken in the period between 01/10 to 31/03.;
- During construction an Ecological Clerk of Works will supervise construction activities when required in order to identify any protected species. In the event protected species are identified, works will cease until a suitable protection measure can be put in place:Where possible, existing access paths will be used in order to minimise damage to plant communities. The movement of machinery and heavy equipment will be restricted to designated construction zones in order to minimize damage to the ecosystem of mountain meadows;
- Where possible top soil (up to a depth of 30 cm) that is removed will be suitably stored on site for later use in site restoration. Locations of borrow pits or landfills (after use) will be fenced for 12 months following the end of construction in order to provide sufficient time toform a vegetation cover before any grazing takes place;
- On completion of construction, habitats will be managed to ensure that the correct, indiginous plant species are planted on disturbed areas of ground.

*Bats*

- Construction work could adversely affect the feeding (and migration) of *Plecotus macrobullaris*. For this reason, the construction work should be limited to the time of day. If construction works are limited to daylight hours only, this will minimise the impact on this species in particular and on bats in general;
- Construction works will only be carried out in the summer in order to avoid disturbing hibernating bats;

*Birds*

- During construction an Ecological Clerk of Works will have the following tasks:
    - To monitor and manage the environmental and ornithological issues during construction (due to the possible presence of bird nests), and provide advice, which will contribute to the preservation of the existing situation and the quality of the composition of birds;

- To provide on-site guidelines to contractors, to ensure compliance with the legal basis of protection of certain species;
- To maintain contact with officials at the local level, responsible for similar tasks, as well as other competent bodies, to ensure the protection of the environmental features of an area;

- Areas under forest vegetation correspond to species such as Black stork, Montagu's harrier, Common buzzard, Long-legged buzzard and Red-footed falcon, where they nest, live and feed. Therefore, it is very important to protect the forest vegetation. Smaller steep slopes, that result from excavations will covered or protected with barriers at the end of each day, in order to prevent a dangerous trap for young nesting birds in the soil.

*Mammals (Mamalia)*

- Prior to construction protected species surveys will be carried out to determine if there are any protected species within the construction area and in particular any breeding populations. This includes the wolf. If their presence is established, these sites should be avoided. This may include searching cleaned surfaces just before the start of works. Installed fences would have the task to prevent the return of the relocated animals to the areas from which they were relocated;
- Work will be carried out only in the daytime, to avoid disturbing nighttime activity of mammals;
- During works, advice will be sought from qualified members of the local hunting club, in relation to any works that may affect the hunting grounds.

*Reptiles*

- During all earthworks on site it will be necessary to ensure that any reptiles found are relocated to safe areas. This may include search of cleaned surfaces just before the start of works.

### *6.2.3 Landscape (visual impact)*

During construction there is no possible mitigation measures.

### *6.2.4 Culrural Heritage*

If findings of archaeological and/or cultural interest are discovered during construction activities all works will be immediately halted and the competent institution consulted, i.e. the Commission for the Protection of Cultural and Historical Heritage.

### *6.2.5 Socio-Economic Measures*

*Land Use*

During construction the project will cause a temporary reduction in land available for sheep grazing. Whilst the actual impact will only be short term, there are certain measures which will be implemented to mitigate it, as well as prevent any impacts to livelihoods. These measures include:

- upon the completion of construction activities, the land will be fully reinstated so that it can be used for its former purpose;
- compensation for privately owned land will be executed.

Difficulties in accessing land as a result of increased traffic and access track upgrades will be managed by the implementation of following measures:

- traffic management plan will be developed and implemented;
- timely information will be provided to users of land of when access to their land might be more difficult (e.g. scheduled access track upgrades);
- a community grievance mechanism will be implemented.

*Employment and Procurement Opportunities*

Engagement of all construction workers will follow international best practice, with the main measures comprising the following:

- recruitment procedures that will be put in place will be transparent and fair;
- all temporary workers will be engaged in line with both national legislation and applicable international ILO (International Labour Organisation) standards and recommendations;
- a grievance mechanism for workers will be provided;
- a training programme for the local workforce will be implemented to enable them to take advantage of the opportunity.
- timely and transparent information regarding employment opportunities related to the Project will be provided to local communities.

In order to generate indirect employment opportunities, the Project will procure goods and services locally whenever possible.

*Livelihoods*

Economic displacement of persons whose land use may be affected by construction and generally any loss of livelihoods as a result of loss of land available for sheep grazing will be mitigated by undertaking the following measures:

- minimise the amount of land occupied / disrupted during construction;

- timely information will be provided to users of land of when construction is planned to begin and how lost income from livestock and damages will be compensated;
- to compensate all users of land for lost income from livestock farming and any other damages at full replacement value, in accordance with the Federal BiH Law on Expropriation (*Official Gazette of the Federation of BiH, no.70/07 and 36/10*) and IFI policies;
- upon the completion of construction activities, land that is not permanently occupied will be fully reinstated;
- a grievance mechanism will be implemented.

These measures will ensure that land loss is minimised, however, approx. 11.8 ha of land will continue to be unavailable for agriculture after construction.

To prevent any livelihood losses as a result of transport and increased traffic, the following measures will be implemented:

- timely information will be provided to people/households located along the selected transport route that there will be increased transport activity in their area and the possible impacts as well as foreseen mitigation measures;
- compensate any business losses with full replacement value, in accordance with the BiH legislation and IFI policy 35;
- if compensation alone is not sufficient to restore livelihoods, implement livelihood restoration measures in accordance with IFI policies;
- a grievance mechanism will be implemented.

*Community Health, Safety and Security*

The influx of workers into the Project area causing disturbances for the local population, will be minimised by the implementation of the following measures:

- contractors will be encouraged that hire local workforce, i.e. give preference to suitably qualified and experienced applicants from the local communities;
- enforce workers code of conduct;
- cooperate and coordinate with local health and safety facilities (i.e. hospitals and police).

*Infrastructure*

Transport of heavy machinery could lead to damage of existing road surfaces, which may lead to accidents, vehicle damages, etc. The following measures will be undertaken to mitigate these impacts:

- preparation of roads for heavy transport before construction;
- restoration of roads to at least pre-construction level.

### *6.2.6 Water/drainage*

Excavations will be minimised during construction in order to limit sediment load into water ways that may result from direct water runoff. In addition, all excavated material, which will not be used during construction activities, will be deposited appropriately and protected from erosion that may cause water pollution incidents.

In order to manage accidental release of fuels, oils, chemicals, hazardous materials, etc., to the ground, groundwater and/or surface water, all these materials will be stored in a specialist store.

Repair of machinery and vehicles, and refueling will be carried outside of the construction site, by an authorized company. For the transportation of equipment and materials to the construction site, only correct technical equipment and means of transport will be used. Materials handling procedures and a spillage procedure will be implemented and enforced to minimise risk to ground and water. A Construction Environmental Management Plan will be prepared which will include the management procedures for mitigating construction impacts to water.

In addition to the spillage response procedure waste water management systems should be situated away from open water, and appropriate primary and secondary containment should be in place. This should include management of domestic waste waters and vehicle washing. It will forbidden to wash machines and vehicles in the area of works.

