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NON-TECHNICAL SUMMARY
ENVIRONMENTAL IMPACT ASSESSMENT STUDY OF PROJECT OF CONSTRUCTION OF WIND FARM ON THE LOCALITY OF KOSTOLAC

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Pursuant to the Law on Planning and Construction (Official Gazette of RS No. 72/2009, 81/2009, 24/2011 and 145/14), for the objects over 50 meters high, facilities for electricity generation of 10 MW and more, electricity lines of transformer stations of voltage 110 kV and more; facilities for the production of energy from renewable energy sources with a capacity of 10 MW or more, a construction permit is issued by the Ministry in charge of civil engineering affairs (according to Article 133 of the Law), and based on the Project for Construction Permit with accompanying documentation, which, among other things, contains Environmental Impact Assessment Study. A special document defines a list of projects/facilities for which environmental impact assessment is mandatory (Regulation on the establishment of a list of projects for which an environmental impact assessment is mandatory and projects for which an environmental impact assessment can be required, Official Gazette of the Republic of Serbia, No. 114/2008). According to this Regulation, facilities for the production of electricity in wind farms exceeding 10 MW and 110 kV transmission lines are on List II, so they can be requested for the development of a Study on Environmental Impact Assessment. The Law on the Environmental Impact Assessment (Official Gazette of RS No. 135/04, 36/09) defines the procedure of impact assessment for projects that can have significant impacts on the environment, which includes:

- defining the contents of the Environmental Impact Assessment Study by the Competent Authority, abased on the Request submitted by the Investor,
- implementation of the process of participation of interested bodies and organizations and the public at all development phases of the Study,
- cross-border notification by the Competent Authority for projects that may have significant impacts on the environment of another state,
- implementation of the process of drafting and approving the study, which results in the approval of the study or the refusal of a study by the Competent Authority,
- supervision and other issues of importance for environmental impact assessment.

In accordance with the above, the Ministry of Agriculture and Environmental Protection of the Republic of Serbia, within its competencies and in accordance with the provisions of the Law on Environmental Impact Assessment (Official Gazette of RS, No. 135/04 and 36/09), and upon the request of the project holder PE „Elektroprivreda Srbije“, adopted a Decision determining the need for development and determining the scope and content of the on the Environmental Impact Assessment Study of the project for Construction of wind farm on the locality of Kostolac (Decision No: 353-02-01621/2016 -16, dated September 13, 2016).

The complex of the planned wind power plant involves the construction/installation of 20 wind turbines, an internal cable network (underground cable lines of 35kV voltage level), a 35/110kV substation with command and administrative building, access roads and a temporary delivery point for the delivery of equipment. The realization of the project that is the subject of the Study is fully in line with the national policy in the field of renewable energy sources (RES) formulated in the Energy Development Strategy of the Republic of Serbia until 2025 with projections until 2030 ("Official Gazette of RS" No. 101/2015) . Its realization will have multiple significance both in terms of positive environmental impact and in terms of increasing the share of RES in total electricity production.

When deciding on the location of the Kostolac wind farm and planning the spatial disposition of individual wind turbines, the principle of preventive environment protection and its factors was applied in order to prevent or minimize possible negative impacts. Regarding the selection of the location of the wind farm, the starting point was innovative and it involved the implementation of the project on devastated soil, which in this case in the previous period was used for mining activities. In doing so, account was taken of the necessary distances from the objects on which the realization and exploitation of the project could have an impact (noise, shadowing, etc.) In the context of the preventive protection of the flying fauna, ie the determination of the appropriate/optimal spatial disposition of the wind turbines, a one-year monitoring of the impact of the subject project was carried out on ornithofauna and hiropterofauna, which analysed the potentially dominant effects of planned purposes on environmental elements, and the results of monitoring were incorporated into this Study, as an integral part of the text, and in Annex I of the Study. In addition, other observations (phoenix and floristic-vegetation) have been carried out in order to fully understand the existing state of the environment at the project location and identify the possible impacts of the project on the environmental elements.

The task of this Study is to analyse in detail the possible positive and negative impacts of the planned project of the Kostolac wind farm on the environment and on the basis of the obtained results, anticipate the appropriate measures by which the positive impacts will be maintained in the estimated frameworks and the negative impacts would be minimized or completely eliminated.

1.1. Site description

Physical-geographic characteristics of the site

The locations of the planned Kostolac wind farm are located in the territory of Pozarevac in the Branicevo district, between the towns of Kostolac and Pozarevac and about 14km by the air line from the border with Romania east of them (Figure 1).

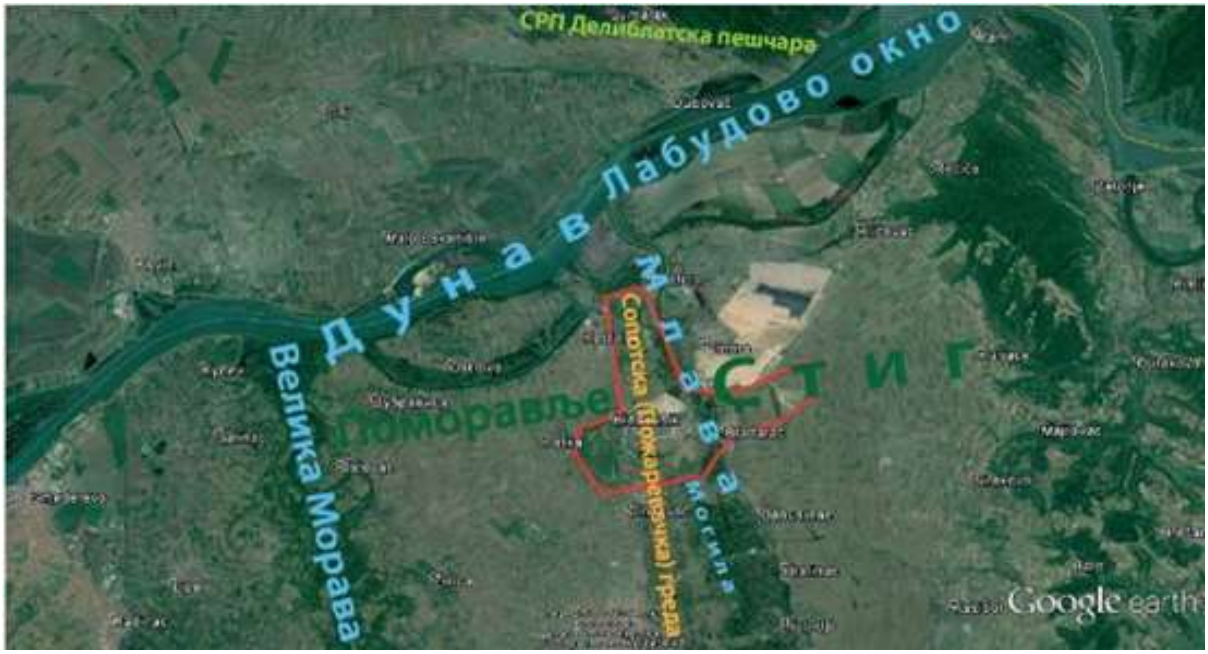


Figure 1. *Position of the planned Kostolac wind farm in relation to the wider environment*

All four locations of the wind power plant are mostly recultivated landfills of the Kostolac coal basin in the area of predominantly agricultural land and the zones of mining activities and thermal power complexes and settlements.

Figure 2. *View from the Sopotska greda at the location Kostolac on the staged anthropogenic relief of the closed surface mine Klenovnik and the lower plain region of Pomoravlje*

In biogeographical terms, the site is located in the mezian province, characterized by the original forest vegetation and biomes of predominantly southern and submediterranean deciduous forests, and due to the presence of numerous water courses and stagnant waters and azonal vegetation of aquatic and humid habitats (Figure 3). However, in the greater part of the mezian province, the original vegetation and autochthonous ecosystems are highly reduced, fragmented and transformed by centuries of anthropogenic activities, mostly in agrobiocenosis, and these processes continue. This typical situation with the dominance of agrobiocenosis is characteristic for most of this area.

Figure 3. *Anthropogenic forest plantations and agrocenosis at the location of Petka*

Location Drmno is located south of the surface mine Drmno, and east of vilage Bradarac. It covers an area of approximately 2.4 km^2. It is located on a tailings exteral landfill that is formed in the form of stages, slopes and cupped piles, of different widths and heights. The thickness of the fill layer is about 50 m, and the highest altitute of the terrain is about 141 m above sea level. Upon completion of taililngs deposit, the site was recultivated. In the immediate vicinity of the location there are no populated places.

The closest populated place is Bradarac, about 1.2 km from the border of the location, ie about 1.4 km from the position of the nearest wind generators. The largest part is covered with ruderal grassy vegetation, while the woody and shrub vegetation is present only in the form of smaller forests and shrubs, as well as individual trees and small groups (Figure 2.6), with only one larger fragment in the central part. Wood-shrubby vegetation, dense complex (mainly slugs and scrubs), is represented only on slopes and at the base. At the location and in the immediate vicinity, there are no aquatic and humid habitats or agricultural land. There are no buildings on the site, but there are several hunting feeders waiting in a rather deserted state. North of the location, at a distance of 400-500 m from the border and about 700 m from the position of the nearest wind turbine, there is a complex of facilities of the Administration of the Surface mine Drmno which have a certain, but not high, cryptic potential for bats. Of all locations, this is characterized by the smallest, low, trophic and cryptic potential for both birds and bats

Figure 4. *The central plateau of the Drmno site*

Location Ćirikovac is located on the alluvial plain of the river Mogila and partly on the Sopotska Greda, west of the stream of the Mlava River, south of the surface mine Cirikovac, southeast of the settlement of Klenovnik and northeast of the settlement Ćirikovac. The location represents the external and part of the internal landfill of the surface mine Cirikovac. It covers an area of about 1.7 km^2. The thickness of the deposited layer is 10-40 m, and the altitude ranges 75-130 m above sea level. Near the border of the location is Klenovnik settlement, but the positions of the nearest wind generators are about 1.4 km away from it, so the positions of the wind generators are closer to the Ćirikovac settlement - the closest to only 800 m. Significant part of the site is covered with low woody and shrubby vegetation, mostly shrike and forestry dominated by acacia and poplar, which is why the terrain is relatively unpredictable and difficult to pass, and peripheral are also agricultural areas and grassland vegetation. A large part of the site occupies an ash landfill with a water surface whose marginal parts and the surrounding area are swamped at its lowest positions (Figure 5) - there are several zones of floating and swamp vegetation of the bulrush type, with thick bushy vegetation in the outer zones, which provides an abundance of cryptic conditions for

numerous types of birds and other animals. On the south-western border of the site, at a distance of 500-650 m from the position of the nearest wind turbine, there is a complex of facilities of the Administration of surface mine Cirikovac, which have a certain cryptic potential for bats and small songbirds, as well as individual trees within this complex.
Overall, this site has a moderate cryptic and trophic potential for birds, while for bats it has moderate trophic and low cryptic potential, but potential shelters are in close proximity.

Figure 5. *Ash landfill in the central part of the site Ćirikovac with swamped bordering and the surrounding area*

Location Petka (Figure 6) is located south-east of the settlement of the same name, southwest of the settlement of Klenovnik and the surface mine Cirikovac and northwest of the settlement Ćirikovac. It covers an area of approximately 2.64 km^2. The location is a tailings landfill from surface mine Cirikovac. The thickness of the deposit layer is about 60 m, and the highest altitude of the terrain is about 136 m above sea level. The closest settlement is Klenovnik, which is located against the border of the location, but the position of the nearest wind turbine is about 750 m. Ćirikovac settlement is about 350 m from the border, and about 1.2 km from the position of the nearest wind turbine, while the Petka settlement is about 750 m away from the border of the location, and about 1 km from the position of the nearest wind turbine.
The site represents a successful example of land recultivation and is characterized by relatively developed forest vegetation, with agricultural areas - fields, meadows and lucerries. At the foot of the location towards Ćirikovac there are artificial stands of black pine, while the greater part of the foot and slopes of the site is covered with dense forests of acacia and poplar trees. Much of the site's plateau is covered with woody vegetation dominated by acacia and poplar trees, but mostly shrubbery of very thick structure (Figure 2.8), or young plantations. At the site and in the immediate vicinity there are no aquatic and humid habitats. In the eastern part of the site there is a waste dumpsite. On the site there are no buildings, only a few game feeders. In the immediate vicinity, there are few individual facilities (for example, within the hothouse near the eastern border of the site), and at a distance of less than 500 m are the closest facilities to the settlements of Klenovnik and Ćirikovac, as well as the complex of the facilities of the surface mine Ćirikovac. This location has relatively high cryptic and trophic potential for birds, while for bats it has high trophic, but low cryptic potential.

Figure 6. *The hard-to-pass shrubbery and scrub dominate the central plateau of the Petka site*

Location Klenovnik (Figure 7) is the only part that represents the natural part of the terrain, that is, the Sopotska Greda, which on the western part borders with the closed Klenovnik surface mine, and in the far south with the closed surface of Ćirikovac. It covers an area of approximately 3.3 km^2. The terrain is extremely stratified with a highest altitude of about 174 m above sea level. At the very border of the location is the settlement of Stari Kostolac, from which the positions of the nearest wind turbines are about 500 m away, as well as from the settlement Kostolac, which is about 200 m away from the border. The settlement Klenovnik is about 400 m away from the border of the location, but about 1,1 km from the position of the nearest wind turbine. On the site there are grassy, bushy and woody vegetation, and in some parts, especially in the west, in the pockets of deposited tailings, a system of a larger number of smaller and several large stagnant waters with a whole complex of water, swamp and wetlands has been formed on the surface of almost 1 km^2. In the immediate vicinity of the site, at a distance of 0.5 to 2 km, there are complexes of aquatic and humid habitats of the Mlava, Dunavac and Danube rivers.

