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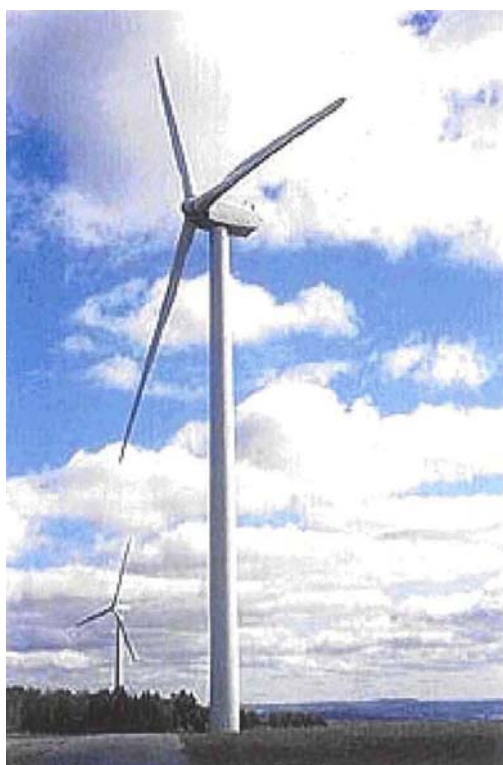
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REPORT

ON

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Of Investment Proposal: “Construction of Wind farm on the land of the Villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna”



VOLUME 1

(Supplemented in conformity with letters No 1766 dated 20.04.2006, Ref. No 3151 dated 12.07.2006 and Ref. No 4236 dated 20.09.2006 of the Regional Inspectorate for Environment and Waters – Varna)

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REPORT ON ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Of Investment Proposal:

**“Construction of Wind farm on the Territory of the Villages of
Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik
Chounchevo, Municipality of Kavarna”**

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ATTACHMENT V: Letter No 1766 dated 20.04.2006 of the Regional Environment and Waters Inspectorate – Varna for returning the Report for revision and supplement; Decision for approval of the Terms of Reference for EIA: Terms of Reference for Report on EIA investment proposal “Construction of Wind farm on the Territory of the Villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna”

GENERAL INFORMATION

TITLE OF THE INVESTMENT PROPOSAL:

“CONSTRUCTION OF WIND FARM ON THE TERRITORY OF THE VILLAGES OF BULGAREVO, SVETI NIKOLA, HADJI DIMITAR, RAKOVSKI AND POROUCHIK CHOUNCHEVO, MUNICIPALITY OF KAVARNA”

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INFORMATIONAL PROVISION

The goal which the team set up during the preparation of the Report on EIA is to determine the impact of the implementation of the investment proposal under consideration over the components of the environment: air, waters, soils, vegetation and animal world, potentially affected population, the health risk and the zones subject to health protection, the cultural – historical heritage and the protected territories, by rendering an account of the extreme situations of the factors exerting influence over these components, their duration and the possibilities for eventual corrections over the project solution in view of exclusion of sharp ecological disbalances.

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The EIA Report was drawn up based on the Terms of Reference for the EIA Report relating to the investment proposal, approved by decision of RIEW (Regional Inspectorate of Environment and Waters) Varna and signed by RIEW Varna Director Ms Teodora Karaivanova, which was delivered to the investor with cover letter outgoing No. 782 of February 17, 2006. The recommendations made and the omissions admitted stated in letters of the RIEW – Varna to GEO POWER LTD with Ref.. No 1766 dated 20 April 2006, Ref. No 3151 dated 12 July 2006 and by Ref. No 4236 dated 20 September 2006 signed by the Director of RIEW – Varna, Eng. Sinan Mehmed, are reflected in the EIA Report.

The EIA Report relating to the investment proposal “Construction of Wind farm in the Area of the Villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Kavarna Municipality” was made up in accordance with the relevant statutory acts operating in Bulgaria – the Environment Conservation Act (promulgated in the *Official Gazette*, No. 91/2002, amended, No. 98/2002 and No. 86/2003, supplemented, No. 77/2005) and Article 10, Paragraph 1 of the Ordinance Establishing the Terms and Conditions for Assessment of the Impact on Environment adopted by Council of Ministers Decree No. 59/2003 (promulgated in the *State Gazette*, No. 25/2003, amended and supplemented, No. 3/2006 (Annex II)). It is in line with the latest tendencies and methods used in making assessment of the impact on environment for the purposes of investment proposals for construction, activities and technologies, and in line with the recommendations and research made by Bulgarian and international teams assessing the environmental impact in connection with investment intentions.

The EIA Report is developed on the basis of the contract dated 10 October 2005 entered into between Company SP “EKOEM – K – Emilia Kostakeva”, city of Sofia and GEO POWER LTD, city of Sofia.

The following materials and documents were used during the preparation of the EIA report:

- Report on EIA of “General Structural Plan and Detailed Structural Plan of Wind farm in the Territory of the Village of Sveti Nikola, Municipality of Kavarna”
- Wastes Management Program, Municipality of Kavarna (term of validity 10 years),, adopted by the Municipal Council, town of Kavarna by decision No 8.1.11.99/02.02.1999.
- Draft for Environmental Management Program, Municipality of Kavarna, term of validity 2004 – 2008

This Report on EIA of Investment Proposal “Construction of Wind farm on the Territory of the Villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski And Porouchik Chounchevo, Municipality of Kavarna” was developed by a collective team of experts competent to perform environmental impact assessment with manager Chief Assistance Eng. **Emilia Hristova Kostakeva**, holder of Certificate No 25 dated 13 March 2001 issued by the Ministry of Environment and Waters with areas of competence: waters, waste matter and manager of collective body, and at the moment is in procedure of re-licensing (letter No OVOSL – 7466 dated 14.04.2006 of the Ministry of Environment and Waters, Annex 1).

Members of the Collective Team:

Experts:

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2. Eng. Zhivka Nikolova Vassileva, holder of Certificate No 233 dated 17 July 2001 with spheres of competence: ambient air, waters, industrial wastes.
3. Senior Research Associate Peter Todorov Ivanov, holder of Certificate No 1441 dated 08 April 2002 with spheres of competence: ambient air.
4. Senior Research Associate Eng. Snezhna Todorova Dakova, holder of Certificate No 1372 dated 29 October 2001 with spheres of competence: surface and underground waters
5. Lyubomir Dimitrov Angelov, holder of Certificate No 1415 dated 15 February 2002 with spheres of competence: underground waters, bowels of the earth, inclusive of geological environment and underground natural resources
6. Assoc. Prof. Eng. Margarita Pencheva Mondeshka – Nedyalkova, holder of Certificate No 1280 dated 18 April 2001 with spheres of competence: lands and soils
7. Prof. Dr. Eng. Georgi Atanasov Puhalev, holder of Certificate No 1404 dated 21 January 2002 with spheres of competence: vegetation world, landscape
8. Nikolay Petrov Karaivanov, holder of Certificate No 1616 dated 11 October 2004 with spheres of competence: animal world
9. Senior Research Associate Dr. Michel Salvator Israel, holder of Certificate No 1134 dated 13 September 2004 with spheres of competence: hazardous physical factors, inclusive of noise, vibrations, hazardous emissions
10. Prof. Dr. Ada Ivanova Baynova, Dr. M. Sc., holder of Certificate no 36 dated 23 April 2001 with spheres of competence: hazardous physical substances, health-hygienic aspects of environment

Consultants:

1. Assen Emilov Salkin – sphere cultural and historical heritage: Director of the Town Historical Museum of the town of Kavarna
2. Eng. Antonia Blagoeva Petrova – sphere waste matter, engineering – technical facilities, infrastructure: Master – Engineer in EKOEM LTD.