On the construction site a sufficient number of mobile chemical toilets with tanks for sanitary waste water will be provide, according to sanitary regulations. These will be emptied by an authorized legal entity. A system for the adequate disposal of waste water will also be implemented on the site.

### *6.2.7 Traffic and Transport*

Transport of construction materials and equipment will involve both public roads and site roads on the wind farm site. In order to optimise and improve traffic safety, a Transport Management Plan will be developed and implemented to include two separate sections: one section on public road traffic, and one for on-site traffic. It will be the responsibility of the Contractors to prepare and implement the Transport Management Plan.The plan may be a sub-section of the project Environmental Plan, or may be stand alone. The Transport Management Plan will establish:

- for traffic on public roads: methods to reduce the number of trips, suitable routes to follow to/from the project area agreed with the local governments of the localities crossed by transport routes, agreements with the local governments regarding transport delivery, transport scheduling, public warning;
- for site traffic: the traffic routes between the work fronts and the site logistics facilities/ supply areas, travel speed limits, necessary practices in avoiding excessive dust emissions and the fouling of public roads.

In order to minimise traffic and transport impacts, the following mitigation measures will be implemented:

- delivery hours to to be restricted to reduce noise nuisance and congestion;
- heavy construction traffic will be subject to the traffic management plan.

Management and mitigation measures will be incorporated into the Environmental Management Plan once transport requirements and suitable options have been confirmed.

### *6.2.8 Noise*

Overall, noise from construction activities would be managed to minimise the impacts on the noise sensitive receptors. Noise control measures would include:

- the use of Best Practicable Means during construction works;
- ensuring that all staff and operatives are briefed on the requirement to minimise noise nuisance from site activities;
- establishment of agreed site working hours for "normal" construction activities;
- programming works such that the requirement for working outside of normal working hours is minimised;
- use of attenuation measures such as silencers/enclosures where appropriate;
- plant and machinery will be well maintained;
- plant and machinery will be tuned off when not in use;
- establishment of agreed criteria whilst undertaking significantly noisy or vibration-causing operations near to sensitive locations.

Construction traffic will follow pre-determined routes to access the site to minimise impacts, and where possible, routes will be selected to avoid areas of habitation.

### *6.2.9 Air Quality*

In order to minimise dust emissions during construction and ground works, as well as emission from generators and vehicles, dust management procedures will be put in place. This includes water spraying of roads and stockpiles of dusty materials, covering vehicles carrying dusty materials on leaving the site to prevent materials being blown from the vehicles, speed limits on unmade surfaces on site to limit dust and assurance that all engines operate to national standards and are fully maintained, particularly to prevent the release of black smoke.

## 6.3 Operational Phase Mitigation Measures

This section identifies mitigation measures that will be implemented during the operational phase of the proposed WF Vlasic. An overarching mitigation includes the implementation of

environmnetal management procedures (e.g. ISO14001) that will put in place strict controls to avoid and minimise the environmental impacts identified.

### *6.3.1 Ecology*

*Plant Communities*

No additional mitigation measures are required.

*Bats*

- Wind turbines will only switch to operational at wind speeds of 5.5 m/s and above in order to minimise the likelihood of bats, which decrease their activity at higher wind speeds, being affected by the turbies;
- Vegetation will not be permitted to grow close to the turbines that would encourage bats to forage for food close to the turbines;
- Lighting will be kept to a minimum across the site;

*Birds*

- All carrion that is found within the proposed WF Vlasic site will be removed in order to prevent carrion eating birds from entering the turbine area. Birds and nests of registered protected nesting birds such as the Golden Eagle and the Common Buzzard will be continuously monitored throughout the life of the wind farm. Where any collisions with turbines occur, these will also be recorded. Monitoring information will be passed onto the relevant authorities responsible for environmental monitoring and tracking of biodiversity losses (i.e., the *Federal Ministry of Environment and Tourism).All available guidelines for monitoring th*e impacts of wind farms on birds, will be used and the relevant statutory bodies consulted.

*Mammals (Mamalia)*

No mitigation measures are required.

### *6.3.2 Landscape (visual impact)*

There are no mitigation measures proposed for landscape and visual impacts during operation of the WF Vlasic.

### *6.3.3 Socio-Economic Mitigation Measures*

*Land use*

No mitigation measures are identified for the operational phase.

*Employment and Procurement Opportunities*

To manage direct and indirect employment opportunities, a transparent and fair recruitment policy will be put in place. Goods and services will be procured locally wherever possible.

*Livelihoods*

Economic displacement of persons whose livestock farming may be affected by repairs and generally any loss of livelihoods as a result of loss of land available for sheep grazing will be mitigated by undertaking the following measures:

- minimise the amount of land occupied / disrupted during repairs;
- compensate all users of land for lost sheep grazing and any other damages at full replacement value, in accordance with the Federal BiH Law on Expropriation and IFI policies;
- fully reinstate the land after disruption;
- implement a grievance mechanism.

*Revenue Generation for the Local Government/Community*

To ensure the continuation of the beneficial impacts EP BiH will make all compensation payments to the Central Bosnian Canton, Travnik Municipality and Federation of Bosnia and Herzegovina in a timely and transparent manner.

### *6.3.4 Water/drainage*

In order to manage accidental release of fuels, oils, chemicals, hazardous materials, etc., to the ground, groundwater and/or surface water, all these materials will be stored in a specialist store and appropriate management put in place.

In addition to the spillage response procedure waste water management systems will be situated away from open water, and appropriate primary and secondary containment will be put in place.

### *6.3.5 Traffic and Transport*

No mitigation is required for general operational traffic. In the event of a component failure, a replacement will be brought to the site. This movement will be handled in the same manner as during the construction phase.

### *6.3.6 Noise*

In the event that noise levels cause significant complaint, the operator will investigate the cause for the noise and remediate, e.g. through modifying turbine speeds. It should be possible through modifying the pitch (angle) of the turbine and thereby the speed of rotation.

## 6.4 Mitigation measures decommissioning

Mitigation measures for the decommissioning phase will be similar to those for the construction phase and are therefore are not repeated here.

# 7. MONITORING PLAN

## 7.1 Introduction

This section sets out the required monitoring of environmental conditions during operation of the proposed WF Vlasic. The primary focus is on ecological monitoring but other environmental parameters are included.

The purpose of monitoring is to:

- check predictions made in the ESIA and identify whether there are any significant deviations from the predicted impacts;
- test the effectiveness of mitigation measures; and
- identify whether there are any additional mitigation measures that need to be implemented.

Monitoring will be the responsibility of Elekroprivreda and will be undertaken for a minimum of 24 months. Where necessary monitoring plans will be agreed with with relevant authorities (most likely the Ministry of Tourism and Environment). Further details are provided within the Environmental and Social Action Plan (ESAP) that has been prepared for the project[70].

## 7.2 Ecological monitoring

*Ornithology*

The most vulnerable among birds are birds of prey;of the 26 registered priority species of birds that were identified within the study area, 20 species are birds of prey. However, the all registered priority species are threatened and, as such are all strictly protected.