Although the area of the eastern slope of the Sopotska Greda in this zone is categorized as a forest in the Spatial Plan, here, except in the narrow zone along the Mlava River, there is no forest, but fragments of shrubbery and scabs with very rare individual trees. There are also several loess sections that have a cryptic potential for certain species of birds, mainly on the edge of the mentioned depression with humid habitats (Figure 2.9), but also landslides that prevent their nesting in these places in the south of the site. There are landfills of municipal waste along the north-western and north-eastern boundary of the site. and scabs with very rare individual trees. There are also several wood sections that have a cryptic potential for certain species of birds, mainly on the edge of the mentioned depression with wet habitats (Figure 2.9), but also landslides that prevent their nesting in these places in the south of the site. There are landfills of municipal waste along the north-western and north-eastern boundary of the site.

On the site there are 3 buildings of grange type and one cottage with low cryptic potential for bats. North of the site, the coal conveyor belt passes through with functional lighting. Some parts of this site have very high cryptic and trophic potential for birds, while for bats they have high trophic, but low cryptic potential.

Figure 7. *At the site Klenovnik are represented aquatic and humid habitats and loess sections*

However, in the immediate vicinity of the site, just 1.5 km northeast of the location, there is Labudovo okno (Figure 2.10) - a complex of river and aquatic habitats of the Danube in the Deliblatska Pescara area. The largest part of this complex, that is, the Banat bottomland and the Danube River between Dubovac and Stara Palanka, Dubovački rit, Zilovo island and Čibuklija and the confluence of the river Karas, is covered by the boundaries of the Special Nature Reserve (SNR) Deliblatska Pescara (Official Gazette RS, No. 3/02, 81/08).

Natural characteristics and conditions

The existing morphology of the terrain has been significantly changed due to the long-term surface exploitation of coal on surface mines (SM) "Drmno", SM "Klenovnik" and SM "Ćirikovac" with accompanying tailings landfills and large deposits of slag and ash from TPP Kostolac A and Kostolac B. The spatial position of the named, artificially formed, morphological forms is shown in Figure 8.

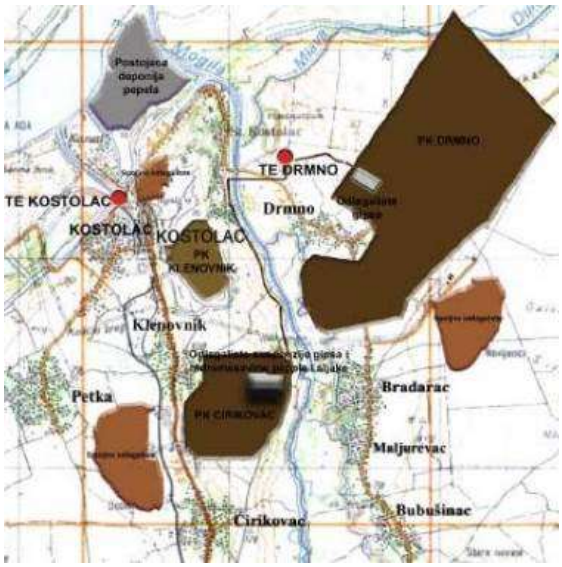


Figure 8. *A schematic map of contemporary morphological shapes formed as a result of the operation of mines and thermal power plants*

the plant and animal world at the site is highly degraded and altered under the influence of anthropogenic factors. Former natural vegetation was replaced by agricultural crops and mining activities that created new ecological conditions. Natural vegetation was kept only on small surfaces. In the wider surroundings of the area planned for the construction of a wind farm intensively cultivated fields dominate, i.e. agrobiocenosis, with predominantly one-year crops. In addition, populated areas with associated infrastructure, as well as surface mines, industrial-energy facilities and accompanying infrastructure (power lines, roads, etc.) contribute to the general ecosystem disturbance. The remains of the original ecosystems, primarily forest and aquatic, in the wider surroundings are present in the river valleys of the Mlava and Mogila. Locations where the installation of wind turbines is planned are spatially disturbed by surface exploitation and landfilling of tailings and ash. Because of mining works, the original vegetation was removed, and the ruderal (weed) vegetation developed spontaneously, which is, depending on the location, in different stages of succession. Woody and bushy vegetation is present sporadically, predominantly in the form of thicket, shrubbery and individual trees. They spontaneously covered the area, and partly they were planted for the purpose of recultivation. The animal world does not differ much from that which is present in other plain parts of Vojvodina. The abundance of insects and other small animals provides rich food for frogs, snakes, who are the basis of the diet of numerous swamp and migratory birds (wild ducks, geese, mussels, grey and white herons and pheasants).

The area of the Drmno and Kostolac mining and energy basins, as part of the southern periphery of the Pannonian Basin, is characterized by a moderate continental climate that emphasizes steppe-continental climatic influences of neighbouring Banat. The characteristics of this climate are colder winters and warmer summers. The main source of data for the climate analysis are the long-term measurements carried out by the Republic Hydrometeorological Institute of Serbia at the Main Weather Station Veliko Gradiste, 27 km east of the Thermal Power Plant, which is climatologically representative for the subject area On the basis of available data on wind measurements delivered by PE EPS, data from 3 measuring points were obtained: Klenovnik, Drmno and Petka (Figure 9).

Legend:	
	The boundary of the zone of interest for instalation of wind farm

Figure 9. *Existing meteorological masts - shown on the Google Earth map*

Comparative overview of the frequencies roses and speeds for all three locations are given below.

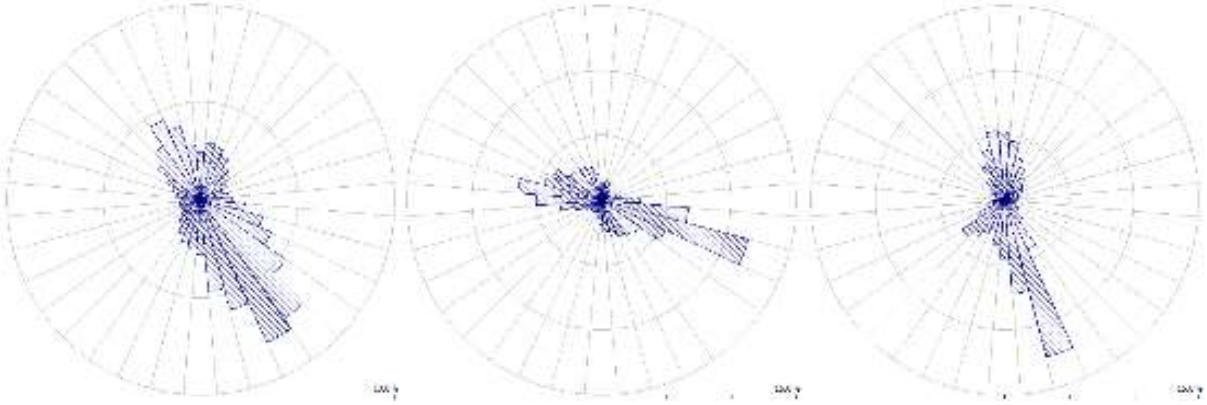


Figure 10. *Frequency roses for locations Drmno, Klenovnik and Petka (from right to left)*

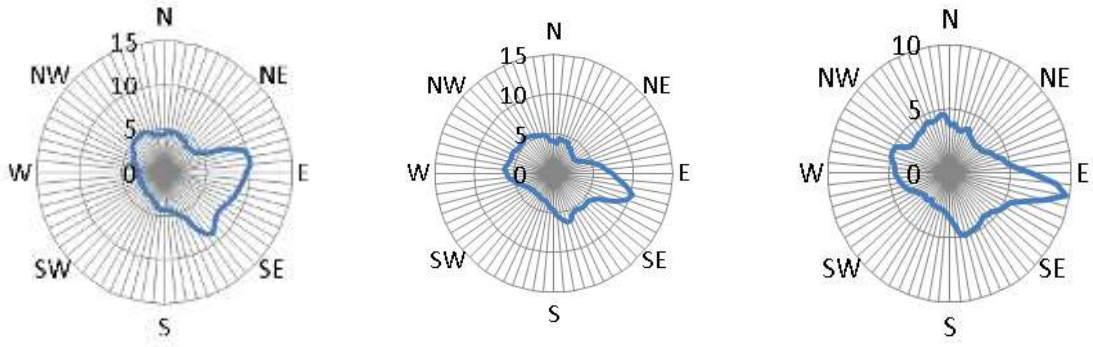
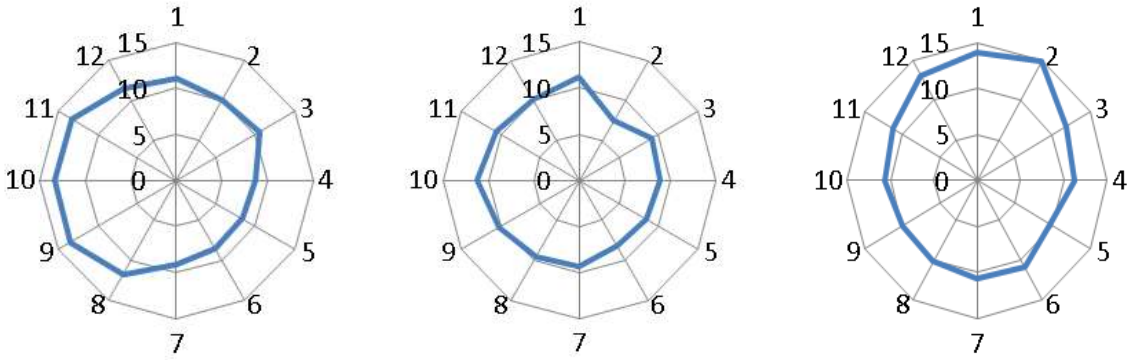


Figure 11. *Speed roses for locations Drmno, Klenovnik and Petka (from right to left)*



Location:	Drmno	Klenovnik	Petka
Medium ambient turbulence intensity [%]	10,80	9,54	11,54

Figure 12. *Graphic and tabular display of the turbulence intensity - Drmno (60m), Klenovnik (60m) and Petka (50m)*

In addition to the elaborated data, there is also an anemometer at the Drmno location, at height of 120 meters, from which data on air currents that are important for estimating the production of the planned Kostolac wind farm are also collected.

This location is in a pedological sense drastically changed in relation to the former natural characteristics and is dominated by the so-called technogenic land originated mainly by deposited tailings from the surface mines, without significant prudential qualities (Figure 13.)

Figure 13. *Map of the wider area of the Kostolac coal basin (Source: Google Earth)*

Based on the seismic map of Serbia (Figure 2.22), this area belongs to the seismic intensity of the 7th degree MCS scale (Mercall-Cancani-Sierberg scale). The following description of manifestations corresponds to this degree: difficulty in standing; breaking of the furniture; minor damage to objects well designed and constructed; small to medium damage on solidly built building structures; significant damage to poorly built or inadequately designed facilities; some chimneys broken; noticeable to persons while driving motor vehicles. For a detailed analysis of the local soil response to seismic activity, a detailed Seismic micro-regulation of the terrain at the scope of the Project has been done.

The main feature of the hydrographic network of the exploration area is the Danube River with the Dunavac, and the tributaries Velika Morava and Mlava.

Orinthofauna

In the entire research area from December 2014 to November 2015, the monitoring carried out in total showed the presence of representatives of 120 species of birds. Representatives of many of the recorded species were present in extremely small numbers. Of the listed number of species, 17 are classified as target species in terms of their national and international importance and status of conservation and protection, as well as on the basis of susceptibility to the risk of collision with wind turbines due to their specific bionomy, behavior, route and height of flying and eventual disturbance of habitat by building wind turbine infrastructure. Of the ecological groups of birds that are sensitive to wind turbines, and therefore was given special attention and which are especially classified in the so-called target species, only *Falconiformes* can be highlighted. It is surprising that in the subject area there were no significant *Anseriformes,* primarily geese (*Anser sp.).* In addition to the small number of wild ducks (*Anas platyrhynchos*) and a flyover of two *Cygnus olor* in autumn and winter months the usual *Anseriformes* flocks were not been recorded. Cloves and roe (*Ciconiiformes)* were recorded only sporadically either individually or several birds together. Although the subject area is not far from 3 rivers, and above all the Danube River, the lack of larger optimal water and humid habitats at the site does not favour the presence and retention of these two ecological groups of birds, which makes their nutrition, concealment and nesting difficult.

Because of this, members of a small number of species of *Anseriformes* and *Ciconiiformes* are met in very small numbers and with very low frequency of recording. Daily predators are constantly present at the site. This can be explained by the fact that there is a significant trophic base for the birds of this ecological group, which are primarily *Rodentia*, which are a significant element of fauna in agricultural habitats. For this reason, the most common are *Buteo buteo* and *Falco tinunnculus*, then seasonal and other predators such as *Circus sp*. and *Falcon sp.* A wider range of prey have *Accipiter gentilis* and *Accipiter nisus*, but members of these two species are recorded in an extremely low number. The finding of the *Haliaeetus albicilla*, which was observed only once in the control area, is also the only finding of eagles during more than 12 months of research. None of the flyover of the other target species can be characterized as significant. Night predators - owls (*Strigiformes*) were scarce in the subject area and presented with 4 species. Although their status of vulnerability is relatively high, they are not classified into target species due to their specific way of life and oriented hunting of rodents living on or in the surface, so the risk of kill during the operation of wind turbine infrastructure is low. Sing birds are represented by a large number of species, but mostly by a small number of representatives to which the potential wind farm would have no significant impact. Nevertheless, numerous examples of *Alauda arvensis, Sturnus vulgaris,* several species of herds and three types of swallow can be distinguished as important findings. Each of these species can be exposed in particular to the influence of the wind farm, but their classification into the lower categories of vulnerability, a positive population trend and a significant number do not give rise to concern. Other singers because of their ecological status and habitat use are even less likely to be endangered and at risk from the project of construction and operation of the Kostolac wind farm

Based on the foreseen layout of wind turbines on the future Kostolac wind farm and on the basis of data at the observation points, it can also be assumed that the significant negative impact of the construction and operation of the wind farm on the bird fauna should not be. The wind turbines at the future wind farm Kostolac, which are according to the project 20, according to the plan provided by the investor at the beginning of this monitoring, were located on four sub-locations on the location of the area. Based on the analysed data on the presence and directions of the overflights of members of different bird species, as well as on the basis of the layout of wind turbines, it can be assumed that the greatest influence of the construction and operation of the future wind farm Kostolac will be on the members of the largest and most frequently present species. However, due to the registered characteristics of their overflights, and most often other target species that were flying at critical altitudes were very few, with considerable certainty it can be estimated that the influence of wind turbines on them will be minor. On the other hand, the original arrangement of positions of wind turbines was relatively acceptable from the point of view of the influence of bird fauna, except for the wind turbines that were predicted at the west part of the investigated area, around the established OP 2. In synergy with preliminary findings and recommendations for the monitoring of bats, wind generators at the Petka location (OP 2) are therefore relocated. After the suggestions to the investor, the initial arrangement of the turbine, which is a compromise and satisfactory solution, was determined in the initial stages of the operation. The new situation in the area of the potential wind farm, besides meeting the requirements of preservation and protection of bird fauna, meets the criteria for protection and conservation of the fauna of the bats. Unlike bats, birds in the subject area do not have pronounced and strict flight corridors, but with minor investor movements of the wind generators it was been noticed that their new positions have a smaller effect on the area where there is a greater presence of target species, which can only increase the chances of safe passage of migratory and diurnal flight of the birds (and bats).