Declarations of the experts, in possession of professional competence for performance of an environmental impact assessment and copies of their certificates as well as declarations of the consultants are presented in Annex I.

A list of the members of the collective team who developed the EIA Report with signatures against the parts elaborated by the relevant expert is given at the end of the Report in Annex I.

1. ANNOTATION OF THE INVESTMENT PROPOSAL

1.1. POSSIBILITIES FOR USE OF THE RENEWABLE ENERGY SOURCE – THE WIND

The production of electricity in Bulgaria uses mainly nuclear power, fossil fuel and the country's hydropotential. Bulgaria's energy resources are very limited. The renewable energy sources (RES) are an alternative for the development of an energy sector generating inexhaustible power in an environment-friendly manner.

The use of renewable energy sources has been of great interest over the last few years, which is explained by the rise in the prices of conventional energy sources (coal, oil, natural gas) as a result of economic and political factors. In this sense wind power generation presents an opportunity widely used in a number of countries all over the world.

Installations driven by the wind were created and used for the first time in China and the Middle East. Later on, such facilities were used for driving windmills and pumping stations (Holland) on the territory of Europe. During the eighties of the twentieth century the idea of using the energy of the real natural resource the wind for production of electric power obtained fast development most of all in California. Later on the wind generators were perfected as technology and structure and at present there is a comparatively great diversity of facilities with various capacity – between 10.0 W and 2.0 MW. As a result of this a nearly four-fold increase of the production of electric power through the use of the wind power has been observed on global scale. According to data of the European Wind Energy Association in Europe the increase is by about 33 %. It is expected that as at year 2030 in Europe capacities will be installed for about 100 000 MW. In accordance with the energy strategy of the Republic of Bulgaria it is expected that by year 2012 8 % of this energy will be produced by renewable energy sources, and a part of this energy will be supplied by the wind.

The use of this energy source is not so widespread in Bulgaria although a lot of research has been going on to identify the potential sites that meet to the greatest extent the basic requirement for wind power generation – the wind. Irrespective of the fact that the National Energy Strategy makes provisions for the use of energy efficient and renewable energy sources, this country has little experience in the planning, design work, construction and impact assessment of such complexes.

Within the meaning of the stated hereinabove, the investment proposal, subject-matter of this EIA Report represents one of the first projects for construction in our country of a wind farm. It is due to this reason general information will be provided here about the wind power complexes.

Technical requirements to the territory selected for construction of a wind farm

The world practice recommends the observation of the following 5 main requirements during the selection of a terrain for the construction of a wind farm:

- Availability of energy resources of the wind for various points in space and for various heights

- Possibilities for inclusion in the electric power distribution network – technical and financial effectiveness of the connections with the existing networks and facilities of the technical infrastructure
- Built-up transport infrastructure and possibilities for access to the terrain;
- Availability of sufficiently big area for the construction of the facilities
- Clarified ownership of the land

In the specific event all these preliminary kinds of research were realized. First model investigations of the velocity and the direction of the wind were made, the needed area for the construction of the park was determined with defined 62 nos. of generators guaranteeing the effectiveness of the investment, the connections with the transport and technical infrastructure were studied, the ownership over the land and the manner of permanent use were established.

Ecological requirements to the territory selected for the construction of a wind farm

Further to reporting the expectations of all the plans and policies at national, regional and local level during the environmental impact assessment, the following ecological requirements should be taken into consideration:

- Landscape classification – availability of protected landscapes and admissible remoteness from their borders
- Visual compatibility of the selected territory – visual connections from and to the territory, in particular from significant points of view and routes
- Remoteness from territories for inhabitation in view of protection of the latter from noise, disturbance of the television signal, reflecting lights and visual changes
- Preservation of protected vegetation and animal species which are permanently or seasonally present at the territory
- Remoteness from sites and complexes of the cultural and historical heritage – archeological and historical monuments
- Compatibility with existing communications on the territory and in the neighborhood – radio transmission stations, TV, facilities of mobile operators and others
- Provision of the safety of the flights and the work of airport complexes located in the proximity of the territory of the wind power generation complexes

In this specific case ***the EIA Report pays particular attention to the protected areas and protected plant and animal species, the residential areas (population centres) and the areas of possible visual impact.***

1.2. PHYSICAL CHARACTERISTICS OF THE INVESTMENT PROPOSAL

The territory considered in connection with the investment proposal is situated on the community land of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Kavarna Municipality, and has a total area of about 60 sq km. There are no elements of the National Environmental Network in the vicinity. It has been proposed to designate the area including Sveti Nikola, the Roussalka resort complex and Cape Kaliakra as a CORINE site, i.e. one of the most important sites for nature conservation in the Europe, under the name of “Kaliakra” and include it in the NATURA

2000 Network, which has not been regulated by law so far. The problem of the contact with the Kaliakra Reserve is discussed in detail in an EIA Report made up in connection with the planned change in the general structural plan of Kavarna Municipality for the purpose of constructing a wind farm on municipal land, for which there is a positive resolution of EEC of RIEW – Varna with No 1 – VN/2004 with investor YOMI ENGINEERING LTD.

The plot of land under consideration has been allocated under the operating territorial structural plan that targets farming and other compatible production activities. The wind energy production and farming are compatible activities and can be conducted without the creation of conflicts regarding the land use and the type of crops grown there up to now and after the implementation of the investment intention.

The location of the separate wind power sectors is shown on Figures 1 and 2. The already proceeded 7 nos. of generators (standpoint in conformity with ecological assessment No 1 – VN/2004 for coordination of “General Structural Plan and Detailed Structural Plan of Wind Power Plan in estates No 73 and no 80 on the territory of the village of Sveti Nikola, Municipality of Kavarna”) with Employer YOMI ENGINEERING LTD are not indicated in these figures and the investment intention does not include them.