All registered priority species of bird will be monitored over 24 months through a number of site visits by a registered ornithologist. Engagement of the same would be/should be the responsibility of the wind farm owner/operator. This will include monitoring injury and mortality rates across the site, as well as monitoring flights, breeding and migration behaviours and patterns. The scope of the ornithological monitoring will be agreed in advance with Federal Ministry of Environment and Tourism. However, in summary the monitoring will likely include:

- *Activity of birds around wind turbines*:

[70] *Technical Assistance for Wind Farm Vlašić Travnik-BiH, Environmental and Social Action Plan (ESAP)*

For each wind turbine, activity will be recorded over a period of two years. Records will be made of:

- species;
- number of specimens;
- behavior (flying, walking or stationary).

➢ *Flight records:*

*Records will be made of:*

- direction of flight;
- distance from the wind turbine; and
- height in relation to the wind turbine (below the blade level, in the blade level, on the edge of blade coverage, above the blade tip).

The findings of the monitoring will be reported periodically to the Federal Ministry of Environment and Tourism. During monitoring, particular attention will be focused on Paklarske stijene and the southern part of the Concession area, where activities of birds are the most conspicuous, especially the Golden Eagle and Common Buzzard. When monitoring, attention will be paid to the wind turbines near the "buffer" zone - the zone of wind turbines 1, 2 and 8, because this is the area in which more birds are likey to be present.

*Monitoring of bats*

Bat monitoring will be carried out over a period of 24 months and the scope will be agreed in advance with Federal Ministry of Environment and Tourism. However, in summary the monitoring will likely include:

➢ Monitoring the activity of bats with appropriate bat detectors on the specified transect routes to cover the period of migration (spring and autumn), and the highest activity and reproduction period (spring, summer). Transect methodology will be implemented with a combination of capture with meshes, and telemetric monitoring and other available methods;

➢ monitoring of habitats to identify any changes in habitat condition

When monitoring mortanlity rates it will be necessary to monitor an area around the turbine bases with radius equal to the height of wind turbines, but not less than 70 meters around the individual wind turbine. When bat mortalities are identified a record will be made of species of bats, approximate age, condition, estimation of time of death, and GPS reference.

During monitoring, particular attention will be focused on Paklarske stijene and the southern part of the concession area, where activities of bats are the most conspicuous, especially those who have their shelters on the southern cliffs and whose activity is extremely high. When monitoring, attention should be paid to the wind turbines near the "buffer" zone.

The findings of the monitoring will be reported periodically to the Federal Ministry of Environment and Tourism. The monitoring will be conducted by the authorized institutions, and a report will be submitted to the Federal Ministry of Environment and Tourism.

## 7.3 Traffic and Transport

It is not deemed necessary to undertake any specific monitoring associated with traffic and transport. However, it is to be expected that the transport management procedures will include an audit process to ensure that the construction traffic is following the transport plan and using the appropriate transport routes.

For monitoring of traffic and transport in relation to Health and Safety plesae refer to *Section 7.6*.

## 7.4 Noise

Noise levels will be monitored continously during operation near the mountain lodge "Devečani" during operation. The purpose of this will be to identify times when the operation of Turbines 8 and 9 need to be modified in order to reduce noise emissions levels to within permitted levels.

A noise map will be created immediately after the construction and commissioning of the wind farm in order to check that noise predictions made during the assessment stage were correct. These measurements will be repeated every 2 years to track any changes in noise emissions and these will be reported to the Federal Ministry of Environment and Tourism.

It will not be necessary to carry out noise monitoring during the construction phase unless complaints are made from local communities.

## 7.5 Socio-Economic

Complaints and grievances submitted through the Project grievance mechanism will be regularly monitored. Feedback received from various Project stakeholders will alert EP BiH of any problems or issues that need to be dealt with, whether on an individual or community level.Grievance management itself needs to be monitored to ensure that all received complaints are addressed as described in the Project SEP. This will also apply to worker's grievances.

Reinstatement of land upon completion of construction activities will be monitored to make sure that the correct procedures are followed. This will ensure that people can continue to use their land and enjoy the same quality of sheep grazing, such that their livelihoods are not affected.

The restoration of roads following construction will be monitored to ensure that all roads have been reinstated to at least pre construction level. The same applies during operations, concerning road repairs and maintenance.

Compensation payments made for impacts caused by the project (e.g. loss of grazing areas, loss of business through traffic disruption) will be monitored to ensure that it is being paid in a timely manner, so as to prevent any loss of livelihoods.

## 7.6 Health and Safety

There is no proposal for any specific monitoring associated with Health, Safety and Public Nuisance. However, it is expected that the management systems implemented for construction and operation will incorporate appropriate communications processes to receive communications from internal and external stakeholders, to implement a non-conformance and corrective action process to record issues reported by internal and external stakeholders. Also to incorporate audits to review the Health and Safety Performance during all phases of the project and encompassing

work undertaken by all workers associated with the project, particularly those that are involved with site work.

Transport management procedures will include an audit process to ensure that the construction traffic is adopting the appropriate transport routes and that health, safety and public nuisance issues are not being caused.

Implementation of the health and safety management activities are part of the Environmental and Social Action Plan (ESAP)[71].

## 7.7 Soils and Water/Drainage

There is no proposal for any specific monitoring associated with surface water, effluent and land and ground quality. However, occasional inspections will be carried out during construction and operation.

It is expected that the management systems implemented for construction and operation will incorporate appropriate training for all personnel involved in the handling and management of hazardous materialsAnon-conformance and corrective action process will also be implemented to record issues reported by internal and external stakeholders.

An accidental spillage procedure will be drafted and put in place prior to construction beginning.

Implementation of the management activities will be part of the Environmental and Social Action Plan (ESAP)[1].

[71] *Technical Assistance for Wind Farm Vlašić Travnik-BiH, Environmental and Social Action Plan (ESAP)*

# 8. ALTERNATIVES

During project development, and in accordance with the Terms of Reference, twelve (12) different variants of turbines were analyzed with the aim of identifying the most approriate turbine type and turbine configuration. A feasibility study has been carried out to determine the benefits and disbenefits of the various turbine type and as a result a shortlist of 4 was selected. These included:

- Alternative 1: Turbine type with a rotor of the outer diameter of 116.8 m and capacity of each of turbines of 2.4 MW;
- Alternative 2: Turbine type with a rotor of the outer diameter of 114 m and capacity of each of turbines of 2.5 MW;
- Alternative 3: Turbine type with a rotor of the outer diameter of 113 m and capacity of each of turbines of 3.2 MW;
- Alternative 4: Turbine type with a rotor of the outer diameter of 117 m and capacity of each of turbines of 3.3 MW.

## 8.1 Alternative 1

Alternative 1has the IEC class IIIA (IEC IIIA). This alternative would consist of 18 turbines each with a capacity of 2.4 MW, with a rotor of the outer diameter of 116.8 m and hub height of 91 m. The turbine rotor is with three (3) blades, and the maximum width of the blades is 3.496 m, with a slope of 0-90°. Turbines include a de-icing system, which works by heating elements, resistant to icing on blades.