Hiropterofauna

The monitoring of the bats fauna for the needs of the project of construction of the Kostolac wind farm, which was implemented from November 2014 to November 2015 in the area of the wind farm, the immediate surroundings and the control area, by the ultrasound audio-technology the activity of 14 species has been registered whose members can be reliably differentiated by the echolocation signals: *Rhinolophus ferrumequinum*, *Miniopterus schreibersii*, *Myotis bechsteinii*, *Myotis emarginatus*, *Myotis nattereri*, *Barbastella barbastellus*, *Pipistrellus pygmaeus*, *Pipistrellus pipistrellus*, *Pipistrellus kuhlii*, *Pipistrellus nathusii*, *Hypsugo savii*, *Nyctalus leisleri*, *Nyctalus noctula*, *Vespertilio murinus* and *Eptesicus serotinus*. In addition to these, the activity of representatives of the 4 groups of species whose members cannot be reliably distinguished on the basis of echolocation signals is also registered - *Myotis myotis/oxygnathus*, *Myotis brandtii/mystacinus/alcathoe*, *Myotis daubentonii/capaccinii* and *Plecotus sp*. - so it is certain that at least one species from each of these groups is present at the site, which makes at least a total of 19. However, it is very likely that this number is actually higher, i.e. 23, because at least occasionally and/or sporadic the presence of 8 species from these groups (*Myotis brandtii*, *M. mystacinus*, *M. alcathoe*, *M. myotis*, *M. oxygnathus*, *M. daubentonii Plecotus austriacus* и *P. auritus*) is almost certain based on their wider distribution and the existence of appropriate ecological conditions at the site and in the immediate vicinity.

Similar to ornithofauna, the optimum spatial distribution of wind turbines has been maximized for the preventive protection of hiropterofauna, by applying additional site development measures in order to minimize the hiropterofauna effects.

Overview of cultural heritage

There are no registered and protected cultural heritage and archaeological sites at potential locations for the construction of the wind farm at the Kostolac site. Considering the richness of the surroundings with archaeological sites and protected cultural assets, it is necessary to pay special attention to the realization of the project, that is, to the foundation of wind turbines in order to avoid possible damage to the elements of cultural heritage. On the wider area of the planned wind farm Kostolac B, there is a site called Rukumija - an archaeological site from the Bronze Age and a monastery. Today's monastery is from the time of Prince Miloš Obrenović (1852) and is located near the village of Bradarac, about 1km southeast of the closest wind turbine.

Overview of settlements and infrastructure

Anthropogenic activities are very present in the vicinity of sites, and the sites themselves are mostly the product of anthropogenic activities. Directly along the border of the locations are numerous settlements – town Kostolac and the village of Stari (Old) Kostolac, Drmno, Bradarac, Maljurevac, Ćirikovac, Petka and Klenovnik, as well as the complexes of administrative and/or industrial facilities of Thermal power plants and surface mines Kostolac. The most spread activities are agriculture and, specifically, mining and energy, which is why a very different infrastructure is developed. The location and surroundings are intersected with a dense network of high-voltage power lines. Between the locations of Petka and Ćirikovac, and next to Klenovnik, the state road of the IIA order Požarevac-Kostolac passes, while the state road of the IIB order Ram-Kličevac-Bratinac passes along the Drmno site Only the unpaved roads exist at the locations themselves, with at least one well

maintained road from the crushed stone which passes through the entire location and exits to one of the mentioned asphalt roads, while the side roads are mostly dirt roads and poorly maintained. In some parts of the unpaved roads there are initial landfills, especially in the zone around the settlement. Construction sites on the locations are rare, and the closest are the complexes of the administrative and industrial facilities of the Thermal Power Plant and the surface mine Kostolac. The settlements are located in the immediate vicinity, but at a minimum distance of about 500m from the nearest wind turbines.

1.2. Project description

Technical-technological description of wind farm

The complex of the wind farm (Figure 14) consists of the following functional units: wind turbines representing generator units (consisting of rotor, gondola, pillar and foundation, 690V/35kV voltage level), internal cable networks (underground cable lines of voltage level 35kV), substation 35/110 kV with command and administrative building (through which the wind farm connects to the transmission system for the placement of generated electricity and from where the power plant operates) and access roads (physical access for the transport of equipment, construction and installation of the equipment of the wind turbine and substation; it can coincide with the internal cable network route partially or completely). In the context of the above, it can be concluded that the complex of a wind farms consist of infrastructural facilities for the production of energy (wind turbines), facilities for transmission of energy (internal cable network and SS with administrative and command building) and traffic facilities (access roads).

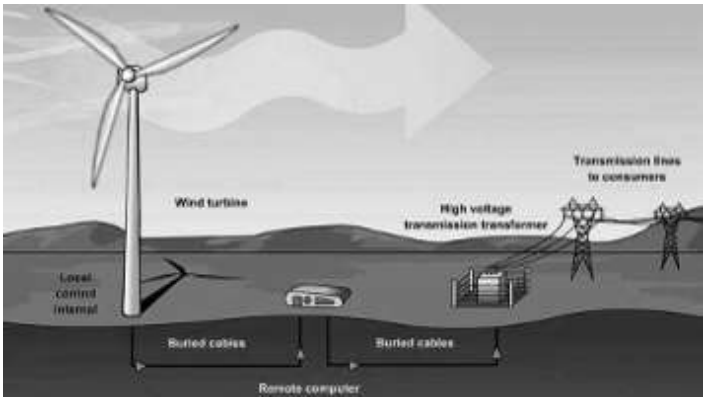


Figure 14. *The principle of complex and functioning of the wind farm*

Spatial characteristics of the wind farm

The complex of the wind farm is located predominantly in the areas of external landfills in Kostolac, which were created as a result of mining activities. All functional units of the wind farm are located in the territory of the municipality of Požarevac, within the cadastral municipalities Bradarac (locality Drmno), Klenovnik (part of the locality Petka and part of the locality Klenovnik), Ćirikovac (part of the locality Petka and the entire locality of Ćirikovac) and Kostolac Selo (part of the locality Klenovnik).

Figure 15. *Layout of wind turbines within the wind farm in Kostolac*

No of WTG.	Coordinates for wind turbines		Cadastral plot No.	Cadastral municipality
	Y	X		
01	7,520,058.63	4,950,558.27	429	Bradarac
02	7,520,341.48	4,950,844.31	475	Bradarac
03	7,520,690.05	4,950,965.89	468	Bradarac
04	7,521,045.85	4,951,073.81	452/1	Bradarac
05	7,520,238.33	4,949,721.22	612, 613	Bradarac
06	7,520,579.29	4,949,985.23	547	Bradarac
07	7,520,923.42	4,950,293.97	522	Bradarac
08	7,514,114.83	4,948,955.24	2896	Klenovnik
09	7,513,893.13	4,948,359.10	1550	Cirikovac
10	7,514,336.57	4,948,295.17	1550	Cirikovac
11	7,517,042.52	4,948,913.09	1551/1	Cirikovac
12	7,516,721.82	4,948,448.70	1551/1	Cirikovac
13	7,516,390.04	4,948,159.02	1551/1	Cirikovac
14	7,515,767.36	4,948,122.53	1551/1	Cirikovac
15	7,516,280.40	4,950,439.97	2482/1, 2482/2	Klenovnik
16	7,516,061.38	4,951,403.63	1433, 1434	Klenovnik
17	7,515,811.00	4,952,203.00	2650/1	Kostolac Selo
18	7,515,218.52	4,951,883.76	1417	Klenovnik
19	7,515,049.81	4,952,757.18	1640/1	Kostolac Selo
20	7,515,040.65	4,953,925.17	1640/1	Kostolac Selo

Table 1. Coordinates of wind turbines positions according to the locations on which they are located

Technical description of the temporary delivery point

Temporary delivery point (TDP) is foreseen on the existing asphalt plateau, which has been used for transhipment in building TPP Kostolac, and is located between the river Mlava and the coast fortification embankment. In front of the TDP, a turnaround is foreseen in order to place the transport vehicles in the position so that the parts of the wind turbine could directly

place to the transport vehicles from the barges with the appropriate mechanization of the transhipment. It is envisaged to raise the existing asphalt plateau to the level of the road, or about 3 m in relation to the existing asphalt plateau.

Figure 16. *Position of the TDP in the macrolocation*

Transport, unloading, further transport, installation and commissioning of wind turbine equipment is conditioned by the manufacturer's propositions in order to obtain a guarantee on the delivered equipment. In accordance with the above, the manufacturer/supplier also transports and supplies equipment to the sites of individual wind turbines. The TDP site is one of the points in the transport, but the transport technology is within the competence of the manufacturer/supplier of the equipment, in accordance with the indicative offer and the technology applied, depending on the case. Because of this, the definitive technical solution for the equipment transhipment is not available at the time of development of this summary, nonetheless, potential transhipment options are being examined.

Architectural and construction description

The main objects of the wind farm are the pillars and foundations of the wind turbines whose height can vary depending on the selected type of wind turbine. The wind farm consists of a total of 20 wind turbines whose height of the rotor axis is 117 meters and the total height with the blade in the vertical position is 180 meters (117 + 63 = 180). Wind turbine consists the foundation, steel pillar made of segments that are connected, gondola in which a generator unit is located, rotor that mechanically drives the generator unit and the blades that transform the kinetic energy of the wind into mechanical and conveys to the rotor. For the needs of the construction of a wind turbine, the access ramps on which the crane is mounted for mounting the equipment (placement of steel segments of the pillar, then the gondola, rotor and the blades) are used which are located along the access roads. The positions of the pillars are predominantly located at sites that were formed by filling of the tailings from SM Ćirikovac and SM Drmno (the exception is the so-called Požarevačka Greda, i.e. the locality of Klenovnik).

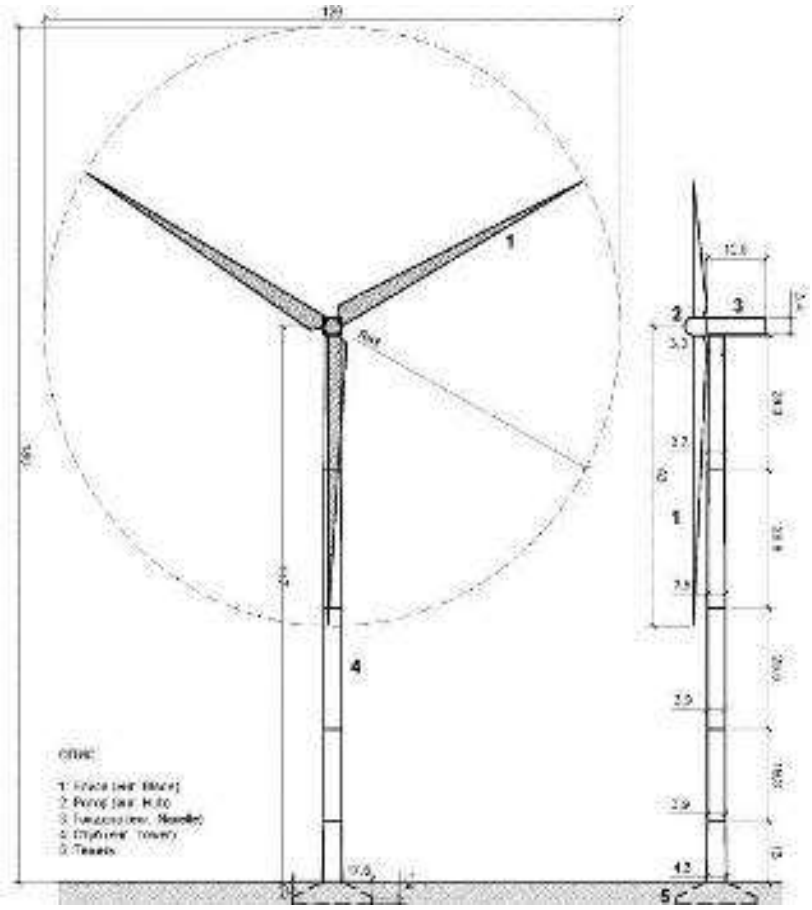


Figure 17. *Layout of a typical wind turbine*

The foundation of the wind turbine pillars must ensure the stability of the wind turbine during the entire exploitation period. The pillar of the wind turbine usually has a shape of a hollow, sealed coupe, and is made of high quality steel.

In addition to the pillars of the wind turbines, this project envisages the construction of the 110/35 kV substation and the administrative building of the wind farm located on the common plateau. An open storage space is also provided on the same plateau. The plateau is 135 mx75 m and is completely enclosed with an outer fence. The administrative building of the wind farm is separated from the substation by the inner fence, as well as the storage space. Along the plateau, a tank for supply of the fire and technical water is planned (Figure 18). The administration building of the distribution system is the ground level facility approximately 20x15. The building can be divided into two functional units- for equipment storing and people premises, who control the operation of the wind farm and servicing of equipment. Up to five people are foreseen to work in one shift. When choosing the floors, walls and ceilings treatment, resistance to fire must be taken into account. The facade walls, windows, doors and roof structure must meet the requirements of energy efficiency, and is recommended to use the autonomous systems to supply electricity and heat. The building is equipped with ventilation and air conditioning installations, lightning protection, lighting, grounding and heating.