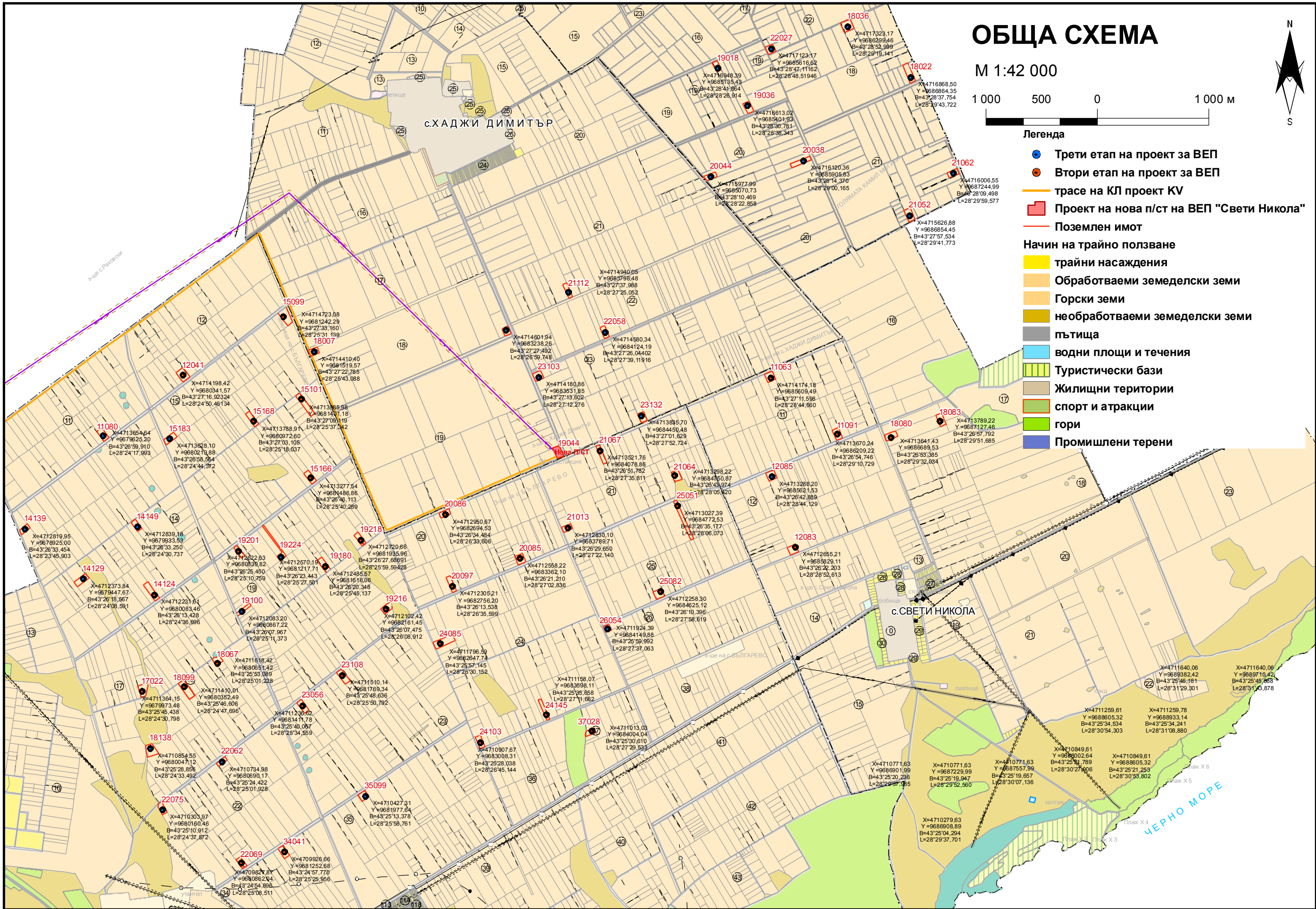
After performed preliminary balance sheet of the territory it was established that the implementation of the investment proposal will require about 12 ha or 0.15 per cent of the overall territory. The area needed for the construction of the sub-station is included in this area.

The land distribution plan shows the landed property earmarked for the project as farmland. The future land users will keep its initial use and a possibility will be sought in the detailed structural plans to change the use of a small area of cultivated land envisaging at the same time maximum reclamation of temporarily destroyed areas by subsequent recultivation. The investment intention will not impair the zoning or land use according to the approved Kavarna Municipality territorial structural plan.

It is envisaged that the construction works will be performed by taking into account the basic use of the land for farming purposes; the wind power generators will be installed during the inactive farming season. The phases of construction, subsequent exploitation, reclamation and closure will be all one-time ones, the purpose being to have a minimum built-up area. The exploitation maintenance of the facilities, which are modern technological machines, does not require additional or communicative areas. After the construction and installation works are completed, it is envisaged to cover the temporary roads and working sectors to be covered with a layer of soil and reclaim the land. This is possible because in general it is not part of the practice of constructing wind energy parks to build a permanent transport network for each of the energy generating facility. In this sense, it is not envisioned to build a new or change the existing road infrastructure for the realization of the investment proposal. All pieces of land chosen to install the facilities on have access to the existing farm roads.

Figure 1





ОБЩА СХЕМА

М 1:42 000



Легенда

- Трети етап на проект за ВЕП
- Втори етап на проект за ВЕП
- тресе на КЛ проект KV
- Проект на нова п/ст на ВЕП "Свети Никола"
- Поземлен имот
- Начин на трайно ползване
- трайни насаждения
- Обработваеми земеделски земи
- Горски земи
- необработваеми земеделски земи
- пътища
- водни площи и течения
- Туристически бази
- Жилищни територии
- спорт и атракции
- гори
- Промислени терени

Figure 2 - General scheme



1.3. Main characteristics of the production process

A wind power generator was chosen to implement the investment proposal, manufactured by the German company Re Power Systems, with about 10% market share¹. The rotors of the generators manufactured by the company, vary from 48.4m to 126.0 m. The height of the main corpus is from 59 m to 100 m, it is massive, compact, metal, cone-shaped, and depending on the height consists of 3 to 5 segments. Each segment is equipped with a platform and emergency lighting. The diameter of the first ring of the main corpus is 4,5 m. To secure the emergency access there is a door and a stair-case which, in case of bad weather, allows for the emergency access to the casing of the motor. The chosen model possesses the following characteristics²:

Table 1 Characteristics of the wind power generator MM82

No	Component	Parameters
1	Rated power	2 MW
2	Rotor	82 m
3	Number of blades	3
4	Rotation speed	8.5 – 17.1 rpm
5	Maximum power	23.3 rpm
6	Height of the pole	59 – 100 m
7	Working area	5281 m ²
8	Direction of rotation	Clockwise
9	Electrical system	690 V
10	Frequency	50 Hz
11	Control	PC modem, graphical interface
12	Weight of the blades	6 t
13	Hub	16 t
14	Casing of the rotor	60 t

¹ <http://www.repower.de/>

² <http://www.repower.de/typo3/fileadmin/download/producte/MM82-tech-uk.pdf>

This model is suitable for a variety of conditions and it could be mounted on land as well as in aquatories. For the foundation of the generators an area of 30/30 m must be provided.

The choice of the exact parameters of the generators (especially the height of the pole, which for the chosen model is 65, 95 or 114,50 m) depends on the results, obtained from the model investigations during the elaboration of the working project of the wind-energy park.