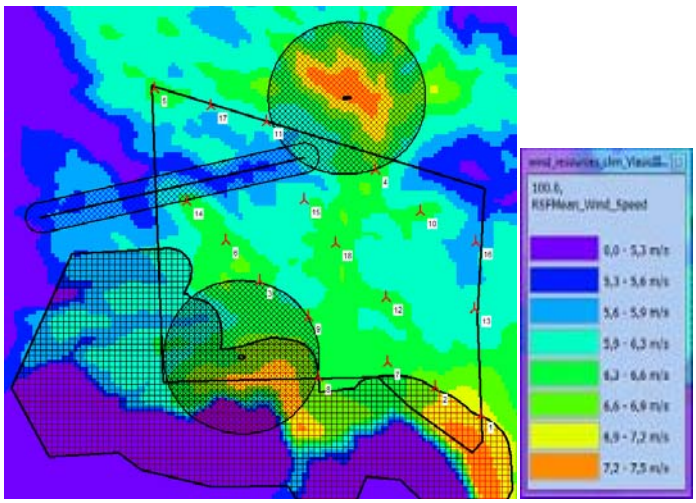

*Figure 87: Layout of 18 turbines with a rotor of the outer diameter of 116.8 m and capacity of each of turbines of 2.4 MW;*

## 8.2 Alternative 2

Alternative 2has the IEC class IIA (IEC IIA). This alternative would consist of 18 turbines with capacity of 2.5 MW, with a rotor of the outer diameter of 114 m and hub height of 93 m. The turbine rotor is with three (3) blades, and the maximum width of the blades is 3.86 m, with a slope of 0-90°. Turbines include a de-icing system, which works on the principle of circulation of hot air (coating for protection against icing).

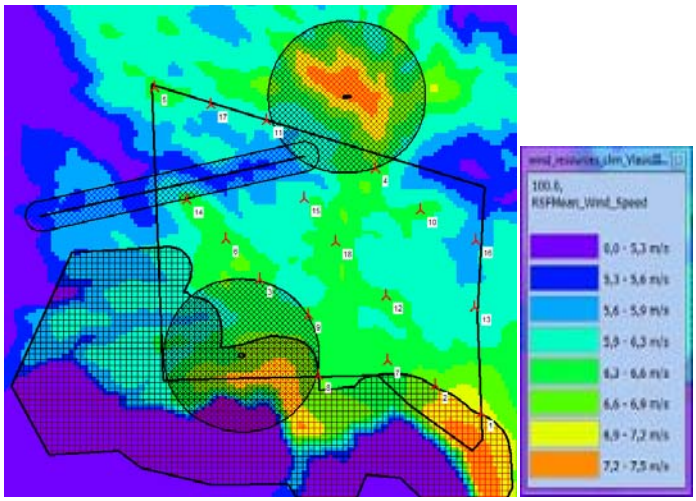

*Figure 88: Layout of 18 turbines with a rotor of the outer diameter of 114 m and capacity of each of turbines of 2.5 MW;*

## 8.3 Alternative 3

Alternative 3 has the IEC class IIA (IEC IIA). This alternative would consist of 15 turbines with capacity of 3.2 MW, with a rotor of the outer diameter of 113 m and hub height of 92.5 m. The turbine rotor is with three (3) blades, and the maximum width of the blades is 4.11 m, with a slope of 0-90°. Turbines are with the de-icing system, which works by heating elements, resistant to icing on blades.

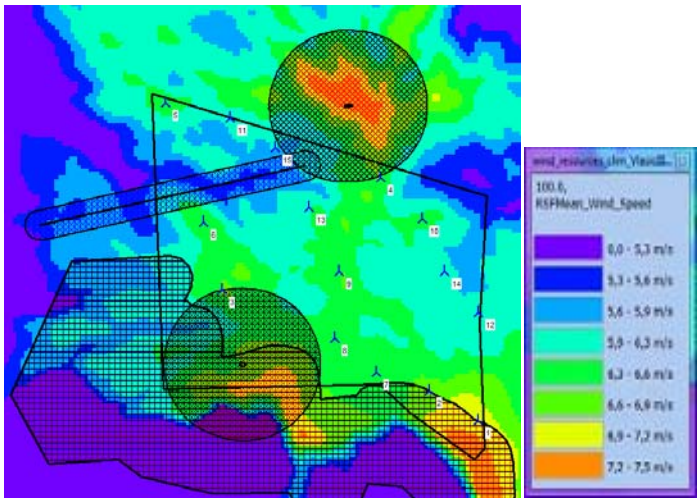

*Figure 89: Layout of 15 turbines with a rotor of the outer diameter of 113 m and capacity of each of turbines of 3.2 MW;*

## 8.4 Alternative 4

Alternative 4has the IEC class IIA (IEC IIA). This alternative would consist of 15 turbines with capacity of 3.3 MW, with a rotor of the outer diameter of 117 m and hub height of 91.5 m. The turbine rotor is with three (3) blades, and the maximum width of the blades is 4 m, with a slope of 0-90°. Turbines are with the de-icing system, which works on the principle of circulation of hot air.

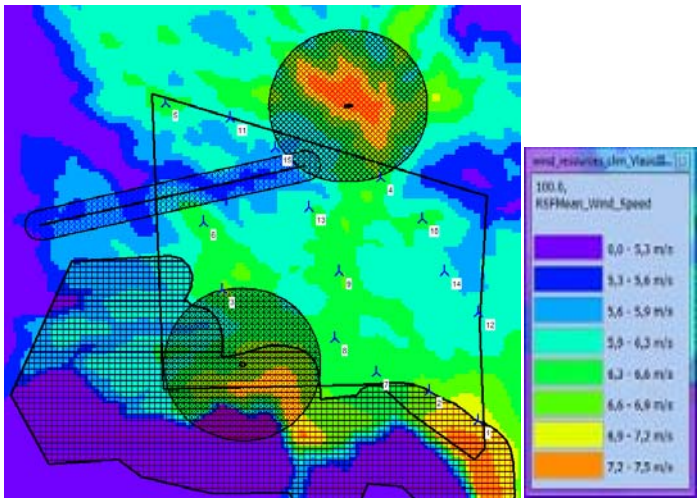

*Figure 90: Layout of 15 turbines with a rotor of the outer diameter of 117 m and capacity of each of turbines of 3.3 MW;*

## 8.5 Preferred Alternative

From the shortlisted four variants, the preferred alternative was determined to be Alternative 2. This selection was based on a number of considerations including financial calculations and key environmental constraints including consideration of the noise and flicker analyses and the birds and bats collision analysis. For example, Alternative 2 was determined to be preferential in terms of noise impacts as the manufacturer is able to supply the tyrubines with noise mitigating technology that reduces the noise impact at sensitive locations (in particular at the mountain lodge). On the other hand modelling of Alternatives 3 and 4 determined that this layout would have upto 25% less impact on birds as a result of bird strike.