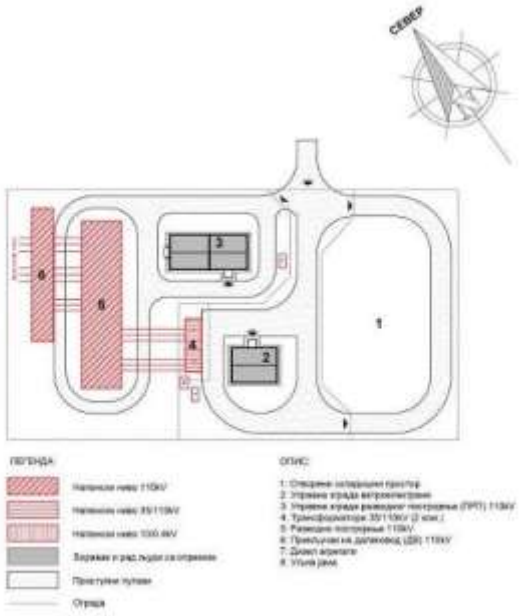


Figure 18. *Complex and organization of the 110/35 kV substation and the administrative building of the wind farm Kostolac*

Electrical description

The 110kV switchyard is designed for outdoor installation and is implemented with two bus systems, positioned to facilitate the introduction of a 110 kV transmission line. It consists of two transmission fields, two transformer fields, one coupling field and two measuring fields. All necessary switchgear and oxy-coupling equipment is installed in the fields. The switchyard should be dimensioned on the basis of short-circuit data that are valid for the electrical grid at the point where the wind farm is connected and according to the technical conditions of the transmission system operator. Auxiliary consumption facility is powered through a power distribution grid, over a voltage level of 10 kV. The connection is performed by air (cable), according to the Investor's definition along the roadway of the Drmno-Bradarac-Kličevac road (Figure 3.11 - red line). The length of the 10 kV supply line that needs to be built is 6.1 km

Figure 3.11. *Auxiliary consumption line*

The 10kV switchyard is in the form of a tin-plated internal installation. It consists of: feeding cells, transformer cells and connecting measuring cells. With the 10 kV distribution, a distribution plant of 0,4 kV is supplied through the transformer 10/0,4 kV. Transformers are dry for internal assembly, power 250(400kVA). The power of the transformer will be selected at later stages of design, when the basic energy equipment is contracted. Transformers are another`s 100% reserve. The safety power supply of the most important consumers at 0,4 kV, 50 Hz, is carried out using a diesel generator, power of 160 kVA, for which a special 0,4 kV distribution is foreseen. The safety supply of the most important consumers on DC voltage is provided through static, automatically controlled rectifiers 400/230V, 50Hz/220V, DC. The source of the safety DC voltage 220V are two rechargeable batteries with a capacity of 420Ah. Sources of the safety continuous voltage 230V, 50Hz are 220kV, DC/230V, 50Hz converters. Reserve power supply is provided via isolating transformer 230/230V, 50Hz.

Electricity produced in wind turbines through a cable network is transmitted up to 35 kV distribution system and further through the transformer 35/110 kV into the electric power system. The configuration of the cable network is conditioned by the disposition of the wind turbine pillars, the position of the substation and the 35kV facility. The type and cross-section of the cable network will be selected based on the load on the circuit, according to a separate calculation. The cables are freely laid into the ground in cable trunks, according to the applicable norms, standards and technical recommendations for such equipment. In addition to the cables, all necessary equipment for cable extension, cable endings as well as equipment for protection and marking of cables are foreseen. In addition to the cable installation, an optical cable network in the field of a wind farm is envisaged, which aims to enable the transmission of information between the wind turbines in the field and the central control system located in the administrative building of the wind farm. The laying of optical cables is provided in the same trunks with power cables in the appropriate protective pipes or otherwise in accordance with the technology and technical conditions of the transmission system operator.

Transport and traffic description

The transport of the equipment of the wind turbine (blade, gondola, pillar, rotor, etc.) is planned by water and ground road. By water, the equipment will be transported from the production facilities of the selected producer to the temporary delivery point (TDP) at the confluence of the Mlava River to the Danube. At the TDP site, the unloading is carried out by a crane, or a newly installed crane in a temporary port in the deeper riverbed of the Topla Mlava River. From TDP, the equipment is further transported by road on the reconstructed existing road along the defensive embankment on the right bank of the Mlava River to the Kostolac-B TPP (TEKO-B) where temporary storage of the wind turbines equipment will be established. From the temporary warehouse, the equipment is further transported by road to the individual locations of each of the wind turbines. The loading of equipment must not be carried out in the period from mid-March to the end of June and from the beginning of October to the end of November, during the migration and nesting cycle of birds. Examination and verification of the possibility of transporting equipment along the embankment was carried out and elaborated in the Study on geotechnical conditions for the use and reconstruction of embankment and plateau for the need of the preparation of the technical documentation of the Preliminary Design with the Feasibility study for the construction of the wind farm in Kostolac with an analysis of the temporary delivery point at the confluence of the hot water channel and the Mlava River in the Danube and the embankment for the need of transport of equipment of the wind farm. For the needs of

assessing the usability of the existing defensive embankment for the transport of the planned wind farm equipment, as well as the possibilities of using the existing concrete plateaus as a temporary delivery point, field and laboratory testing were carried out.

Remote control and monitoring system

Wind farm operation will be done from the operating building using appropriate monitoring room with central monitoring system. This system will be connected with each of the turbines using optical cable networking. Each turbine with the generator is supplied with its' own operating system.

Grounding and lighting system

Grounding system of the wind turbine consists from ring and foundation grounding parts. Lighting system (external lighting) is planned for substation complex with the administrative building. Obstruction lighting system for the wind turbines have to be in accordance with Civil Aviation Directorate.

Aspects of the project related to the impact on the environment

The impact of the wind farm on the environment due to the specificity of the technological process and the application of "clean technology", is reflected above all in the possible impact on ornithofauna and hiropterofauna as the dominant potential impacts. Other impacts are of a temporary character (mainly in the construction phase) and have limited intensity and spatial conditions. Such impacts should not burden the capacity of the space in any segment, especially if the defined environmental protection measures, environmental monitoring and other procedures that will be implemented during project operation.

1.3. Overview of main alternatives

Locations of wind generators - The location of wind farms was determined by the performed wind estimation and electricity production in the specific area, as well as the existence of a planned basis, the possibility of solving property-legal relations over land, etc.

The main alternatives considered by the project holder, taking into account the environmental impact, concerned the spatial disposition of the wind turbine pillars. The above alternatives were analysed primarily in the context of the protection of ornithofauna and hiroftofauna, but also from the aspect of other possible environmental impacts.

Upon the recommendation of the company conducting ornithofauna and hiropterofauna monitoring, PE EPS applied the principle of preventive planning and accepted and changed positions of individual wind turbines (Figure 20).

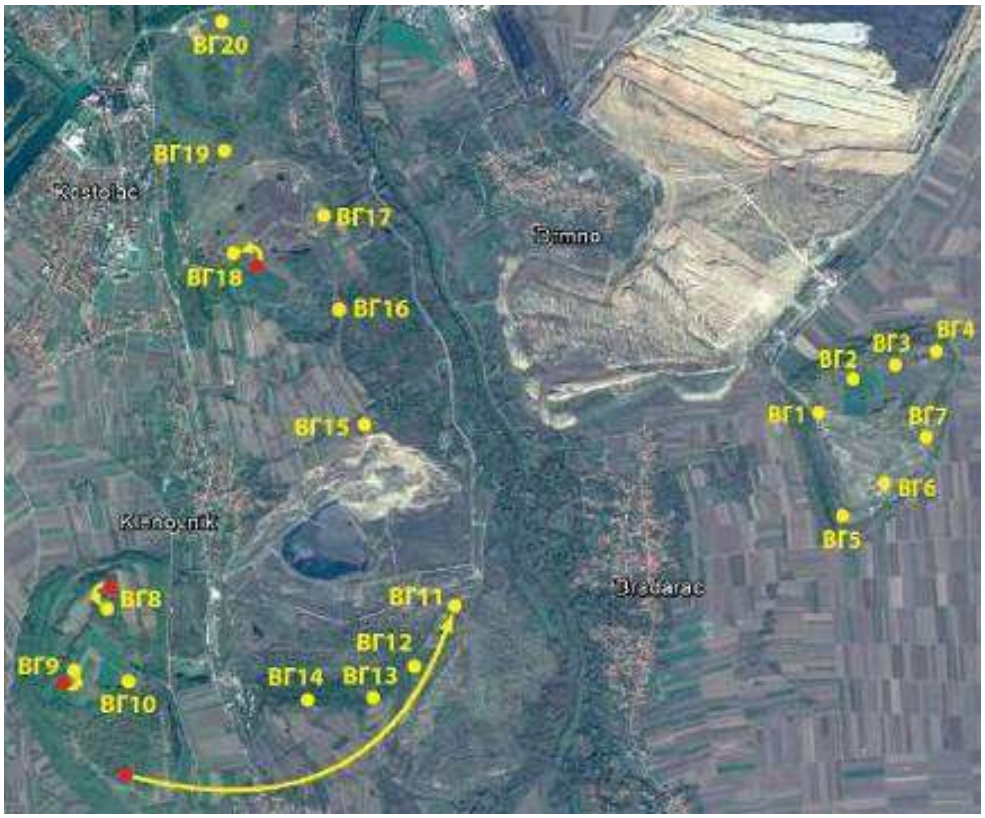


Figure 20. *Changes in the spatial disposition of the wind turbines as a result of the analysis of potential conflicts with the flying fauna (red - the position of the wind generators according to GD, yellow - the position of the wind turbines after the conducted monitoring of the flying fauna)*

Variant solutions of the temporary delivery point (TDP)- According to the Law on Navigation and Ports on Inland Waterways (Official Gazette of RS No. 73/2010), it is possible to establish a temporary delivery point where the goods would be stored and further forwarded. The duration of the granted authorization cannot be longer than a year and it is necessary to contact the institutions referred to in paragraph 2, Art. 240 of the Law on Navigation and Ports on Inland Waterways for the purpose of issuing the conditions under which a temporary delivery point may be created. According to the above legal provisions, the Temporary Delivery Point shall be established upon the approval of the Agency for the Administration of Ports with the prior consent of the Ministry competent for water management, the competent authority of the local government unit, the Directorate i.e. an authorized legal entity for the technical maintenance of state waterways, or an authorized legal entity for technical maintenance state waterways in the territory of the Autonomous Province and Port Authority.

The variant solutions for the transhipment of the wind turbine equipment include the following or the combination of the following options:

1. The use of a temporary crane on the TDP for the loading of barges/ships, and the same crane will later be used for the installation of the wind turbines;
2. Use of ships/barges with crane, or their combination, if it is not possible to access the TDP by a larger ship;
3. Use of ships/barges with crane with supports, in the event that the riverbed of the Topla Mlava, and if the water level causes the ship/barge to become trained, i.e. additional factors of uncertainty regarding stability and functionality;

4. Use of the pontoon bridge or platform as a pre-access part of TDP, which should be combined with one of the above mentioned variants.

It should be noted that the final variant of TDP solution will depend on the manufacturer/supplier of the equipment. It is possible to apply individual variant solutions, as well as a combination of the mentioned variants. The preliminary assessment concludes that the entire equipment of the wind farm (more precisely - wind turbines) will be delivered to the confluence of the Hot Mlava in the Danube, and then transported by a smaller barge/ship to the TDP where the overloading will be carried out. The exact way of transhipment will be subsequently determined according to the primary and main cargo, the capacity of the Topla Mlava gauze during the period of cargo delivery (May-September) and the mass and size of the contracted equipment for delivery. When selecting the method of transhipment, the timing of the technical solution should be taken into account – forming of TDP is conducted for a period of one year, and due to the specific opinion of the Institute for Nature Protection, the transhipment cannot be carried out only during the period from the half of March to the end of June and from the beginning of October to the end November, at the time of the migration and breeding cycle of birds. This means that preparatory actions such as adjustment of the plateau (if necessary), and in particular the provision of administrative permits and approvals in a timely manner in order for the TDP would be in operation at the beginning of an approved period of exploitation. The proposed variant solutions should be harmonized with the manufacturer/supplier of the equipment in order to obtain credible data on the technical solution based on which the competent authorities will issue the approvals

Technology and working methods - Wind farms can play an important role in the energy system of a country. In addition to certain negative impacts that can have on environmental elements, wind farms also imply numerous benefits in relation to the quality of the environment. Thanks to their constructive and operational characteristics, they produce electricity in an ecologically clean way, and it is known that every kW of electricity produced from renewable sources represents kW less energy from non-renewable sources, which production often requires devastation and degradation of large land surfaces which disturbs the quality of the environment and has a marked negative impact on biodiversity, and also on the health of the population in the influential area. In practice, there are no significant differences in the technological process and methods of work itself, and different variants in this respect are not significant. However, the possibility of placing a larger number of wind turbines of less installed power, on the one hand, and a lower number of wind turbines of greater power, on the other hand, was considered. Taking into account the economic and ecological benefits, the decision of investors was for the second variant.

Site map - The results of one-year observations of ornithofauna and hiropterofauna have been consulted for the selection of microlocation of wind turbines, thus applying the principle of preventive protection of the flying fauna, which is considered the most dominant influence of the wind farm.

Type and selection of materials - The wind farm, according to its structural and energy elements, is a typical, constructional and technical-technological solution, where it is known in advance which type of material is used. Materials for construction are delivered by the selected manufacturer. These are parts of wind generators that are assembled at the site itself. In that sense, one can only be discussed about the choice of equipment manufacturers and the choice of materials that is always the same or similar (steel, concrete or hybrid), and the decision to choose a company is based primarily on the quality of the equipment that produces

steel pillars that require a smaller quantity materials for the same characteristics. In addition, the choice of concrete pillars could involve spilling parts of pillars on the site itself, which is less favourable from the aspect of environmental protection.

Timetable for the execution of the project - The order of works is: 1. Construction of the foundation, 2. Electrical works, 3. Access roads and work plateaus, 4. Transport of the equipment and 5. Installation of equipment. The dynamics and eventual changes in the order of execution of the works are directly conditioned by the dynamics of development of project technical documentation and the provision of appropriate documentation necessary for the start of the construction.