As for the ecologic considerations, the chosen model has the following advantages:

- No leakage of oils and lubricants due to the flat construction secured by additional pans (tanks);
- Closed system for greasing of the mechanisms;
- Protection of the operating staff by screening of all electric conductors;
- Lack of wind noises in the construction of the pole due to the chosen compact body (unlike the grid poles).

The generators possess a properly chosen system for protection and control. The control signals are transmitted by a fibro-optical cable for protection from electromagnetic fields. The multilayer coating in compliance with ISO12944 protects all parts of the generator from corrosion. The protection against lightning corresponds to the international standards IES 61021 – 1. All functions of the generator are controlled by a microprocessor system. The critical functions are monitored by an additional system of control and emergency break off.

In the substation to the wind park included in the investment proposal, dry transformers are to be used which excludes the eventual leaks of oils and lubricants.

The main activity connected with the investment proposal is the production of electric energy and its transition to the Kavarna substation, to be further included in the national electric power network for which the investor has come to the approval and the conclusion of a preliminary agreement with NEC No EP-528/June 24, 2005 (see Attachment IV)

The construction of the wind farm which is the subject of the present EIA Report concerns only the construction of the foundations and the installation of the towers, the rotors and the auxiliary devices for control and emergency break-off. The execution of the foundations will be monolithic, and ordinary concrete will be used. During the operation of the wind farm the resource of the wind potential will be mainly used. This is a natural resource of the territory chosen for the construction of the wind farm and this is the great benefit of its construction and exploitation.

The investment proposal foresees a minimum distance between the generators of 500 m, and a maximum distance of 2,0 km. The nearest new generator will be 1,0 km far from the village of Bulgarevo and 3,0 km far from the rock edge. The nearest wind farm owned by others is at a distance of about 6,0 km. There the installation of 33 wind generators was planned on an area of 2 500 000 m². The distance to the nearest road is 600 m.

The investment proposal includes the construction of a substation to which the produced by the separate generators electric energy will be transmitted by ground cables of 20 kV. The substation will be constructed on an area of 6 000 000 m² with built-up area

of 4 500 000 m². The respective installations and the control room will be located in the substation, and a fence is to be built up around the site. No water pipes to the site of the substation have been planned. The substation will be operated by two operators. Mineral water will be provided for drinking and for sanitary purposes water will be supplied in water tanks. No sewer system is to be built and there will be no toilets so the detailed design must solve the problem with the sanitary wastes and the waste water generated by the operation of the personnel (chemical toilets and/or cess-pit).

From the substation the electric power is to be transmitted by an air cable 110 kV to the Kavarna substation.

The investor has signed a contract with the NEC on joining the national electric power network with the produced energy of about 130 MW (Attachment IV).

The investment proposal will be implemented in stages, and the construction of the wind farm will be in two stages as follows:

- **First stage** – construction of a substation, electric power network and 30 wind generators with installed capacity of 60 MW in 2006 – 2007
- **Second stage** – construction of 30 wind generators with installed capacity of 60 MW in 2007 – 2008.

The implementation of the investment proposal does not include the construction of a new and the change of the existing road infrastructure. The property on which the equipment will be mounted was chosen with an access to the existing third class roads.

The method of the construction is installation and the foundation is to be monolithically executed.

1.4. Information about the territory, chosen for the construction

The territory chosen for the implementation of the investment proposal “Construction of a wind farm on the community land of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Kavarna Municipality”, is in the north-eastern part of the Republic of Bulgaria. The municipality of Kavarna is located in the Dobrich region and its territory is 48.3 km². Within its borders there are 21 towns and villages and according to the latest census, its population consists of 18 285 people, which represents about 2% of the population of the Dobrich region. The area of the municipality is 480 865 000 m², which is about 0.43% from the territory of the country.

The road network of the municipality includes 121,4 km, 24,2 km of which are first-class roads. The international highway E87 crosses the territory of the municipality.

The protected territories within the borders of the municipality of Kavarna are the natural reserve “Kaliakra” with an area of 697, 5 ha and the protected territory “Taukliman” with an area of 89, 5 ha. The significance of these protected territories is international due to the existence of rare and threatened with extinction types of vegetation, animals and birds. Via Pontica crosses the Dobrich region which should be taken into account upon elaborating the EIA report and which to a certain extent makes the task of the EIA experts more complex.

The national archeological reserve “Yailata” is located at the border of the Kavarna and Shabla municipalities, with an area of 90 ha and guarded territory of 182 ha. It contains cultural monuments from the Vth century BC and a restored fortress from the Vth – Vith century. According to the preliminary investigations, areas related to the cultural and historical heritage belong to the chosen territory, subject of the evaluation.

The zones determined as protected, sanitary – guarded or belonging to the NATURA network according to the Bulgarian legislation and the EU directives, definitely do not fall into the region of implementation of the investment proposal.

Figure 2 presents the plots of land on which the wind generators will be allocated. With letter No 47-22 PSK – 467 from May 8, 2006 of the Ministry of Health, the sanitary hygienic distances of the wind generators to the residential areas - 500 m (see Attachment III) were presented for co-ordination.

Third class roads cross the area of the wind farm. Their dimensions and traffic are such that allow the use of the roads for the purposes of the installation activities.

The municipality of Kavarna is power supplied from the SS “Balchik” with 110 V. On the territory of the future wind farm there are poles for 110 V which have been installed but whose construction is not complete yet and they still lack equipment. The design of the power lines through the territory will take account of this fact.

2. Alternatives for the possible ways of achieving the goals of the investment proposal

2.1. Evaluation of the alternatives concerning the location of the wind farm

The location of the separate sites in the region was presented in the attached maps (Figure 2). The territory concerned by the investment proposal includes 60 km². On the basis of a preliminary balance of the territory it was established that the implementation of the investment proposal will utilize 12 ha or 0.15% of the whole area.

The analysis of the evaluation of the impact on the environment of the location of the wind generators will be based upon the following considerations:

- permissible distances between the wind generators;
- the migration route of the birds Via Pontica;
- the preservation of the variety of the vegetation on the said territory;
- the non-problematic addition of the wind generators into the land shaft.

2.2. Evaluation of the alternatives of the impact on the environment, including the “zero alternative”

The discussed investment proposal for the construction of a wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, all in the municipality of Kavarna includes the installation of 30 at the first stage, and at a later stage – of 32 more wind generators, manufactured by the German company Re Power Systems, each with the rated power of 2 MW, on an area outside any protected zones (natural reserves, buffer zones, objects of architectural, cultural and historical heritage, residential areas, resorts, etc.). The produced energy will be included into the national electric power distribution network. The potential of the territory will be used for the production of electric energy from an alternative renewable source – the wind. This is in compliance with the energy policy of the country and the modern trends of steady development.

One of the most significant characteristics of the investment proposal for the construction of a wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, all in the municipality of Kavarna, is the production of electric energy from a renewable source. It is typical for these sources that their

utilization does not result in exhausting the earth's natural resources like petroleum, coal, etc., and does not lead to the accumulation of harmful wastes like in the Nuclear power stations and the Thermal power stations. It is in this respect that the investment proposal complies with the energy strategy of the Republic of Bulgaria.