In the *Financial Bankability Study*[72], the 4 variants selected, Alternatives 1, 2, 3 and 4, was based on financial analyses and other related analyses with regard to CAPEX (Investment budget) and OPEX (Operational budget). Following this the Levelized Cost of Energy (LCoE), the internal rate of return (IRR), and the net present value (NPV) without and with financing were calculated. Finally, sensitivity analyses were performed based on input from Elektroprivreda.

Based on the ranking exercise both from an LCoE, an IRR and a NPV perspective, and in combination with consideration of environmental impact, the Alternative 2 was identified as the most promising WTG variant for the proposed WFVlašić project. although the difference to the next in rank (Alternative 1) was very small.

[72] *Technical Assistance for Wind Farm Vlašić Travnik-B&H, Financial Bankability Study*

# 9. ESIA LIMITATIONS

During the ESIA there have been a number a challenges to address and these are described below.

## 9.1 Baseline data availability

In some instances, there has been a lack of baseline data available for inclusion within the ESIA. This has included limited information being available on hydrology and hydrogeology, as well as current state of the mammal populations. Overall however, it is considered that sufficient information has been available in order to allow for an assessment of likely effects to be made.

## 9.2 Spatial planning documentation

Spatial planning evolves over time and for the purpose of the ESIA it proved difficult to obtain recent, accurate data. In particular limited information was available related to the process that was carried out to award concession for the investigation works.

## 9.3 Extention to the Concession Area

During the preparation of the ESIA, the Concession area was extended which led to the need to extend the study area for the birds and bats assessment. This led to a delay in the programme.

# 10. NON-TECHNICAL SUMMARY

## 10.1 Introduction

Elektroprevreda is seeking an Environmental Permit from the Ministry of Tourism and Environment in order to allow them to construct a Wind Farm, known as WF Vlašić that will include 18, 2.5 MW wind turbines, access roads and associated energy infrastructure.The maximum generating capacity of WF Vlasic would be 45 MW. The maximum height to turbine tip of each wind turbine will be 150 m; with a hub height of 93 m and 3 blades with a maximum rotor diameter of 114 m. The operational life of the wind farm is expected to be approximately 25 years.

## 10.2 Environmental and Social Impact Assessment (ESIA)

An ESIA is a study that systematically assesses the likely sigificant effects of a proposed project on the environment and social setting of a defined area. The findings of the ESIA are set out in the ESIA Report which is submitted to the Ministry of Tourism and Environment for approval.

This non-technical summary (NTS) presents a summary of the main findings of the ESIA in non-technical language. As such this NTS provides a short summary of the large amount of technical data that is available for WF Vlasic, highlighting the "likely significant environmental and social effects" that have been identified, along with the actions that are being proposed to mitigate these effects.

The ESIA for WF Vlasic has been carried out to meet the requirements of international standards required by the European Investment Bank (referred to as "EIB") and other international financial institutions (IFIs), BH legislation and Terms of References (ToR). This includes meeting the requirements of the European Directive on Environmental Impact Assessment (EIA Directive 2014/52/EU). This ESIA has been prepared to meet the requirements of both FBiH and the EU EIA Directive and covers the following aspects:

- Hydrology;
- Geology and soils;
- Ecology;
- Landscape and visual;
- Cultural Heritage;
- Socio-economics;
- Shadow flicker;
- Air quality;
- Traffic and transport;
- Noise and vibration

Effects considered include those that are temporary, arising from construction activities, those that are permanent due to the presence of the wind farm, associated infrastructure and access roads and cumulative effects of the nearby committed developments.

*10.2.1 The ESIA process*

The ESIA process has been carried out in a series of stages:

- **Baseline:** information gathered to tell us about what the existing environmental conditions of the site and wider study area are.

- **Assessment:** identification of the likely significant environmental effects from the construction, operation and decommissioning of the proposed development. Where possible, industry standard methodologies and significance criteria have been used to assess the effects on the environment. Where these do not exist, professional judgement and experience of similar projects have been used.

- **Mitigation:** Measures intended to avoid, reduce and, where possible remedy, significant adverse environmental effects of the project.

- **Iterative process:** environmental specialists have provided feedback to the design process so that the final design solution incorporates mitigation and enhancement measures where possible. In addition, mitigation that will be implemented during construction and operation of the proposed development has been proposed.

- **Residual effects:** effects that would remain after mitigation and enhancement measures have been fully implemented, are stated in the ES.

*10.2.2 Project Location*

The site of the proposed WF Vlasic, known as the Concession Area, is located about 15 km to the north-west from Travnik city and covers an area of about 4.5 $km^2$ (450 ha). The site location is shown in *Figure 91*, and the proposed turbine layout is shown in *Figure 92* below.