Functioning and cessation of operation - The working life of the wind farm is from 20 to 25 years. When the working life is nearing its end, it will be assessed whether the wind farm should stop working and be removed or turbine replacement will be made. There are various options: general overhaul and equipment renewal for extended service life, turbine replacement, etc. These alternatives will be considered in accordance with the circumstances that will exist at the time.

Date of commencement and completion of the execution - The framework period for the works on the construction of the wind farm is from 2018 until the end of 2020. Alternate dates will be determined in accordance with the dynamics of obtaining the appropriate documentation needed to the construction start.

Production volume - The production volume will depend on the wind speed during the year, and is directly conditioned by the choice of wind turbines, ie the height of the pillar and the diameter of the rotor (blade).

Pollution control - Power transformers for the Kostolac wind farm are not manufactured as dry transformers, so in that context there were no alternative solutions. Continuous monitoring of the condition of the devices containing oil and periodic testing and replacement of oil is foreseen.

Disposal of waste - Disposal of waste generated during the construction of a wind farm will be disposed in accordance with the provisions of the Law on Waste Management and in accordance with defined *Waste Management Measures*, which will be implemented in the Detailed design and is not the subject of this Study.

Responsibility and procedures for environmental management, training, monitoring, emergency plans - After the construction of a wind farm, a responsible person will be chosen who will be trained for carrying out tasks and implementation of procedures related to environmental management and monitoring of the operation of the wind farm. In addition, the Emergency Plan, or the Accident Plan, will be developed and implemented in a manner as presented in the section of the *Accident Protection Measure*.

Method of decommissioning, regeneration of the site and further use - Planned working life of the wind farm is about 25 years. After this period, unless the decision on the extension of the working life of the wind farm is made, the plant will be closed and removed. Before the removal of the plant begins, it will be necessary to make a project for closing and removing of the wind farm that will include a detailed plan for the rehabilitation of the previous wind farm area. As part of the project, it will be necessary to formally establish a list of protective

measures and requirements that need to be met, based on possible specific conditions that may arise at that time. The mentioned project will need to be harmonized with the Conditions issued by the competent institutions. The project with a recovery plan should be accepted by the competent environmental authority as well as all other stakeholders (including the financial institutions that participate in the project financing). In addition, the defined *Measures of prevention and mitigation during the closure of the wind farm* will be implemented.

1.4. Environmental state description

The environmental quality of the area where the construction of the Kostolac wind farm is planned is influenced by several different industrial complexes: TPP Kostolac A (two power blocks of 110 and 210 MW), TPP Kostolac B (two power blocks of 348.5 MW each), surface lignite mine Drmno, ash and slag landfills at the locations of the Kostolac Middle Island and Ćirikovac, as well as local sources of pollution within the settlements Stari i Novi Kostolac, Petka, Bradarac, Klenovnik, Klicevac, Drmno. Since the implementation of the technological process of using wind energy in wind farms does not imply negative impacts on the quality of the basic environmental factors (water, air and soil), these environmental factors will be described descriptively with the status score. Data on the quality of the basic environmental factors (air, land, water) were taken from the Environmental Report of PE EPS.

Air - The most important air pollutant emitters in the area of interest are TPP Kostolac A and B. In order to monitor and control the emission of pollutants, TPP Kostolac A and B have developed systems for continuous monitoring of emissions into the air for pollutants that are regulated by appropriate regulations, i.e. for sulphur dioxide, nitrogen oxides and PMs. At the time of design and construction on the blocks of TPP Kostolac A and B, no measures were taken to reduce air emissions, except for electro-filter plants, since at that time the emission limit values (ELV) were not prescribed, but the impact on air quality was assessed on the basis the imision values of certain pollutants in the vicinity of the TPP. In the past period, after the adoption of the regulation on ELV in the air, as the first measure in order to harmonize with the set emission limits, reconstruction of the electro-filter plants was carried out at the mentioned power plants, which contributed to a significant reduction in emissions of PMs through gas. Individual measurements of air pollutant emissions in 2016 confirmed the deviation of mass concentrations of PMs at the exit from electro-filters in relation to the guarantees of the suppliers, on both blocks of TPP Kostolac A, where the increased gas temperature at the electrostatic precipitator inlet in relative to the projected values. The obligation to examine all parameters influencing the efficiency of the EF operation was undertaken in order to take appropriate measures in order to improve the efficiency of the EF operation in TPP Kostolac A. Mass concentrations of SO_2 in gas are significantly above the ELVs prescribed by RS and EU regulations. In order to reduce the emissions of sulphur oxides, it is planned to install gas desulphurization plants according to the agreed dynamics defined with the European Commission. Environmental impact assessment study of the gas desulphurization plant TPP Kostolac B was carried out (which was approved by the Ministry of Environment in August 2015). Also, construction of desulphurization plant at TPP Kostolac B is in progress.

Soil – The TPP Kostolac branch has been monitoring the quality of land every two years in the past period, and since 2015 every year. During 2012, measurements were carried out in the wider area of the company, which covers about 450 km^2. The results of these tests indicate that the average value of the total content of heavy metals in the soil of the test area is

common for agricultural land. The total content of most heavy metals such as zinc (Zn), mercury (Hg), lead (Pb), cadmium (Cd), copper (Cu) does not exceed the threshold limit value (TLV) in none of the samples. The total content of arsenic (As) and chromium (Cr) in two samples ate above the TLV while nickel (Ni) is in 40% of the samples above the TLV. The program of soil control includes: field and laboratory measurements at representative measuring points that are entered on the topographic map, which will enable monitoring of the changes of the tested parameters at the same measuring points in the following period. The tests are carried out 2 times a year. Measuring points are defined depending on the distance from the landfill:

- from the landfill (ash),
- in the influence zone: zone 1 – up to 1 km to landfill, zone 2 – from 1 km to 3 km to landfill and zone 3 – from 3 km to 5 km to landfill,
- outside landfill impact zone (control points).

Regarding the content of heavy metals, the exceedance of nickel content in relation to TLV in 25 soil samples in the vicinity of each landfill has been recorded, as well as exceeding the lead content in two samples around each landfill. For other analysed substances, no exceedance was recorded in any sample. The content of heavy metals and other toxic elements in ash and soil was in the usual concentrations and below the remediation values for: chromium (Cr), cadmium (Cd), mercury (Hg), arsenic (As) and iron (Fe). Measured values are far below remediation, when repair measures are required. Taking into consideration all the results of the soil survey, it can be concluded that the investigated area is not polluted by most heavy metals. As a more pronounced pollutant, nickel (Ni) occurs, whose high content is largely determined by the geochemical composition of the parent substrate. Also, the differences in the average values of metals by zones do not clearly indicate the impact of the distance from the pollutant to the content of the pollutants, especially due to the large variation in values within the same zone.

Water - The program of quality control of surface and wastewater in the area under the influence of TPP Kostolac includes measurements of physical-chemical, bacteriological and radiological parameters: air and water temperature, turbidity, pH, el. conductivity, soluble O2, saturated O2 %, COD BOD5, residual evaporation of unfiltered water, residual evaporation of filtered water, total suspended matter, sedimentary matter, total surfactants, mineral oils, phenols, alkalinity, F, Cl, NO2, NO3, PO4, NH4, Ca, Mg, hardness, Al, Fe, Mn, Cd, Cr6 +, total Cr, Cu, Ni, Zn, Pb, Hg, As, B, and ß activity, microbiological analysis. Control includes: wastewater at the place of production and/or the discharge point in the river and/or discharging into the heat channel; and waters of the river - water recipient on the profiles upstream and downstream from the waste water discharge site. By analysing the data, it can be concluded that Mlava does not suffer significant negative impacts of TPP Kostolac B, because the concentrations of pollutants are below the TLV. The most significant adverse impacts of ash and slag landfills come from arsenic and sulphates that migrate from the deposited mass into underground and surface waters. Sulphate ion migrates quickly and is considered an excellent indicator of pollution of groundwater due to the operation of the landfill. Measurement of pollutants in groundwater was carried out in pyrometers in the landfill area. The water temperature in Mlava downstream of the waste water influent from the TPP Kostolac B increased on average by 1^{o}C, and after the Mlava flows into the Danube, the water temperature in the Danube did not change.

Noise - The occurrence of noise which is registered further from the main building of the TPP Kostolac B is created by the regular operation of the blocks, especially when blocks are

moving as well as in special situations during regular operation (activation of the safety valve). Another source of noise, which is manifested at the very location of the planned Kostolac wind farm, comes from the roads connecting the settlements in the zone of the wind farm and, to a lesser extent, from the conveyor belt that crosses the location. Measurement of noise was carried out in 2014 at six measuring points: TEKO A - River police, FIO Minel, TEKO B - Viminacium, Zatvaracnica at Mlava and SM Drmno - Vidikovac, the road to Kličevac, of which the most significant measuring points are the last two for the Kostolac wind farm. Measurements were performed during the summer period during the day and night, and the measurement results show that the relevant noise level exceeds the values of 50 dB (A) at all measuring points except at the measuring point "FIO Minel" and "road to Klicevac", whereby the highest value recorded was at the Viminacium measuring site.

Population - At the periphery of the area that is located in the scope of the planned wind farm project, there are several settlements - Kostolac, Drmno, Bradarac, Maljurevac, Ćirikovac, Petka and Klenovnik, as well as the complexes of administrative and/or industrial facilities of Thermoelectric power plants and mines Kostolac. The settlements are mainly agricultural households, and the project of the wind farm will not significantly impede the usual agricultural activities in the area in question.

Flying fauna - During the twelve-month monitoring at the site, the presence of 119 bird species was detected (120 in the entire research area, which, in addition to the subject, would include control), most of which were in low numbers. As mentioned earlier, the greatest reason for the low number of specimens of recorded species in the investigated area is the extreme uniformity and the presence of sub-optimal habitats. there are almost no trees, as well as the middle floor vegetation (shrubs). For the investigated area characteristic are species that live on the ground. Of the species that would have potential damage from the wind generators, 17 target species were selected, which were specifically monitored and recorded. The extent, the height and the directions of the flyovers speak about the potentially low effect and the intensity of any damage. Certain effects of wind turbine functioning can be assumed for some species of Falconiformes that were the most numerous target species and recorded at critical heights such as *Buteo Buteo* and *Falco tinnunculus*. Other species, such as *Circus aeruginosus, Accipiter gentilis, Accipiter nisus, Ciconia ciconia, and Falco subbuteo*, were significantly less numerous and were flying at different heights from the surface but mostly up to 50m, a height that would be beyond the reach of the future blades of the wind turbine generator. The nesting of almost all kinds of predators has not been established, except for the most numerous - *Buteo buteo and Falco tinnunculus*. The most significant number of flights was recorded for the two species mentioned, while the number of overflights recorded by other species is significant or extremely small. Based on the foreseen layout of wind turbines on the future Kostolac wind farm and on the basis of data at the observation points, it can also be assumed that the will not be significant negative impact of the construction and operation of the wind farm on the bird fauna.

At the location of the wind farm with ultrasound audiodetection, the activity of 14 species of bats is registered, whose members can be reliably distinguished on the basis of echolocation signals: *Rhinolophus ferrumequinum, Miniopterus schreibersii, Myotis bechsteinii, Myotis emarginatus, Myotis nattereri, Barbastella barbastellus, Pipistrellus pygmaeus, Pipistrellus pipistrellus, Pipistrellus kuhlii, Pipistrellus nathusii, Hypsugo savii, Nyctalus leisleri, Nyctalus noctula, Vespertilio murinus* and *Eptesicus serotinus*. In addition to these, the activity of representatives of 4 groups of species whose members cannot be reliably distinguished on the basis of echolocation signals is also registered- so it is certain that at least

one species from each of these groups is present at the site, which makes at least a total of 19. However, it is very likely that this number is actually higher, i.e. 23, because at least occasionally and/or sporadic there is the presence of 8 species from these groups (*Myotis brandtii*, *M. mystacinus*, *M. alcathoe*, *M. myotis*, *M. oxygnathus*, *M. daubentonii Plecotus austriacus* and *P. auritus*) almost certainly based on their wider distribution and the existence of appropriate ecological conditions at the site and in the immediate vicinity.

Climatic characteristics - Based on the analysed climatic conditions, it can be concluded that the area of the planned wind farm Kostolac has a moderate-continental climate with certain specificities. The transition season, spring and autumn, are distinguished by the variability of the weather, with the warmer autumn of the spring. In the summer, due to the movement of the subtropical high-pressure belt to the north, this area is under the influence of the so-called Azores anticyclone, with fairly stable weather conditions and occasional rainfall of local character. In winter, this area is under the influence of cyclonic activity from the Atlantic Ocean and the Mediterranean Sea, as well as winter so called Siberian anticyclone. Data on air flow characteristics, from measuring points at the location of the planned wind farm Kostolac, are presented in point 2.2.3. of the Study.

Buildings, cultural heritage, archaeological sites and ambient units - In the context of the architectural heritage and cultural values of the location concerned, the objects of settlement structures on the perimeter of the site and the sites identified in point 2.4 of this Study can be discussed. There are no significant ambient units on the location in question.

Landscape - Due to the dominant effect of anthropogenic factors on the site, primarily mining activities, the landscape values of the site can be characterized as low quality. The anthropogenic altered areas altered by the mining activities in the previous period dominate, and the objects of thermal power plants dominate the space in a visual sense.

Relationship between named factors - In summary, it can be noted that the quality of the basic environmental factors at the microlocation of the planned wind farm Kostolac is somewhat distorted as a result of primarily mining activities and the operation of thermal power plants in the environment. However, due to the nature of the technological process in wind farms, there is no significant interaction between the elements of the environment in which, as a result of cumulative and/ or synergetic factors, increased environmental pollution could not occur. Although Article 6 of the Rulebook on the content of the Environmental Impact Assessment Study explicitly states that this chapter must include all the above factors, it should be pointed out that the project concerned, due to the nature of the aforementioned technological procedure, will not have influence on most of the above mentioned environmental elements (climatic characteristics), some elements may have a minor impact (flora, soil, water, air), while the effects on other elements, especially on the flying fauna, can be significant, which is given in more detail further in the Study.