It is of special significance to review the specific characteristics of the ecological impact of the production of electric energy by the wind generators, in order to assess the alternatives of the EIE. This was done in a number of papers. Some of them are the summaries elaborated for the EU in the publications "Wind power – the facts", published under the ALTENER programme in 1999 and 2004 in Brussels.

Figure 3 presents the CO₂ emissions in the production of electric energy by different technologies.

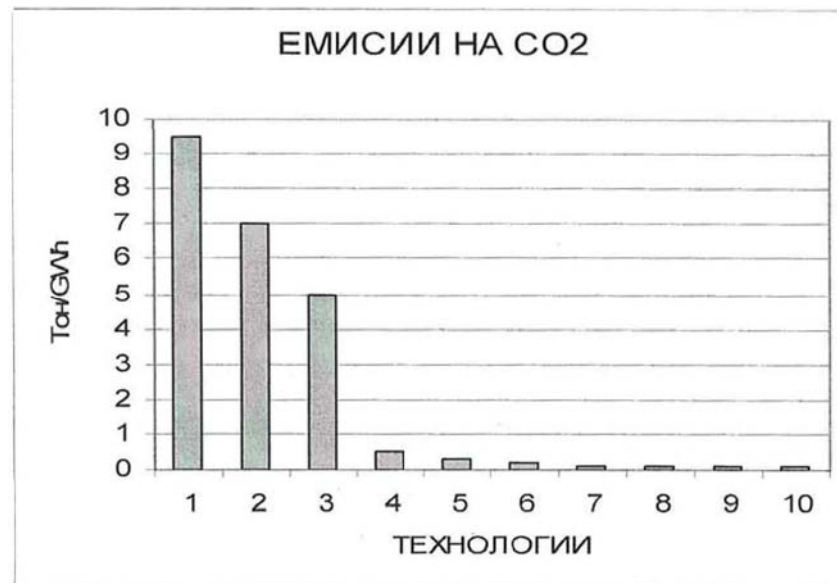


Figure 3: CO₂ emissions in f different technologies.

1 – Thermal power plant (TPP) – coal; 2 – TPP – mazut; 3 – TPP – natural gas; 4 – geothermal; 5 –Water power plant (WPP) – small one; 6 – Nuclear power plant (NPP); 7 – Wind power plant; 8 – WPP – big one; 9 – solar thermal

It could be observed that the use of wind power for the production of electric energy does not generate any CO₂ emissions as well as such of other green house gases unlike the classical technologies.

The effect of the wind generators on the loss of birds is presented in Figure 4, compared with other technologies and activities – bird hunting, electric power transmission lines, traffic. It could be seen that the effect of the wind generators on the loss of birds is many times smaller than that of the other activities.

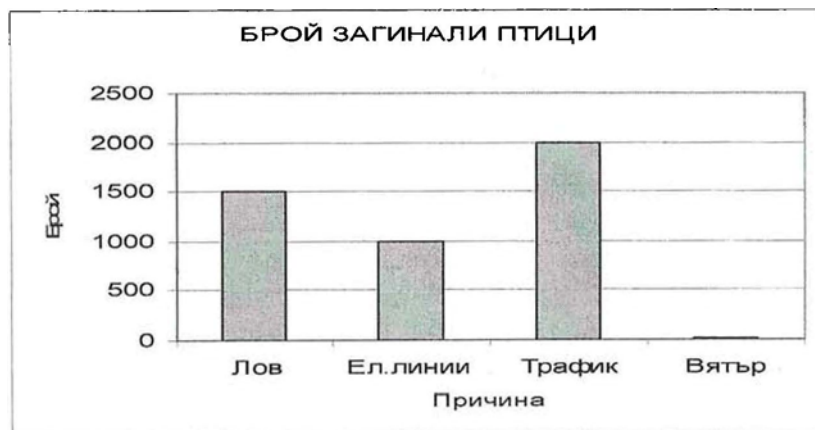


Figure 4: Average annual number of lost birds for different reasons

X-axis – cause: hunting, power transmission lines, traffic, wind; Y-axis – number

Another problem of considerable ecological significance is that of the area , necessary for the production of 1 GW of electric power by the different technologies (Figure 5). Here the necessary territory is several times smaller than the territory necessary for the classical technologies, as well as that for the other technologies based on the utilization of renewable energy sources.

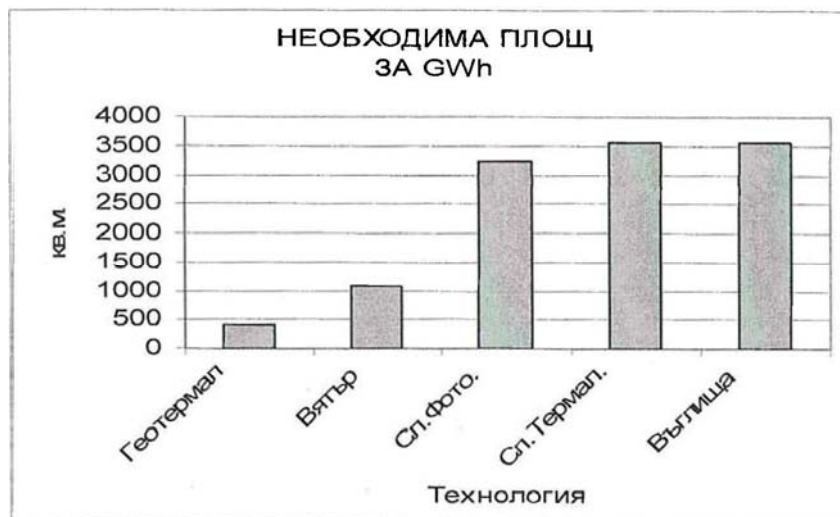


Figure 5: Area required for the production of 1 GW

X-axis – Technology: geothermal. wind, solar photo, solar thermal, coal

Y-axis - m²

The social price of the production of electric energy by different technologies (wind, using 600 and 100 kW generators, coal and gas) is presented in Figure 6 with examples from Denmark. If the price for the energy produced by the wind generators is about 4 EUR Cents/kWh, that for the energy produces by coal is 10 EUR Cents/kWh, and by natural gas – 6,3 EUR Cents/kWh.



Figure 6: Social price of the different technologies

X-axis – technology: 600 kW wind generators, 1MW wind generators, coal, gas

Y – axis – Euro Cents/kWh

On the basis of these characteristics of the production of electric energy by the renewable source wind and from the analysis of the impact on the different components of the environment resulting from the implementation of the investment proposal (item 3 of the EIE report), it could be stated, that the impact of the site of the proposal on the environment could be various. It is for that reason that in the EIE report these effects were evaluated only on the basis of the short-term observations and investigations. On the other side, every site of similar nature and scale is important for its novelty and uniqueness. The latter is related to the utilization of renewable energy sources, one of the important points in the energy policy of the Republic of Bulgaria. The observations of the performance of the wind generators will supply specific information concerning the impact of similar objects on the affected environmental components, discussed in details in the EIE report. The results from these observations will supply objective information on the results of the utilization of wind power complexes and will be useful in the development of further long-term prognostications of the impact of objects of similar type on the environment.