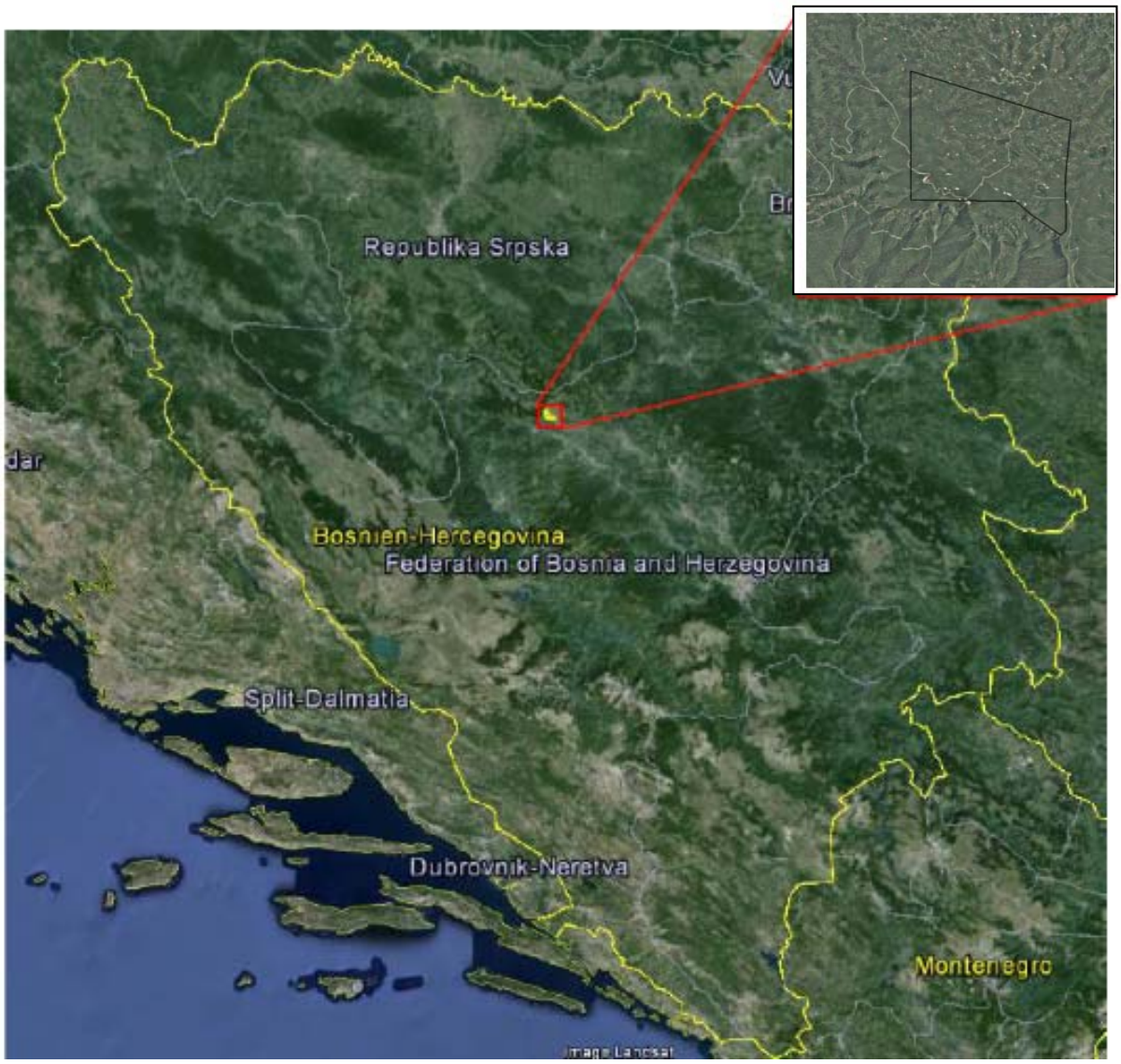


*Figure 91: Site Location*

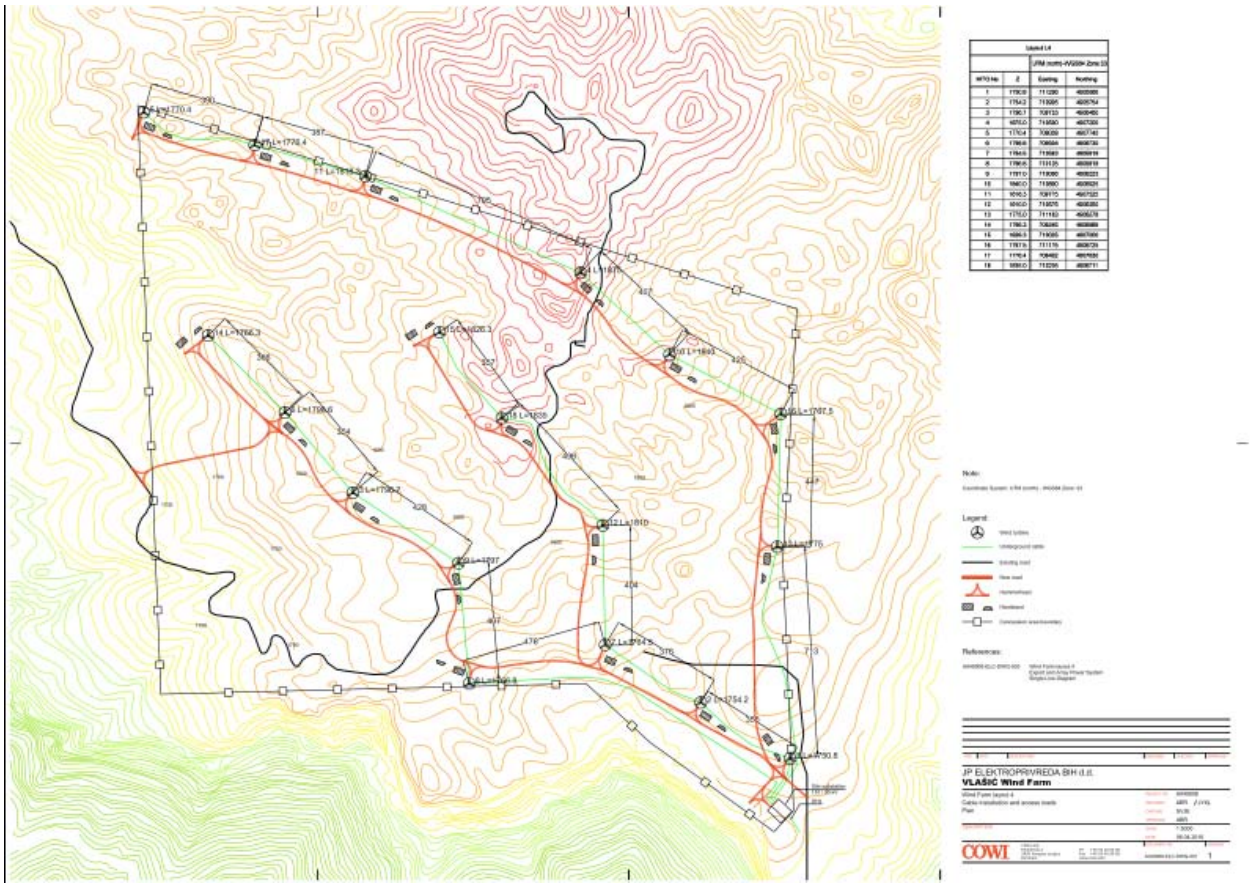


*Figure 92: Wind Farm layout*

The project site is completely within the Concession Area which is the area that has been given authorisation by Travnik Municipality for the potential development of a wind farm. The site is set on hilly and rocky terrain, with steep cliffs along the southern boundary. The local area is uninhabited, privately owned land which is primarily used for sheep grazing. Within the Concession Area there are several unofficial weekend settlements, in addition to 7 cottage facilities, which are seasonal in use. There is one mountain lodge known as "Devečani" which is locatedon the Devečani plateau, in the south-western part of the Concession area.The proposed WF Vlasicis located within areas planned as a "Protected Landscape"/"Nature Park" and is located within the Natura 2000.

## 10.3 The Proposed wind farm Vlasic

The proposed wind farm Vlasic would comprise a number of different elements which are outlined in *Table 25*. Figure 92 provides a layout of the turbines.

| Development proposals | |
|---|---|
| Turbines | • 18, 2.5MW wind turbines. |

| | |
|---|---|
| | • Maximum height to turbine tip of 150m;<br>• Hub height of 93m;<br>• 3 blades;<br>• Maximum rotor diameter of 114 m<br>• Proposed model: Alternative 1 |
| Wind Farm infrastructure | • Substation compound<br>• Control building<br>• Met mast<br>• Craned hardstandings |
| Access tracks | A series of access tracks will be constructed across the project site in order to access the turbines for construction and operational maintenance. |
| Access route, road improvements | The turbine components will be brought to site on trucks, primarily from the port of Ploče through the settlements and cities of Metković, Mostar, Konjic, Sarajevo, Vitez and Travnik. There will be areas where the road will need to be modified in order to allow the passage of abnormal loads, e.g. around tight bends in the road. |
| Land take | The land take of the turbines will be 11.8 ha<br>The landtake from the other wind farm components will be 11.1 ha<br>Total landtake = 22.9 ha |

### *10.3.1 Construction programme*

Construction of the proposed WF Vlasic would take a total of 19 months with an anticipated construction start in 2017.