1.5. Possible environmental impacts

Considering the basic purpose of the wind farm facility, the way it operates and the expected environmental impacts, it can be concluded that the following impacts will occur during the construction phase:

- increased noise level due to the operation of construction machines and transport means;
- increased level of air pollution due to emission of exhaust gases from construction

machines and transport means;
- temporary deposit of surplus land during the foundation of facilities, stones and other waste materials.

These effects are inevitable in the construction phase and cannot be avoided. The possibility of prevention refers to the regular maintenance of means of transport and construction machinery in order to prevent the occurrence of higher noise levels and increased emissions of exhaust gases due to malfunction of means of transport and construction machinery. In the construction phase, there will be the excavation of smaller quantities of soil, stone and other waste materials from the excavation of foundations for the planned facilities. However, this deposit will be only temporary, and the investor will be obliged to organize the permanent deposit of these materials as soon as possible in accordance with the relevant legislation. Free disposal will be prohibited. The evacuation of the surplus of land, stone and other waste materials during the construction phase will be regularly organized and, if necessary, in cooperation with the competent institutions. Free disposal of these waste materials will be prohibited by measures of environmental protection. Waste management during the construction of a wind farm will be defined within the Detailed design and is not the subject of this Study, except for the guidelines that will be defined in that context in Chapter 8 of the Study.

Summarizing the characteristic of possible impacts of the planned project, the following can be noted:

a) the extent of the impact is limited in relation to intensity and spatial extent, and in the context of the current state of the environment. In the immediate vicinity of the building there are no vulnerable objects that can be exposed to the impact.

b) nature of cross-border impact: conditionally possible cross-border impact since the impact on internationally protected species of flying fauna can be considered as cross-border.

c) size and complexity of impact: the size and complexity of potential impacts (positive and negative), and given the nature of the project, is not expressed.

d) probability of impact: probability of impact can only be regarded in relation to ornithofauna and hiropterofauna. These effects are minimized by the optimal arrangement of wind turbines.

e) cumulative and synergetic effects can be expected as a result of the interaction of planned wind turbines within the wind farm itself.

In order to analyze the possible impacts of certain activities and procedures during the construction and exploitation of the park of wind farms at the Kostolac site on environmental elements, from a broader list of potential impact factors (threats) that can be expected for this kind of intervention in nature, 10 possible factors are identified, which are actually individual activities on the realization of the project. Although for each of this item, it is possible to partially determine the summative, ie the average assessment of the effect (impact factor), we consider that their presentation as a whole, without partial analysis, is sufficiently purposeful and functional. For some factors, it can be said that they carry the same or similar information, so it seems justified to reduce their number. The fact is that some of them act synergistically, mutually reinforcing their actions, and therefore that matching information

must be kept in the analysis. The synthetic display of the endangering factor is given over the mean values, not through the summative score that would then be scaled.

Impact factors were evaluated separately for each environmental component relevant to the scope of this study with estimates from 0 to 5 for the impact size, according to the following scale:

0 – no noticeable effect;
1 – low effect;
2 – tolerable effect ;
3 – medium high effect;
4 – high effect;
5 – very high effect (devastation).

For the importance of the impact of the scale from L to M, according to the following scale:

L – impact limited to location;
O – impact of importance for the municipality;
R – impact of a regional character;
N – influence of national character;
M – impact of cross-border character.

For probability of impact from M to I, according to the following scale:

M – possible impact (probability less than 50%);
V – probable impact (probability over 50%);
I – certain impact (probability 100%).

For the duration of the influence from P (occasional/temporary) to D (long term/permanent).

Also, the physical, biological and socio-cultural characteristics of the environment at the site are separated, and within them, a total of 16 components of the environment are defined

The effect of the factor is assessed for the components of the environment at the site (!), and the results of the analysis are shown in the tables - matrixes, for all components of the environment and impact factors in the form of Leopold's matrix, and accordingly commented.

The estimated influence of the impact factors on individual and all environmental components was assessed, and it was estimated that the analysed impacts were assessed as temporary or as minimal, i.e. inevitable (noise and air pollution during construction, partial area changes, etc.) and generally viewed as acceptable in the context of not burdening the capacity of the space.

Summary of possible impacts

Quality of air, water, soil, noise and vibration, heat and radiation - Using renewable energy sources positively affects air quality. This positive impact is noticeable in a wider context and beyond the scope of the project. However, certain negative effects are possible during the construction phase of the wind farm and as a result of the realization of certain segments of the project, primarily the realization of traffic surfaces for the needs of the functioning of the complex of the wind farm and the substation complex. These effects are reflected in the air pollution caused by the manipulation of vehicles and machinery and in the form of raising dust. On the regime and quality of surface waters, the given project can have

an impact during the realization and functioning of the TDP. When using a wind farm, water is not used, so waste water is not generated. Certain negative impacts can occur in the construction phase and in case of accidental situations and oil leakage into groundwater, but the likelihood is at the level of theoretical assumptions. When it comes to the possible impact on the soil, they are predominantly possible as a result of foundation of wind turbine pillars, manipulation of construction machinery on site, and inadequate treatment of waste materials during the construction of a wind farm. In relation to the noise and vibration generation, based on the spatial noise dispersion and the values obtained from noise modelling, noise levels from wind turbines were found to be significantly below the legally prescribed levels. In this context, the spatial disposition of wind turbines is very favourable and does not have significant negative impacts in terms of exposure to people with increased noise intensity and vibrations. The wind farm project does not produce thermal pollution, and in the context of radiation, there are electric and magnetic fields in the substation as a type of non-ionizing radiation. Since there are no residential facilities near the substation, such impacts are not considered significant because there is no exposure of the population to these influences

Health of the population - Due to the specificity of the site in terms of the vicinity to the settlement and the nature of the technological process in the wind farm, there are no effects on the health of the population. During the construction of the wind farm, possible impacts related to possible injuries at work are possible. Theoretical possibilities for endangering the health and life of the population exist only in the event of accidents, in cases where, at the time of eventual accidents (e.g. tearing up/fracture of blades), the people find themselves at the site.

Meteorological parameters - There is no impact of the project on the change of microclimatic characteristics and parameters.

Ornithofauna and hiropterofauna - It can be assumed that the greatest impact of the construction and operation of the future Kostolac wind farm will be on the members of the most numerous and most frequently present species. However, due to the registered characteristics of their overflights, most often and other target species that were flying at critical altitudes were very few, and with considerable certainty it can be estimated that the influence of wind turbines on them will be minor. Of the target species, cumulatively the greatest effect would be the storks and herons, buzzards, kestrels, and the swans, and among the other selected species of Bee-eaters, Eurasian skylark and starlings. It is important to say that the number of members of most of these species is relatively small, and that therefore there should be no significant effect on them. On the other hand, it is necessary to emphasize the possible positive influence of the construction and operation of the wind farm and the accompanying infrastructure on certain types of birds. Thus, the construction of a transmission line in terms of compulsory complementary infrastructure can have a significant effect on the nesting populations of those bird species that favor transmition lines for nesting. As it has already been established, many species are gladly nesting on the transmission lines, such as *Passer* spp., *Sturnus vulgaris, Corvus corax, Corvus cornix, Pica pica*. The ravens nests are usually used by predators such as *Falco tinnunculus, Buteo buteo, Falco subbuteo, Falco cherrug*, and very rarely by *Aquila heliaca*. Maintaining the space around the base of the pillars of wind turbines in the form of grass mowing can contribute to the increase in the number of nesting breeds of species affected by high grass, such as *Anthus* spp., *Motacilla* sp. and *Alaudidae*. As far as the bats are concerned, wind farms have a certain, though not high, significance for conserving the local fauna of the bats. This exclusively refers to local populations of the species *Pipistrellus kuhlii, Pipistrellus nathusii, Nyctalus noctula* (not for

the migratory populations of *Pipistrellus nathusii* и *Nyctalus noctula*), for which at least some of the moderately important ecological functions exist at the sites themselves, atleast occasionally and/or locally here records their high or moderate activity and relative numbers, which may be expected in the near future for *Hypsugo savii*. Based on the preliminary analysis of the conflicts, the investor was suggested, and the investor accepted that certain wind turbines should be repositioned outside the observed zones of increased risk of death, and according to the current plan, all positions of the wind generators are located at a safe distance from the most important identified corridors, so that it is believed that from the aspect of preventing/reducing the suffering of bats, maximum has been achieved by planning the layout of wind generators. Based on the overall preliminary analysis, which has been elaborated and explained in detail, it is estimated that most of the measures necessary for preventing the harmful effects of the wind farm have already been implemented by preventive planning of the positions of wind generators in the function of protecting bats and birds, and all defined positions of wind generators are suitable for construction and work with the implementation of general protection measures.

Population, concentration and migration of the population - There is no impact of the project of the subject wind farm on the population, concentration and migration of the population.

Purpose and use of surfaces – Wind farms physically occupy only a few percent of the area (the surface area for the foundation of the objects) on which they are stretched, while the rest of the surface between the stand of the turbine and around the internal roads can be used for other purposes, that is, it can be used without restriction for the original purpose. In this case, it can still be used for agricultural production, and in the context of changing the purpose of land use there is no significant impact.

Utility infrastructure - The project will have no impact on the existing communal infrastructure, and the planned internal communal infrastructure will be carried out in accordance with the valid regulations and conditions of the relevant institutions obtained in the regular procedure for the needs of the project.

Natural assets of special values and cultural heritage - The smallest distance of the wind farm from the SNR Deliblatska Pescara (which is also an important bird area - IBA) is about 4 km (south-western border), i.e. about 7 km (Deliblatska Pescara itself). During construction work, heavy machinery and vehicles will not jeopardize the Deliblatska Pescara. The distance of the project site from the protected area is large enough that there is no possibility of disturbance or loss of protected habitats in the named area during the construction of the wind farm. According to the data from higher level plans and plans of the surrounding areas, which are related to the subject area, there are no objects that have the character of the cultural heritage, except for the site of Rukumija - a bronze age archaeological site and a monastery, which is considered not to be under impact of the Project.

Landscape characteristics of the area - Analysing the target location of the planned purpose, it was concluded that the wind turbines will dominate the environment, so it can be concluded that the existing landscape will significantly be changed by the construction of the planned wind farm. With careful planning, design and colour of wind turbine columns, this impact can be partially reduced. The opinion of the expert team is that the planned disposition of the wind turbines will not disturb the landscape features of the space, but will give it a special visual identity. On the other hand, on the wider area of the planned Kostolac wind farm, there are energy facilities/thermal power plants whose chimneys already influence the

change of land, which, in summary, diminishes the significance of the potential impacts of the planned wind farm on the landscape and the ambient values of the wider area. In addition, the installation of a wind turbine can have an impact on the shading and glare of the wind turbine or the so-called shadows flickering. Wind turbines are large and high objects and as such they can shine the light, or they can create a shadow in the environment. When the unit is in operation, an unpleasant flickering of the shadow can be detected at distances up to 10 diameters of the rotor. Given the configuration of the terrain, the disposition of wind turbines and existing objects in the surrounding area of the subject area, as well as the course of the Sun's movement, it can be concluded that such effects will not be expressed in a way that would present an obstacle.

Cross-border impacts – Of all the dominant influences that the wind farm can imply in some area (impact on flying fauna, increasing noise intensity, visual impacts and shadows flickering) in the case of the Kostolac wind farm, and in the context of possible cross-border impacts on neighbouring Romania whose border is at about 15 km northeast of the most eastern position of the wind turbine of the Kostolac wind farm, one can speak of:

1. Visual impact (visibility of the wind farm from the territory of Romania) and
2. Impact on a flying fauna with the status of internationally protected species.

When speaking about visual impact, item 6.2.1.3. of the Study elaborated visual impacts and it was concluded that the wind farm Kostolac will dominate the area that is in the immediate vicinity of the wind farm due to the height of the wind turbines. However, in a transboundary context, this impact is completely relativized with regard to the distance of the location from the nearest settlements in Romania (18km - Socol, 20km - Campia, 22km - Parneaura), especially in view of the topography of the terrain. Namely, between the location of the Kostolac wind farm and Romania, on the territory of the Republic of Serbia, there are locations: Lipar, Dos, Dolovi, Veliko Brdo, where altitudes range from 230m to 324m (Figure 21).

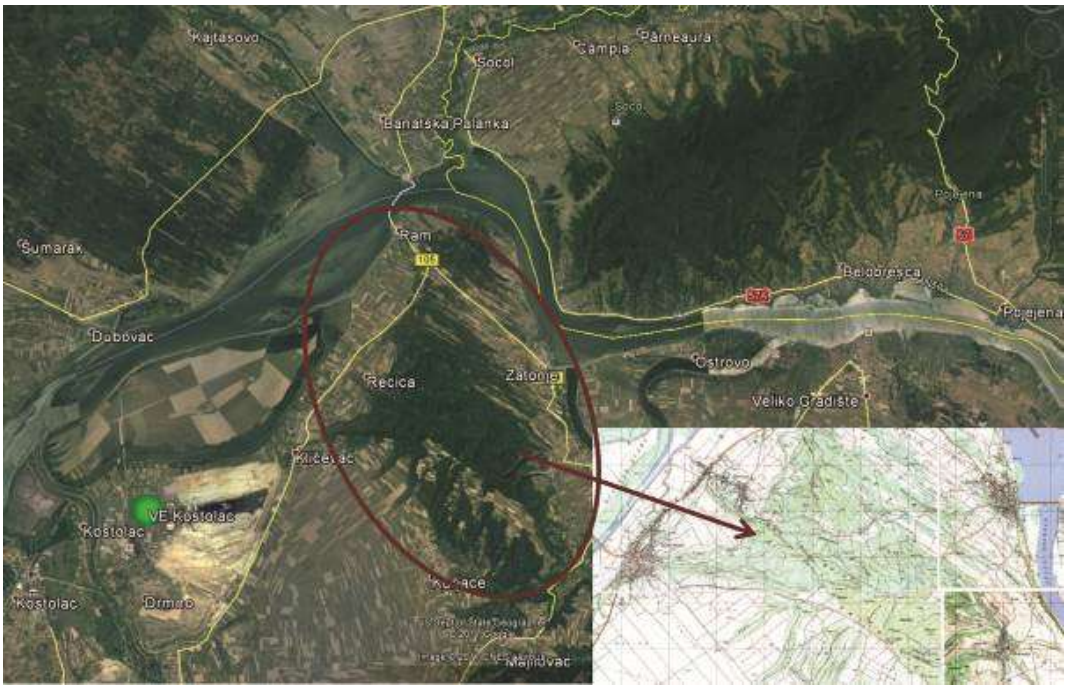


Figure 21. *Topography of the terrain on the space between wind farm Kostolac and Romania*

Bearing in mind the height of the 180-meter wind turbine with the vertical position of the blade, the topography at the site of the Kostolac wind farm (70 meters above sea level), as well as the altitudes of the locality: Lipar, Dos, Dolovi, Veliko Brdo, located on the area between the location of the wind farm and the territory of Romania and its closest settlements, it is evident that the visual impact is considered negligible because either it will not be noticeable or it will not exist at all (depending on the location of observation).