The evaluation of the positive and negative effects of the investment proposal on the environment as well as the possible alternatives concerning the impact on the environment, were made from ecological and economical point of view.

The economical aspect of the investment proposal is undoubtedly favourable - it will assist in the utilization of the natural resource the wind in the region, where the investment proposal was planned to be implemented, and will have a significant contribution in the energy supply of the population in the region. In this respect the following should be noticed again:

- the use of the energy of the wind for the production of electric power unlike the classical technologies does not generate any CO₂ emissions nor such of other green house gases;
- the number of the birds lost in the operation of the wind generators, is many times smaller than the number of the birds killed by the traffic, the hunting and the transmission lines;
- concerning the area used for the production of 1 GWh electric energy the wind generators have an advantage over the classical technologies. When several times smaller territory is to be used for the production of 1 GWh energy by the

wind generators, larger territories will be preserved and used for their main purposes;

- 60 wind generators will be located on 60 km². On the basis of a preliminary territorial balance it was established that the implementation of the investment proposal will require about 12 ha or 15% of the total area;
- the natural resource of the territory in question is comparatively good;
- the climate of the region is characterized by good repeatability of the days with suitable conditions, which in the warm seasons amount to 85% of the days, which means 70% from all the days in the year. This is a favourable factor both for the development of tourism and for living conditions of the permanent population in the region;
- the area foreseen in the investment proposal for the location of the wind power generators includes no industrial enterprises and the soils are not polluted. The only source of pollution is the non-regular depots in the close vicinity of the region of the wind farm.

The forecast for positive ecological changes as a result of the construction of a wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna, includes the following:

- optimal preservation of the environment and of all the significant natural and cultural protected objects in the area and its vicinity;
- preservation of the comfort of the population, both permanent and temporary visitors and passengers;
- improvement of certain components of the land shaft like vegetation, surface of the roads, destructed during the construction, depots on the territory of the wind farm, etc.

According to the experts who have elaborated the respective parts of the EIE report, the influence of each of these factors is insignificant, because the necessary distances to the town of Kavarna and the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo were observed as well as from the protected territories and the archeological objects (the natural reserve Kaliakra and the archeological reserve Yaylata). Due to the insignificant effect of each of the factors, no cumulative effect should be expected. Of course, in comparison with the "Zero alternative" the environment will be affected to a certain, though small, extent. Having in mind, however, the social and economical significance of the used renewable natural source – the wind, the energy strategy of Bulgaria and the latest trends of steady development, this insignificant impact on the environment could be neglected.

As for the alternatives for the production of energy from renewable sources (WPP, bio-mass, solar energy) it could be pointed out that these are unacceptable for the region with its renewable natural resource the wind. The investigations, performed by GEO POWER Ltd on the territory of Bulgaria and the annual measurement of the winds' parameters , and the possibility to combine the two activities – the agricultural and the production of energy, determine the optimal efficiency of the investment proposal.

3. Description and analysis of the components and the factors of the environment and the material and cultural heritage, forecast on and evaluation of the expected impacts on the components of the environment affected by the implementation of the investment proposal

This part of the report determines the natural characteristics of the separate sites for the installation of the wind generators from the standpoint of the location and the existing environmental conditions, the presence of protected territories, reserves and cultural – historical objects. The expected significant effects on the population and the environment were described and evaluated as results from the following:

- the implementation of the investment proposal;
- the use of natural resources;
- the emissions of harmful substances during the normal operation and in case of accidents, the waste generation and the generation of discomfort to the population.

3.1. Ambient air

3.1.1. Evaluation of the air quality by available and updated data

The region of the wind farm where the 62 wind generators (type Re Power Systems – 2 MW) will be located as well as the transmission lines for 20 kV and 110 kV and a substation 20/110, includes territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna. It is near the Black Sea and the cape Kaliakra.

The investment proposal will be implemented in two stages (30 and 32 wind generators) and includes 60 m². After the elaborated preliminary balance of the area, it was established, that 12 ha or 0,15% of the whole territory will be used for the purpose. The generators closest to the residential areas shall be 1 km from the village of Bulgarevo and 3 km from the sea shore. There will be no visual contact with the resorts. The terrain is 100 – 150 m above the sea level.

There are no permanent points on the territory of the municipality for determining the air quality and that is why no data are published in the bulletins of the MOEW – Executive Agency of Environment.

During incidental control measurements by the Regional Inspectorate for Control and Preservation of Public Health and the RIOEW, no pollution of the air, exceeding the permissible limits, has been established. There are no big industrial sources of harmful emissions in the region. It is for that reason that no systematic monitoring of the air quality was recommended.

The monitoring of the ambient air on the territory of the municipality is performed by the mobile station for emission control of the RIOEW – Varna. In a point in the centre of the town the following pollutants are being controlled: SO₂, CO₂, NO, fine dust particles (with dimensions below 10 microns), CO, ozone.

The data from the measurements for the period 1998 – 2002 from this point were used for the purposes of the Program for the preservation of the environment in the municipality of Kavarna, elaborated in compliance with the requirements of the Environment protection act, approved with a resolution by the Municipal council of Kavarna.

Parallel to the said measurements, the meteorological conditions in the near the surface atmospheric layer are also being measured in the same point -the direction and the

velocity of the wind, the atmospheric pressure, the temperature of the air, the sunshine and the air moisture.

The analysis of the accumulated data by types of pollutants shows the following:

Sulphur dioxide

The average 24 hour concentration in 1998 for the warm period was below the permissible limit values (PLV) and in the cold season exceeded the PLV 1.6 times. In 2001 and 2002 it was below the PLV.

During the whole period of measurement, the average annual concentrations were significantly below the PLV.

Nitrogen dioxide

The data show that for the whole period of measurement the average 24 hour concentration and the maximum measured concentrations were considerably below the PLV. The levels of the average annual concentrations vary within a very narrow interval and were also considerably below the permissible concentrations. For the whole period mentioned the background level was comparatively low for the pollution with NO₂.

The observed slow seasonal dynamics is an indication of the effect of the motor vehicles during the warm season.

Nitrogen oxide

The data show that for the whole period of measurement the background pollution with NO is comparatively low.

Fine dust particles (FDP) 10

The monitoring of the FDP in the ambient air shows that the average 24 hour concentrations were below the PLV for the period 2001 – 2002. The maximum individual concentrations were considerably higher than the average 24 hour limit. In the cold season of 2001 the latter was exceeded 1.3 times, and in the warm season – 1.5 times. In 2002 the measurements were performed only during the warm season and these showed emissions of 1.4 times above the PLV.

The high emissions during the cold season could be attributed to the means of household heating with coal and wood in the town of Kavarna, and for the warm season – to the traffic and the repeated suspension of the dust from the roads. The bad state of the roads and the agro-technical treatment of the soil also contribute to the increase of these emissions, as well as another specific for the region phenomenon – the dry winds. It is in this aspect that the preservation and the enlargement of the wind-shelter belts in the municipality is extremely important.