### *10.3.2. Consideration of alternatives*

During project development twelve (12) different variants of turbines were analyzed with the aim of identifying the most approriate turbine type and turbine configuration. A feasibility study was carried out to determine the benefits and disbenefits of the various turbine type and as a result a shortlist of 4 was selected. From this shortlist, the Alternative 1 was selected as the most appropriate for the site based on environmental constraints and technical performance.

## 10.4 Assessment of Effects

### *10.4.1 Hydrology*

The hydrology assessment established the hydrological conditions of the site and identified how drainage would be handled.

Within the majority of the WF Vlašić site there are no surface water flows, because the terrain consists of carbonate sediments that have a high porosity which allows water to pass through it quickly. However, in the area of Devečani there are two small karst springs, (Devečani in the concession area, and Ormanj, close to the concession area). No significant hydrological effects have been identified.

### *10.4.2 Geology and soils*

The soils within the project site are not high quality agricultural land but rather are predominantly used for sheep grazing. During construction, there is a potential for soil erosion to take place and for there to be a potential of ground contamination should there be any accidental spillages of oil. However, it is not considered to be significant and will be controlled through best practice construction.

### *10.4.3 Ecology*

The proposed WF Vlasic site is within an area that is proposed as a 'protected landscape and nature park' and also potentially included within Natura 2000 (a European wide designation established through the Habitats Directive). This is primarily due to the rich variety and quality of species and habitats that exist on the site. The following effects were identified:

- ***Habitat loss -*** Siginificant adverse effects have been identified in relation to loss of habitat for both plant and animal species that are recognised as protected. Sub-alpine and alpine pastures will be particularly effected due to the amound of area that will be disturbed during the construction process. There will be no effects on the forest communities.
- ***Bats*** - during construction, bats are unlikely to be affected. However, during operation bats from the genus *Pipistrellus, Nyctalus* and *Vespertilio* are likely to be significantly effected by the presence of the turbines which are located within areas of their flight paths.
- ***Birds –*** During construction potential disturbance may be experienced by a number of protected species includeing the Common Buzzard, Golden Eagle, Common Kestrel and Alpine Chough. Even though the nesting sites for these species are over 200m from the construction activities, due to the high conservation status of these species it is considered that this is a significant effect.

During operation birds are exposed to the potential risk of striking turbine blades. The areas that is likely to pose the greatest threat in this regard is in the area around Paklarske rocks and cliffs due to the high level of bird flight activity in this area. The most vulnerable species includes birds of prey (Common Buzzard, Golden Eagle and Short-toed Eagle). Due to their conservation status it is considered that this is a significant effect.

### *10.4.4 Landscape and visual*

The landscape and visual assessment considered the proposed WF Vlasic from 18 different viewpoints and considered how the presence of the wind turbines may change the landscape and the views of the area. Due to the location of the proposed WF, turbines will be visible for relatively long distances; however, it is considered that the views from settlements such as Turbe and Travnik will not be significant due to the distance and the intervening terrain. Significant effects will be experienced closer to the site on exposed mountain areas such as the plateau, mountain peaks and from valleys and slopes that are closer to the site.

### *10.4.5 Cultural Heritage*

No cultural heritage assets have been identified on the project site and no significant effects have been identified.

### *10.4.6 Socio-economics*

The construction and operation of a wind farm brings within it many potential socioeconomic effects which have been assessed within the ESIA.

The proposed WF Vlasic is on land that is currently in private ownership. Should the wind farm be constructed this land would be acquisitioned. Due to the compensation measures that are legally in place, it has been assessed that no land owner would suffer financial loss from these agreements.

Employment opportunities, whilst beneficial are not considered to be significant for any stage of the wind farm, although there will be a number of construction stage jobs available.

The local communities will benefit from a financial contribution that must be paid to the Municipality in the event that Elektroprivreda are granted consent to contruct the wind farm. This is known as the 'Concession fee' and would be paid annually.

### *10.4.7 Shadow flicker*

Shadow flicker refers to the flickering effect caused when rotating wind turbine blades periodically cast shadows over neighbouring properties as they turn, through constrained openings such as

windows. The magnitude of the shadow flicker varies both spatially and temporally and depends on a number of environmental conditions coinciding at any particular point in time, including, the position and height of the sun, wind speed, direction, cloudiness, and position of the turbine to a sensitive receptor. The shadow flicker assessment that has been carried out for WF Vlasic concluded that there would be no significant shadow flicker effects.

### *10.4.8 Air quality*

There will be no air quality effects during operation. During the construction phase the only emissions will arise as a result of construction plant. With the implementation of environmental management during construction it is considered that any effects would be effectively mitigated.

### *10.4.9 Traffic and transport*

The transportation of turbine components to the project site requires the use of vehicles that can transport abnormal loads. As a result, a number of modifications will be required on some roads along the route from the port of Ploce to accomodate these large vehicles. During these works local residents along the route will experience some disturbance and other road users will experience some delays. However it is not considered that these effects will be significant and will only be short term and temporary.

### *10.4.10 Noise and vibration*

During the assessment, noise calculations were made in order to identify whether any areas would experience levels that exceed permitted noise levels. It was determined that there would be no noise exceedences except for the area around the mountain lodge „Devečani", which is used as a tourist resource. However, these exceedences relate to the external noise and does not take account of the attenuation that would result from the building itself. It is considered that as most people who visit the lodge would spend the majority of their time whilst visiting the site inside the building, noise levels are unlikely to be exceeded. However, this has not been confirmed and would need further analsysis.

### *10.4.11 Monitoring measures*

Environmental monitoring will be carried out during all phases of the WF Vlasic construction, operation and decommissioning.

During construction and decommissioing, monitoring will be the responsibilitly of the Contracot and will include monitoring of environmental management practices. This will include monitoring of environmental protection measures, supervision of construction plant, monitoring of

procedures for the storage and treatment of hazardous and harmful substances, and supervision of the implementation of the Waste Management Plan.

Monitoring during the operational phase is the Investor's obligation, or the relevant institutions which will be authorized by the Investor to carry out given monitoring. Monitoring will primarily include monitoring of birds and bats, but may also include noise monitoring in the event that compaints from communities are received.

# 12. ESTIMATE OF FINANCIAL RESOURCES FOR PROMOTION AND PROTECTION OF ENVIRONMENT AND SOCIO-ECONOMIC ASPECTS

## 12.1 Replacement and land acquisition - expropriation and compensation to society

The land intended for the construction of the proposed WF Vlašić is privately owned although ownership details are not yet determined. In this case it is necessary to first identify the state of the ownership structure and ownership and then initiate the process of expropriation at the level of the Municipal Council of Travnik, since Expropriation of land and property is legally permitted through the Law on Expropriation (*Official Gazette of the Federation of BiH, nos.70/07 and 36/10*), where real estate is expropriated from private to state ownership for reasons of public interest and where compensation is paid. However, the relevant legislation does not define the term 'general interest' but rather provides important and typical examples. Fair compensation is to be given for expropriated land and property, usually in cash or in the form of substitute real estate if the parties have agreed to this, in which case the expropriation serves not only as a way of cessation of using but also of acquisition of land and property. Provision of a fair compensation for the property is considered as necessary by the current legislation for two reasons. First, the fundamental rights and freedoms are protected in this way, and secondly, the socio - economic development of the community is achieved.