When the second possible cross-border impact is analysed, the impact on the flying fauna, as mentioned earlier, at about 15 km northeast of the easternmost positions of the wind turbine of the Kostolac wind farm is the state border with Romania. Also, from this closest point on the state border along the Danube River in neighbouring Romania, is the *Porcile de Fier* National Park. This very spacious (115,655 ha) protected area represents a unique natural entity with protected or predicted for protection areas in Serbia located in the vicinity of the wind farm's location - Labudovo okno, i.e. Donje Podunavlje, and further downstream with the National Park Djerdap. These protected areas, both in Serbia and Romania, have undoubted importance for the conservation of bird fauna, which has led to the release of several important and internationally important bird areas (IBAs) and internationally protected Ramsar areas in this area. And the entire Danube valley is a very important European migration corridor, both for birds and bats, which is why its stream with the coastal belt is protected by law as an ecological corridor of international importance and part of the ecological network of Serbia.

However, despite the close proximity of such important bird habitat (or perhaps because the ecological conditions for many bird species and bats in these protected zones are incomparably more favorable than in the zone of the wind farm's location), the monitoring of the activities of flying fauna (November 2014 - November 2015) found that the number/activity of migratory bird populations (members of the *Anseridae, Ardeidae, Falconidae, Accipitridae, Gruidae* and others) and the bats (*Pipistrellus nathusii and Nyctalus noctula*) were small/low in the zone of the Kostolac wind farm location, even negligible, so the risk of their suffering is estimated to be small or negligible. By applying the principles of preventive planning in the function of protecting bats and birds, this low risk is further reduced, since all implemented measures for the prevention and reduction of adverse impacts (undertaken by a slightly higher risk identified for some local population of sedentary species) have a positive impact and to migratory populations. In this context, possible transboundary impacts in relation to internationally protected species of ornithofauna and hiropterofauna are maximally minimized by the optimal spatial distribution of wind turbines, based on detailed observations of flying fauna.

Other possible cross-border impacts have not been identified even at the theoretical level

1.6. Environmental impact assessment in case of hazards

There is a possibility of accidents arising from the work of a wind power plant. However, equipment manufacturers predict inevitably all necessary measures to protect against accidents, and these are the following potential accidents:

- fire hazard,
- lightning strike hazard;
- ice-gathering on wind turbines blades hazard,
- wind turbines blades breaking of during severe winds.

The risk of an accident on a wind turbine is very small. Experiences from the world show that

no wind turbine accidents have been reported anywhere that would cause significant ecological consequences.

At the given location there is no direct danger to the objects, even in the case of the most serious hazard (torn blades or other parts during the work or demolition of the entire pillar with a wind turbine). However, special attention should be paid to the way that VG15, VG16 and VG 17 operate in the period of extreme climatic events (extreme wind blows and eventual icing on the blades) and in case of the realization of a new municipal public road that should pass near these positions.

It is of particular importance that the site and work organization are professionally done in order to minimize possible consequences at that stage. This implies the organization of continuous control in the procurement of construction materials and the execution of construction works. The investor is obliged to provide exclusively approved construction materials and equipment from an authorized supplier, and through professional supervision performs regular quality control of the materials that are being installed.

Particular attention must be paid to the transhipment (TDP), transport and temporary storage of building materials and equipment, so that at that stage of the works due to weather conditions or other circumstances, construction materials and equipment would not lose some of their properties and quality and not to jeopardize the quality of the basic environmental factors.

In the construction and exploitation phase of the building, the investor is obliged to take all the necessary fire protection measures and to process them in detail in the appropriate fire-fighting department. Also, all employees, both in the construction phase and in the stage of exploitation of the facility, must be adequately trained and equipped for timely and efficient reaction in such situations.

Regarding the possibility of a lightning strike in the wind turbine, it exists, but manufacturers in their technical specifications inevitably predict the placement of lightning rods on the tips of the wind turbines, thus eliminating this possibility. The manufacturer of the equipment in its specifications also defines the wind speeds in which the automatic shutdown of the system occurs which prevents the possibility of damage.

Dangerous substances could be used in the regular operation of the wind farm are (1) hydraulic oils and lubricants, anti-freeze and other chemicals for cleaning and maintenance of wind turbines (necessary for operation) and (2) transformer oil in the substation.
The use of hazardous substances necessary for the operation of wind turbines are defined by the regulations of the manufacturer which is, as a rule, certified according to the ISO 14001: 2004 standard. The replacement of the oil contained in the lubrication devices and lubricating systems in the type of wind turbine projected by the project will be carried out periodically, as part of the regular preventive maintenance of the plant.
All listed possible accidents are extremely rare and for the prevention of possible impact measures are implemented during the design of the plant, exploitation of the facility, the monitoring of the condition of the equipment and the operational maintenance in accordance with the regulations and standards.

The intensity of seismic hazard in the subject area is in the 7 °MCS zone, and a more detailed analysis of the seismic characteristics of the location of the planned wind farm Kostolac is

elaborated in point 2.2.5. of the Study, and all construction works and materials should be aligned with the values obtained in the analysis of the local soil response to the seismic effect done within the detailed Seismic micro-landscaping of the terrain at the boundary of the Project.

1.7. Environmental protection measures

In designing, constructing and exploiting of the Kostolac wind farm, it is necessary, in addition to the measures included in the Preliminary Design and defined by the equipment specification of the manufacturer, to apply the appropriate environmental protection measures that are listed below.

Measures during the construction

- during the construction of the planned facilities and the accompanying infrastructure, it is obligatory to respect all the acquired conditions of the competent institutions and the measures that have been incorporated on the basis of them in the Project in question;
- the base of the pillars of each wind generator should be built and secured in a concrete deposit and in such a way that mammals that live underground cannot dig beneath them, and which are the potential prey of the birds
- the land around the concrete foundation of the pillars and the land on which the cables are installed must be repaired after the completion of the works and returned to the previous purpose;
- all installations must be earthed and properly insulated to prevent, or minimize, the harm to wild species;
- the accompanying facilities (substations, distribution boxes, etc.) must be constructed as to prevent the settlement of birds and bats;
- the disposal of agricultural and all other forms of organic waste in the area of the wind farm is prohibited;
- the wind farm should be equipped/organized so as to ensure continuous monitoring of the migration of birds and bats over the territory it occupies;
- the construction of buildings, the execution of works, or the carrying out of the technological process, can be carried out provided that no permanent damage, pollution or other degradation of the environment is caused;
- during the execution of construction works, in order to protect the health and life of people, all occupational safety measures prescribed for the intended type of work must be carried out;
- organize the site in such a way as to prevent any penetration of harmful substances into water, air and soil;
- for the needs of the personnel involved in the construction it is necessary to provide portable chemical toilets and their regular maintenance and discharge by an authorized legal entity;
- настали грађевински, комунални и остали отпад мора се отпремити са локације на за то предвиђену локацију у складу са важећим прописима, што треба дефинисати у Пројекту за извођење; the generated construction, municipal and other waste must be dispatched from the location to the designated location in accordance with the applicable regulations, which should be defined in the Detailed design;

- the movement of mechanization and vehicles during construction should be limited to the design areas of roads and access roads;
- from all surfaces where oily or other liquids that can be pollutants may occur, provide a closed collecting and discharging system;
- all surfaces damaged during the execution of the works must be repaired after the works have been completed;
- in the event of damage and spill of motor oil and fuel, the damages must be repaired and the polluted land evacuated and deposited under the conditions of the competent utility service;
- removed humus or soil of similar characteristics (if any) should be separately deposited, protected from the pollution and after the completion of the works use it for the purpose of horticultural arrangement of devastated surfaces;
- for workers involved in construction for sanitary purposes and for the storage of parts and equipment, organize mobile container facilities that should be removed from the site after the works have been completed;
- during the realization of the project achieve noise protection by good site organization and using machinery that does not create great noise;
- the construction of facilities shall be carried out in accordance with the applicable technical norms for construction, with the application of technologies that meet the prescribed environmental standards;
- in the event that in the course of earthworks, a natural good that is geologically-palaeontological or mineralogical-petrographic origin is found, which is presumed to have the status of a natural monument in accordance with Article 99 of the Law on Nature Protection (Official Gazette of the RS No. 36/09, 88/10 and 91/10), the contractor is obliged to inform the Ministry of Environmental Protection within eight days and take all measures so that the natural good could not be damaged until the arrival of the authorized person;
- in the event that in the course of earthworks the archaeological site or material remains of culture is found, the contractor is obliged to immediately suspend it and notify the competent institution for the protection of cultural monuments, and to ensure that, by the arrival of the expert team, the damage or destruction of the findings in accordance with Article 109 paragraph 1 of the Law on Cultural Property (Official Gazette of the RS, No. 71/94, 52/2011 - other laws and 99/2011 – the second law);
- the foundation of the wind turbine must be carried out in accordance with the requirements of the manufacturer of the equipment, and special attention should be paid to the joint of the bearing pillar and foundation;
- collecting surface water flow from the surfaces on which the works are carried out through temporarily constructed drainage channels and precipitates in order to prevent direct entry into the natural recipient (soil), especially during the precipitation period;
- atmospheric wastewater generated by flowing from the manipulative surfaces of the site may potentially contain suspended matter and petroleum products. Provide the controlled acceptance of potentially contaminated atmospheric waters and their treatment in a precipitates or a separator of fats and oils to ensure that the quality of purified water meets the criteria prescribed for discharge into a particular recipient and removal by an authorized person;
- blades of the wind turbine shoud be marked for observation by day, alternating with red and white colours, so that the field at the top of the blade is red. In total, there should be two red fields. The height of the field must be 6 meters (Rules on airports "Official Gazette of RS", number 23/12);

- mark the pillar of the carriers of each wind generator as an obstacle for flying, for spotting at night and in conditions of reduced visibility by placing a flash lamp with white light, medium intensity "type A", for marking obstacles in air traffic at the top of the pillar (Airport Rules "Official Gazette of RS", No. 23/12 and 60/12).
- the holder of the right to dispose of the facility is obliged to submit a technical report on the determination of the coordinates in the WGS-84 coordinate system, as well as the absolute and immediately after the construction of the facility, to the Directorate of Civil Aviation of the Republic of Serbia and the Air Traffic Control Agency of Serbia and Montenegro, the relative height of the objects, for the purpose of publishing them in an integrated airborneinformational package;
- windgenerators must be equipped with devices for protection against lightning strikes (lightning rods);
- take measures that will prevent the creation of ice on the blades of the wind turbine in the period when its it is possible;
- construct the facilities in accordance with the Law on Fire Protection (Official Gazette of RS, No. 111/09) and other related legal and sub-legal acts in accordance with the conditions of the Ministry of Internal Affairs - Emergency Situations Sector;
- provide an access route for fire-fighting vehicles in accordance with the provisions of the Rules on technical standards for access roads;
- the implementation project foresee the way of constructing and using a TDP that will not adversely affect the quality of water, the coastal plant and animal world and the emergence of erosive processes by Detailed design;
- the implementation project foresee the way of constructing and using of the docking bay that will not adversely affect the quality of water, the costal and water plant and animal world and the emergence of erosive processes by Detailed design;
- the transhipment of the equipment at the TDP shall not be carried out between the half of March to the end of June and from the beginning of October to the end of November, during the migration and nesting cycle of birds;
- at the sites of temporary disturbance of vegetation, the eradication of trees and shrubs is not permitted, in order to prevent soil erosion and allow faster spontaneous renewal of vegetation;
- during the construction phase, monitor the implementation of the defined protection measures for this phase of project implementation;
- all facilities must be built in accordance with the applicable legal and by-law acts regulating the specific area.

Substation complex protection measures

- by technical solution, prevent the release of transformer oil into water and soil. The collecting pit, pipelines, collecting channels must be waterproof and protected from the hazard spillage and penetration into the underground aqifers;
- use a special system of oil pits, separators and absorbent wells of atmospheric waters. The system must be closed and oil from the separator should be transported to the tanks for further processing;
- transformers to be installed outdoors and provide reinforced concrete foundations, separated from other buildings. Directly between concrete (base walls) and its sides to build concrete tanks for receiving any oil;
- any oil spilled must be collected in the lowest part where there is a manhole from which, through the oil sewer pipe (which must be resistant to high temperature), it is taken to the oil pit;

- the oil pit should be constructed so that it ensures the separation of oil from water and the removal of clean water into an absorbent well;
- the oil pit must be waterproof and have sufficient capacity to receive the total amount of oil from the transformer, including the total amount of atmospheric water and firefighting water entering the oil pit through the transformer tank;
- dispose of the concentrative material for transformer oil in accordance with the regulations, entrust to the company with accreditation for the manipulation, transport and permanent disposal of hazardous waste;
- the grounding system of the medium voltage plant, as a lightning protection system, should in all cases be aligned with the grounding system and the lightning protection system of the connection distribution system;
- fire wall is realized between two transformers (transformers tanks), from reinforced concrete in the width of the tanks, ie the foundation of the transformer and height according to the foreseen size;
- build a sanitary facility and a waterproof septic tank at the substation facility, which will be discharged by the competent public utility company;
- in the zone of the substation, near the collecting pit, envisage the production of an appropriate number of piezometers for monitoring the level and quality of groundwater, according to the hydrogeological characteristics of the soil.