The data for the average annual concentrations of the FDP 10 show higher values in 2001 – 60.7 µg/m³ (1.3 times higher than the PLV). In 2002 the average annual concentrations were 42.2 µg/m³ which is lower in comparison with the previous year and is about the PLV (average annual limit + permissible deviation = 45 µg/m³). This could be due to the change in the relative share of the factors mentioned above.

Carbon monoxide

It is characteristic for this pollutant that its concentrations are low and vary within a narrow interval, remaining below the PLV for the whole period. A certain dynamics of the values was observed, the latter being higher in the cold months. This is mainly due to the fuels used for heating during the cold season.

Ozone

The ozone was measured as a secondary pollutant resulting from photo-chemical reactions of volatile organic compounds (VOC), nitrogen oxides and CO in the presence of UV solar radiation.

The results show that the average 24 hour concentrations for 1998 varied a little below the PLV – 100 $\mu\text{g}/\text{m}^3$ for the summer, and for the winter were considerably below PLV. During the following years a regular decrease in the concentrations was measured, remaining below the PLV.

The data for the average annual concentrations show that the pollution with ozone for the whole period was below the PLV, the highest values being for 1998, with a decrease during the following years.

The presented results lead to the conclusion that at this stage the ozone is not a problematic factor in the pollution of the ambient air in Kavarna.

The concentrations of the air pollutants were compared to the PLV with the permissible deviations in compliance with Ordinance No 8 on the PLV for ozone in the atmospheric air and Ordinance No 9 on the PLV for sulphur dioxide, nitrogen dioxide, fine dust particles and lead in the atmospheric air in the residential areas.

The air basin in the region of Kavarna is comparatively poorly loaded. Due to the long distance from the site chosen for the construction of the wind farm on the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo (about 7 km) to the point of measurement, and taking into account the low concentrations of pollutants and the meteorological parameters, it could be concluded that no transmission of emitted substances could be expected to and from the site.

On the basis of the performed monitoring it could be accepted that the background pollution of the ambient air in the municipality, including the future site, is insignificant.

3.1.2. Existing sources of pollution – traffic, industry, agriculture, combustion installations, natural sources

The emissions of harmful substances to the ambient air, which form its quality in the region of the town of Kavarna, are due to the traffic flow, the combustion installations in the households and in the administrative sector, and to the specific for the region agricultural activity, farming mainly. The industry is poorly developed and the existing small companies are insignificant sources of pollution of the ambient air.

The main sources of pollution of the air in the region of the future site are the dry winds, the traffic on the roads with direction Bulgarevo – Kamen bryag – Kavarna – Hadji Dimitar.

The influence of the household activities as sources of harmful emissions in the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo is insignificant.

There are no natural sources of pollution. The farm areas present an temporary source of dust emissions under certain meteorological conditions.

3.1.3. Treatment installations, points of control and measurement

In the region of the future part there are no installations for treatment of harmful emissions, discharged into the air. The only aeration is the air one. No treatment facilities were planned for the diffuse dust and gas emissions during the construction of the wind farm. No emissions are expected to be generated during its operation.

The town of Kavarna has no stationary point of the National automatic system for environmental monitoring of the MOEW. The periodical monitoring of the quality of the ambient air is being performed by mobile laboratories of the Executive Agency of Environment – the MOEW.

3.1.4. Determining the risk zones

Due to the insignificant loading of the air basin in the municipality and in the region of the site, the small number of sources of pollution local by nature, most of which do not exceed the PLV, no risk zones were determined and no risk zones should be determined concerning the ambient air.

3.1.5. Forecast on and evaluation of the expected changes in the quality of the ambient air (the pollution of the ambient air) including the layer nearest to the surface, territory of the zones of air pollution

The investigated territory where the site of the Wind farm is to be located includes the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo. This is the end eastern part of the Danubian plane in the southern part of the Dobrudja plateau.

The relief of the site is hilly, determined by the geological structure, the vicinity of the sea and the exogenous processes connected with the latter. Concerning the height above the sea level, the terrain remains within the interval of 100 – 150 m.

The expected transmission of air pollutants from the site to the nearby villages and the Roussalka resort during the construction of the site, could be qualified as insignificant, due to the long enough distance and the favourable land shaft characteristics.

The implementation of the investment proposal is not expected to lead to a decrease in the air quality in the region of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo and in the town of Kavarna, resulting from air transition of pollutants to and from the site.

There are no point sources of emissions of air pollutants in the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo.

The production of electric energy by wind generators is not related to any generation and discharge of harmful substances into the ambient air.

The wind generators as installations for the production of electric energy affect each other by the distribution of turbulence of the rotor. That is why a certain distance between every two of them should be observed. This depends of the predominating direction of the wind, the relief and the diameter of the rotor.

The main flow of the traffic passes along the first class road Shabla – Kavarna – Obrochishte – Varna. Due to the long distance from the site to that road, and the characteristic winds for the region, its impact on the environment and the site is insignificant.

During the implementation of the investment proposal, that is the construction activities, the background pollution with dust emissions is expected to increase as a result of the groundworks on the site. The piles of soil, resulting from the excavations for the foundations, will be stored on the site itself and will be used in its recultivation after the construction.

The analysis of the General Structural Plan of the town of Kavarna shows that the planned partial change of the functions within the borders of the mentioned areas will result in insignificant changes in the quality of the ambient air.

Diffuse sources

A) During the construction

The planned construction and installation works in the investment proposal include transportation of materials and equipment, excavation works, storage of excavated material on the site. The transportation of the construction materials and equipment will be along the roads Kavarna – Hadji Dimitar – the site and Kavarna - Sveti Nikola – the site.

The excavation works will lead to the generation of dust. The dust concentration depends on the soil, the use of construction mechanization, the intensity of the activities and other factors. This pollution is local in character and is within the site. The practice has shown that in dry weather, fine structure of the soil, and other aggravating factors, the maximum concentration near the surface could exceed the PLV, but the scope of this impact is minimal, short term and insignificant. These emissions will be temporary in character and their generation will stop at the end of the construction.

The operation of the construction and loading mechanization will lead to the emission of used gases from the motors – nitrogen and sulphur oxides, carbon oxide, hydrocarbons, etc. In case of improper forcing of the machines more considerable discharges could be expected, but these are only incidental, which could be eliminated by organizational measures.

The total volume of the excavations included in the project is 560 m³ on each site and of the excavated material – 700 m³.

The expert evaluation expects an annual consumption of diesel fuel about 22.4 t for the excavation, the temporary storing of the excavated materials on the site of each generator and the re-cultivation of the land. This value was calculated on the basis of 1 excavator Liebherr – 12 l/h (for productivity 30 m³/h excavated soil) and 1 bulldozer – 10 l/h, for 140 days. The exposition of the dust and gas pollution (emissions from mobile sources) is temporary and lasts until the construction of sites of the generators.