In Bosnia and Herzegovina responsibility for expropriation it does not exist at the state level but at the level of the entities – Federation of BiH and Republic of Srpska (RS), as well as Brčko District (BD).

Construction of the facility or any other works must be in compliance with the planning documents of physical planning. Expropriation can be pursued for purposes of the Federation of BiH, cantons, cities, municipalities, public enterprises and public institutions. Expropriated property becomes the property of the expropriation beneficiary (complete expropriation). Complete expropriation terminates not only the ownership rights of the previous property owner but also any other rights to that property. Expropriation can establish easement on the land and building as well as lease of land for a specified time (incomplete expropriation). The provisions of this Law relating to the procedure of complete expropriation and procedure of compensation for expropriated property in the event of complete expropriation shall apply to incomplete expropriation accordingly.

The decision on establishing the public interest for the construction of a building or execution of works in the area of two or more municipalities shall be made by the cantonal government based on previously obtained opinion of the municipal council on whose territory these buildings are to be built or works executed. The decision on establishing the public interest for the construction of wind farm on this site shall be made by the Municipal Council of Travnik where the facility is planned to be built in accordance with the planning documents of physical planning.

Recommendation for establishing the public interest shall be submitted to the municipal council through the municipal administrative services for property and legal affairs, and shall include a study of expropriation (geodetic and cadastral plan of the area of expropriation; information on real estate proposed for the determination of public interest; estimated value of the property; purpose of expropriation and other data relevant for determining the public interest). The competent authority is required to make a decision concerning determination of the public interest within 60 days of receipt of the proposal. The decision on establishing the public interest, pursuant to the provisions of this article, shall also determine the expropriation beneficiary.

Compensation for expropriated property is determined, as a rule, through the provision of another suitable property whose value corresponds to the market value of expropriated property in the same municipality or town, thus providing the owner of expropriated property with approximately the same terms of use he/she had when used that property.

Compensation for expropriated agricultural, construction and urban construction land shall be determined in cash based on the market price of such land. Compensation for barren land, rocky ground and the like shall be determined in the amount of compensati on that would be determined for the lowest class of pasture in the same cadastral municipality.

The agreement on compensation for expropriated property shall include the form and amount of the compensation as well as the deadline by which the beneficiary of expropriation is required to fulfill the obligations in respect of compensation.

The amount of compensation for expropriated property shall be determined in court proceedings according to the circumstances that existed at the time of issuance of the first instance court decision on compensation.

For the purpose ofthe land acquisition analysis for Vlasic Wind Farmproject, price datafor the parcels on the study area were obtained from the Cantonal Ministry of physical planning, construction, environmental protection, return andhousing affairs inTravnik.

The wind farmislocatedin an uninhabitedarea.The land (parcels), isin private ownership.The land cultureispasture.Their categories will be later determined through the administrative procedure.

Regarding that the project is currently at the stage of feasibility study and conceptual design, in the following analysis are given an orientation data and the cost of real estate. In the next project phase, there will be prepared a document “Purchase and compensation”.

The permanent land take for the duration of the project is shawn in the *Table 26* and the temporary land take for the construction period is shawn in the *Table 27*.

*Table 26: The permanent land take for the duration of the project*

| Element | Ground Dimensions | Price (Euro/m2) | Price (Euro) |
|---|---|---|---|
| Wind turbines | 428.45 $m^2$ x 18 pcs | 6 | 46,276.92 |
| External turbine transformer | 4 m x 7 m | 6 | 168 |
| Access track | 12,904 m x 4.5 m x 1.2 m | 6 | 418,089.6 |
| Substation compound | 54 m x 62 m | 6 | 20,088 |
| One control building | 27.25 m x 8.84 m | 6 | 1,445.34 |
| Crane hardstanding | 1,450 $m^2$ | 6 | 8,700 |
| Met mast | 36 $m^2$ | 6 | 216 |
| Transmission line | 5 m x 5 m x 22 pcs | 6 | 3,300 |
| **Total** | | | **498,283.86** |

*Table 13: The temporary land take for the construction period*

| Element | Ground Dimensions | Price (Euro/m2) | Price (Euro) |
|---|---|---|---|
| Construction compound | 80 m x 70 m | 6 | 33,600 |
| Crane hardstanding | 340 $m^2$ | 6 | 2,040 |
| Laydown areas | 61 $m^2$ | 6 | 366 |
| Track shoulders | 12,904 m x 2 m | 6 | 154,848 |
| Turbine foundation areas | 1,466 $m^2$ | 6 | 8,796 |
| **Total** | | | **199,650** |

**An overall price of land acquisition is Euro 697,933.86.**

The realization of those projects follows, in accordance with applicable laws, different compensation to society (local and the wider community), due to the loss of an authentic state and loads of space on which will be built.

The benefits of the wind farm Vlašić will primarily be those for the local communities: land owners, municipalities, local population and governments, but also for other entities such as: power utilities, equipment suppliers/manufacturers, benefiting from the economic development of this sector, as well as the associated infrastructural changes and the demonstration character of the project. *Table 28* below provides a list of different kinds of fees and their distribution.

*Table 28: Different kinds of fees and their distribution*

| Fee title | Distribution of compensation | | | |
|---|---|---|---|---|
| | Total | Municipality | Canton | F BiH |

| | | | | | |
|---|---|---|---|---|---|
| **1** | **Concession fee**; Law on the concession of the Federation of BiH; | | | | |
| **a** | **One-time fee conssecion 1.5% of the total investment** | | | | |
| **b** | **Current concession fee 1.5% of the total annual revenue** | | | | |
| **2** | **Concession fee**; Law on the concession of the Central Bosnian Canton; | | **60%** | **40%** | |
| **3** | **Concession fee**; Law on the concession of the Federation of BiH; Draft | | **60%** | **10%** | **30%** |
| | **One-time fees in total** | | | | |
| | **Total year fees** | | | | |

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# 14. APPENDICES

*Appendix 14.1: List of Bird Species observed in the Vlašić Wind Farm Site;*

*Appendix 14.2: Map of Habitats (1:25.000);*

*Appendix 14.3: Layout of the Internal Site Roads (1:5.000);*

*Appendix 14.4 Layout of Site Substation*

*Appendix 14.5: Synthesis Map of the Current State of the Environment (1:25.000);*

*Appendix 14.6: Map of Woodlands and Hunting Area (1:25.000);*

*Appendix 14.7: Summary of Impacts and Mitigation Measures;*

*Appendix 14.8: Photodocumentation of the Project Area;*

*Appendix 14.9: Landscape Assessment Methodology;*

*Appendix 14.10: Noise Assessment;*

*Appendix 14.11: H&S Management Plan;*

*Appendix 14.12: Waste Management Plan;*

*Appendix 14.13: Monitoring Plan*

*Appendix 14.14: Gap Analysis*

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