Measures during operation

- regularly maintain all equipment and devices, especially mechanical parts of the turbine (lubrication, cleaning, etc.). In the event of regular maintenance of the plant and possible installations of new equipment and devices, care must be taken not to come of disposal of waste oils and lubricants on the ground, and if this occurs, immediatelly repair the damage;
- in case of any failure that can significantly increase the noise level, it is necessary to limit or discontinue operation and to repair the damage;
- limit or interrupt the operation of the wind generator in the period of strong winds in accordance with the technical characteristics prescribed by the manufacturer of the equipment;
- when installing new equipment, one of the essential parameters should be the acquisition of noise data, as well as the purchase of small-scale equipment in accordance with the requirements of the EU Directive of reducing the emitted sound power (Directive 2000/14 / EU on the noise emission of equipment used in the open air area). Upon commissioning, measurements should be made of the influence of noise arising in the area as a result of the operation of new equipment;
- equip the wind farm with equipment for monitoring birds and bats; provided equipment should be according to Rule book for special technical solutions providing secure and uninterrupted communication of wild life (Republic of Serbia Offical Gazzette No. 72/10 from October 2010);
- the obligation of the investor is the implementation of post-structural monitoring of the situation and possible endangerment of ornithofauna and hiropterofauna with appropriate equipment whose technical characteristics and precision of the measurement would be determined in accordance with the first observations immediately after the construction and at the very beginning of the exploitation phase and which will be immediately installed;
- the results of post-construction monitoring must be submitted on an annual basis to the Institute for Nature Protection of Serbia. The report should contain photographs of

possibly dead birds, the exact location and time of finding, the distance from the wind turbine and weather conditions;

- depending on the results of post-structural monitoring, if necessary, and in cooperation with the Institute for Nature Conservation of Serbia, plan compensatory measures:
  - the establishment of new or revitalization of existing sites where species that may be damaged are living,
  - measures of active protection of species, such as setting up nesting platforms and money compensations;
- if it is noticed that birds in large numbers and regularly are gathering in certain locations in the vicinity of wind turbines, or that they are attracted to certain objects (different pillars, trees, wild dumps, etc.), it is necessary, with prior consultations with the Institute for Nature Conservation, to remove objects from the location of the wind farm or apply technical and organizational measures to prevent the retention and gathering of birds;
- possible dead animals, primarily mammals and birds, is necessary to regularly remove from the location of the wind farm;
- it is necessary to periodically measure the noise intensity at the location and near the closest residential buildings;

Waste management measures

- provide the necessary space, the necessary conditions and equipment for collection, classification and temporary storage of waste materials in accordance with the Law on Waste Management ("Official Gazette of RS", No. 36/2009, 88/2010) and other regulations regulating the treatment with different types of waste;
- collect hazardous waste (waste oil), store it safely in closed containers in a specially designated place in accordance with the Regulations on the manner of storage, packaging and labelling of hazardous waste (Official Gazette of RS, No. 92/2010). Collected waste oil is handed over to the authorized organization with which the contract is concluded and which has a valid permit for hazardous waste management (storage, treatment, disposal);
- collected solid waste (secondary raw materials) is classified and disposed of in separate containers. The secondary raw material is handed over to the authorized organization with which the contract is concluded and which has a valid permit (storage, treatment, disposal);
- it is not allowed to dispose of waste materials on the uncovered and non-concreted space in the wind farm;
- the landfill of the land surplus that occurs during the execution of construction works shall be provided from the washing and dismantling and, at the latest after the completion of the works, evacuate from the site and deposited in the place and under the conditions of the competent utility service;
- all specified waste management measures should be precisely defined in the Detailed design.

Protection measures in the event of hazards

- before the start of the operation of the wind farm, develop an Action Plan in the accident situations that should contain (1) the scheme of the response to the accident, (2) the training program, (3) the control program, (4) other instructions and notices.

This Plan will determine which activities are to be undertaken in cases of accidents, which external institutions are notified and how the consequences are corrected;

- force for the implementation of the Plan should include (1) workers in charge of managing the operation of the wind farm at the moment of the accident, (2) other workers who are not in the shift, (3) the competent fire department;
- regularly conduct adequate training of employees that should include and identify disruptions in the operation of wind turbines (unusual sounds from pillars, gondolas or blades) and how to act in such cases;
- during periods of strong wind (usually for wind speeds greater than 25 m/s) wind turbines are automatically stopped and maintained in braked state (due to possible damage to equipment and devices);
- establish a comprehensive program of preventive maintenance and monitoring of key parts of the wind turbine to reduce the risk of the occurrence of failures and potential accidents;
- regularly maintain electrical components and rotating parts in the gondola and thus reduce the risk of temperature rise or spasms (and fires) in the gondola;
- in exceptional cases that can occur (fracture of the blade, fall of the wind turbine) completely remove the generated waste and safely dispose of it. Perform rehabilitation of damaged land and compensation for (eventual) damage done;
- install an automatic fire detection system that will ensure the shutdown of the electricity transmission system as soon as possible;
- the fire scenario on wind generators is a general-type risk and is subject to separate fire protection analyses by authorized institutions. The fire protection report is a separate part of the project documentation and determines the method of response in case of fire and appropriate protection measures;
- the zone immediately around the wind generator must be a zone where smoking is prohibited and accordingly marked;
- in the case of spillage of dangerous substance, collect the used sorbent and deposit according to the Rulebook on the manner of storage, packaging and labelling of hazardous waste (Official Gazette of RS, number 92/2010);
- in case of degradation of soil and water, it is necessary to make remediation or otherwise rehabilitate the degraded environment in accordance with the rehabilitation and remediation project

Measures for preventing and mitigating the impact during the closure of the wind farm

The planned life cycle of the wind farm is about 25 years. After this period, the turbine could be replaced or the closure and removal of the plant. Protective measures during the period of closing and removal of the wind farm contain the same or similar requirements as protection measures during the performance of works and the installation of wind turbines. In that sense, the measures mentioned in the case of construction concerning the protection from noise, traffic management, protection of habitats, flora and fauna, protection of land and groundwater, protection against air pollution, can also be applied in case of closing and removal of the wind farm.

Before the removal of the plant begins, it will be necessary to make a General project for closing and removing of the facilities that will include a detailed plan for the rehabilitation of the area of former wind farm. As part of the general project, it will be necessary to formally establish a list of protective measures and requirements that need to be met, based on possible specific conditions that may arise at that time. The mentioned project will need to be

harmonized with the Conditions of the competent institutions. The project with a recovery plan should be accepted by the competent environmental authority as well as all other stakeholders (including the financial institutions that participate in the project financing).

It is necessary to implement several general measures (principles) of protection which are necessary to be applied in the phase of termination of the project, which are:

- before removing the wind farm and clearing the site, re-execute an ecological location analysis to determine whether special measures and activities are required, depending on the identified species and their habitats;
- during the works, form the central warehouse, by surface and structure, as well as the warehouse during the execution of the works;
- production units and objects are to be removed and shipped from the location. All materials and parts of equipment suitable for reuse are recycled and renewed;
- degrade the concrete foundation to a depth of 1 meter. All waste material should be removed from the site and disposed of in accordance with the regulations governing the treatment of waste;
- rehabilitate the land and restore it to the state as before the existence of a wind farm;
- after the installation is terminated, the production units will be removed and shipped from the site, and all materials and parts of the equipment suitable for reuse will be recycled and renewed.

It is forbidden to:

- discharge or spill the waste oils into or onto land, surface and groundwater and sewage;
- disposal of waste oils and uncontrolled release of residues from the processing of waste oils;
- any kind of waste oil treatment that pollutes the air in concentrations above the prescribed limit values;
- discharge of purified oily wastewater into an absorbent well, and discharging the transformer oil into atmospheric or any other sewerage, into groundwater, as well as on surrounding land.

The producer of waste oil, depending on the quantity of waste oil it produces annually, is obliged to provide a receiving place until delivering for the treatment to the person for whom the permit is issued. Owners of waste oils other than waste oil producers are obliged to hand over waste oil to the person who collects and treats it. The person who collects, stores and treats waste oils must have permission for keeping and keep records of waste oils and the amount that has been collected, stored or treated, and the final disposal of residues after treatment.

1.8. Environmental impact monitoring program

In order to realize the defined protection measures, it is necessary to control the implementation of planned, urban and project solutions in all phases of project realization (in the construction phase, exploitation and after the completion of exploitation). Controls should be conducted by relevant institutions for each individual project area.

According to the Law on Environmental Protection, the level of noise in the environment is controlled by the systematic noise measurement provided by the municipality. Noise measurements are performed by authorized professional organizations in accordance with the Law on Environmental Noise Protection (Official Gazette of RS, No. 36/09 and 88/10) and the relevant by-laws.

During the construction period of the wind farm, and especially after the commissioning of the wind farm, it is necessary to actively monitor the state and impact of the facility and its work on the elements of bird and bats fauna in the period of at least one year. In that sense, it is necessary to provide a field works of the object concerned and the surrounding belt for the collection of data and possibly killed specimens of birds and bats. Monitoring must include recording of the number and determination of the types of dead or wounded birds and bats resulting from the operation of the wind farm. In this context, it is necessary to observe in particular the space within a radius of 100 meters from each individual wind generator every 7 days (in the period from February 1 to May 1 and from August 1 to December 1), that is, every 14 days in other periods of the year. Monitoring must be carried out by a professional nature protection institution, and if necessary, other competent institutions may also be included in the monitoring report submitted to the Institute for Nature Conservation of Serbia.

In the event that in the course of the monitoring, injured specimens are found of species that are protected as natural rarities according to the Rulebook on the designation and protection of strictly protected and protected wild species of plants, animals and fungi (Official Gazette RS, No. 5/10 and 47/11), the investor must finance their transport and disposal at the appropriate Wildlife Refuge.

The further procedure would consist of the identification of these specimens, dissection and natural processing, and their preservation and storage in terms of evidence, but also for other professional and scientific purposes. For these purposes, the support and assistance of the Institute for Nature Protection of Serbia and the Natural History Museum in Belgrade could be provided, which are competent for their work with their capacities and expertise, as well as legal provisions.

In the event that the monitoring establishes possible facts about the impact of the facility and its functioning on the investigated natural values, it would be the duty and obligation of the monitoring entities to inform the initiators and project implementers, as well as the competent institutions about the situation. In that sense, timely measures would be taken to eliminate and prevent possible widespread consequences.

2. CONCLUSION

The Ministry of Agriculture and Environmental Protection of the Republic of Serbia, within its competencies and in accordance with the provisions of the Law on Environmental Impact Assessment (Official Gazette of the RS, No. 135/04 and 36/09), and upon the request of the project holder PE "Elektroprivreda Srbije", adopted a Decision determining the need for development and determining the scope and content of the Environmental impact assessment study of project of construction of wind farm on the locality of Kostolac (Decision No: 353-02-01621 / 2016-16, from 13.09 .2016).

For the needs of the Study, the project holder of the PE "EPS" conducted the public procurement procedure - JN/1000/0162/2016, after which the work was awarded to the company NETINVEST d.o.o. from Belgrade (Service Provider) and company EKO PLAN from Belgrade (member of the group), who gathered a multidisciplinary team for the development of the subject Study, which is usually a part of the documentation necessary in the process of obtaining approval for the construction and preparation of the remaining documentation.

Special attention in the preparation of the Study was devoted to the analysis of the state of the environment at the location where the construction of the Kostolac wind farm and its surroundings is planned. By the nature of the functioning, the wind farm can imply certain negative environmental impacts, both in the construction phase (temporary effects) and at the stage of its exploitation. The most dominant negative effects are possible in relation to the flying fauna, ie on ornithofauna and hiropterofauna. In this context, in the analysis of the situation, for the purpose of preventive protection of flying fauna, one-year monitoring of ornithofauna and hiroftofauna was done. On the basis of observations, the final spatial disposition of wind turbines was carried out, ie the displacement of certain pillars from the original locations, to locations where the possibility of endangering the flying fauna was minimized, and the results of performed observations were incorporated in the Study on Environmental Impact Assessment.

After analysing the state of the environment and analysing the technical documentation, a multi-criteria evaluation of the possible impacts of the planned Kostolac wind farm on environmental components was carried out using the "Leopold's matrix". For evaluation purposes, from a broader list of potential impact factors (threats) that can be expected for this kind of intervention in nature, 10 possible factors were identified as a result of project implementation activities. Impact factors were assessed separately for each component of the environment relevant to the scope of this Study, in relation to the magnitude of the impact, the importance of impact, the probability of impact, and the duration of the impact. Also, the physical, biological and socio-cultural characteristics of the environment at the site are separated, and within them a total of 16 components of the environment were defined.

Summarizing the impacts of the planned projects on the environment, it was found that they are acceptable and that they will be minimized using 89 protective measures defined in the Study and the appropriate environmental monitoring program at the site in question.

In summary, the realization of the planned project involves the use of renewable energy, using clean technology for its exploitation. In the concrete case, it can be concluded that negative impacts of limited intensity and spatial extent have been identified and that adequate protection measures for their prevention or minimization are foreseen.

By planing the micro-locations of individual wind turbines based on the results of annual observations of ornithafauna and hyropterofauna, the principle of preventive protection has been achieved and optimal wind turbine positions have been achieved, ie the maximum in terms of protection of flying fauna.

Having in mind:

- the characteristics of the planned project and the state of the environment at the site,
- results of one-year monitoring of ornithofauna and hiropterofauna
- results of multi-criteria evaluation of planned activities on the environment and
- defined environmental protection measures and environmental monitoring program,

it is concluded that the project of the Kostolac wind farm, in the wider context, will have certain positive impacts on the quality of the environment, and that the smaller identified possible negative impacts will not burden the capacity of the area, especially with the application of defined protection measures that will be implemented at all stages of the project (during the construction, exploitation and after the end of use of the wind farm). It can be concluded from the above reasons that it does not represent a significant environmental pollutant, that its implementation is in the function of realization of the basic principles of sustainable development and that it is in accordance with the national policy in the field of application of renewable energy sources and the appropriate legalization in the field of nature and environment protection. Bearing all in mind, we consider that the Project in question is fully acceptable from the point of view of possible environmental impacts.