The quantities of the harmful substances from mobile sources were calculated according to the “Method of calculation by balance for the emissions of harmful substances (pollutants) discharged into the ambient air” – CHEB code – 94 070300 and are presented in the following Table 2:

Table 2: Quantities of harmful emissions from mobile sources

No	Pollutants	Emission factor EF	Total annual emissions, kg	24 hour emissions, kg
1	NOx	42,7 – kg/Mg - fuel	956,48	2,62
2	VOC	8,16 - kg/Mg - fuel	182,8	0,50
3	CH4	0,25 - kg/Mg - fuel -	5,6	0,015
4	CO	34,2 - kg/Mg - fuel	776,08	2,09
5	CO2	3238 - kg/Mg - fuel	72531	198,7
6	N2O	0,12 - kg/Mg - fuel	2,69	0,007
7	Soot	4,6 - kg/Mg - fuel	103,04	0,28
8	SO2	4 – kg/Mg - fuel	89,6	0,24
9	Cd	0,01 - kg/Mg - fuel	0,224	0,0006

The calculated quantities of the emissions according to the approved method are insignificant and are not regulated by the legislation in force at present.

The small scope of the pollution and its short-term existence by the objects are the basis for the forecast on the expected insignificant impact of the installation and construction works on the air quality.

B) During the operation

The operation of the wind power generators is not connected to any pollution of the ambient air. There are no diffuse emissions.

The operation will be controlled from a remote point of control. The movement of the vehicles in the region of the site will be reduced to a minimum.

There are no point sources of emissions.

The climatic and meteorological factors are not characterized by parameters leading to unfavourable conditions for the air pollution by the site.

3.1.6. Emissions which will exert a significant impact on the environment, evaluated by character and significance, sensitivity, effect on the climate, etc.

The emissions resulting from the implementation of the investment proposal could be ignored as small. Their impact on the air quality is temporary and their territorial scope during the construction is insignificant. No impact on the climate could be expected.

3.1.7. Forecast on the impact on the air quality establishing the territorial scope of the existing impact in compliance with the approved method

The territorial scope of the emissions generated during the construction, is insignificant. No emissions of harmful substances to the air are expected during the operation.

Consequently, no impact on the air could be expected and no territorial scope could be calculated.

3.1.8. Components of the environment, on which the changes in the ambient air and the climate will exert considerable significance

There are no changes in the air and the climate, which could lead to significant changes of the components of the environment.

The environmental effect of the production of electric energy by using the energy of the wind should be pointed out in comparison with the classical technologies in the TPPs.

The performed investigations have established that for the production of electric energy with power 120 MW/h 40 000 Nm³/h of natural gas would be necessary, or 960 000 Nm³/day whose combustion will discharge into the ambient air the following pollutants, presented in Tables 3, 4 and 5.

The quantities of the harmful substances from mobile sources were calculated in compliance with “Method of calculation by balance for the emissions of harmful substances (pollutants) discharged into the ambient air” – CHEB code – 94 030102.

This shows that the implementation of the investment proposal would “spare” these emissions to the environment.

Table 3: Pollutants discharged into the ambient air during the combustion of natural gas

No	Pollutants	Emission factor EF, g/GJ	Total annual emissions, mg	24 hour emissions, mg
1	NO _x	60	714,67	1,958
2	VOC	2,5	29,78	0,0816
3	CH ₄	2,5	29,78	0,0816
4	CO	20	238	0,652
5	CO ₂	55800	664778	1821
6	N ₂ O	3,0	35,77	0,098

Table 4: Pollutants discharged into the ambient air during the combustion of natural gas

No	Pollutants	Emission factor EF, g/Nm ³	Total annual emissions, g	24 hour emissions, g
1	Mercury (Hg)	5.10 -6	1752	4,8

Table 5: Pollutants discharged into the ambient air during the combustion of natural gas

Pollutants	Emission factor EF, µg/Mg	Total annual emissions, mg	24 hour emissions, mg
Dioxins and furans	0,5	134	0,367

Globally speaking, the investment proposal for the construction of wind farm on the territory of the municipality of Kavarna with installed power of 120 MW is expected to contribute to the reduction of the emissions of dust, carbon and nitrogen oxides into the ambient air as a result of replacing the energy production from gas and solid fuel in the country.

3.1.9. Evaluation of the impact on the ambient air with respect to the regulations and standards on the permissible limit values, in force in the country at present

The site is not a source of polluting emissions from stationary sources and cannot be a subject for evaluation according to the regulation on the permissible emissions of harmful substances into the ambient air from stationary sources – Ordinance No 2 from 1998 on the limit emissions (concentrations in waste gases) of harmful substances, discharged into the ambient air from stationary sources (SG No 51, 1998).

The discharged smoke (emissions from mobile sources) by the mechanization and the transport in the course of the construction of the park is still not regulated by legislation in force at present.

The construction and the operation of the wind farm on the territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo are not expected to result in any changes in the quality of the ambient air and respectively the other components and factors of the environment.

The impact of the site and the activities of its construction, planned in the investment proposal, on the component Ambient air, was analyzed and evaluated both for the period of construction of the site and the period of its operation.

3.2. Climate

3.2.1. Physical and geographical characteristics of the region of the wind farm

the investigated region includes the territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna. The terrain is a plane with a small inclination from the west to the east and from the south to the north. The height above the sea level is about 100 m and its decreases to several meters near the sea shore to the east and the north.

The region according to the climatic classification, is located in the Climatic region the northern Black sea coast of the Black sea climatic area of the Continental – Mediterranean climatic sub-area. This is a narrow strip of land by the sea coast, from the Rumanian border to the north to the cape Emine to the south. The winter and the spring are cool and cold with strong winds, the summer is warm to hot and the autumn is long and warm.

The closest meteorological station in the region is near the cape Kaliakra and for this reason we shall further use the available information in the station to characterize the climate in the investigated region, covering 10 – 20 km to the north and the north-west from the meteorological station. Cape Kaliakra is a representative station due to the open and plane relief of the region and the results could be used for the area of the wind farm.

The infrastructure of the region is well developed – there are transmission lines, roads for the transportation of the turbines. There are also forest shelter belts built up for the protection of the farms from the strong winds and the wind erosion of the soil. The location of the generators has to take account of the location of these belts and this is especially important for the well developed belts, with compact vegetation and big height over the

land. Practically the region of the wind farm is open to the wind from the north, east and south.

The remnants from shelter belts with the characteristics of the land affect the regime of the wind, its direction and velocity, especially near to the surface, deforming them according to the laws of hydrodynamics.

3.2.2. Analysis of the climatic parameters

the main parameters of the climate at the Kaliakra station for the period 1991 – 2002 are presented below. They are compared with the former investigation period (1931 – 1970) and are included in the Climatic reference book for the peoples republic of Bulgaria, Vol. 1 “Solar radiation and sunshine” , Vol 2 “Humidity of the air, fog, horizontal visibility, cloudiness, snow cover”, Vol.3 “Temperature of the air, temperature of the soil, frost”, Vol. 4 “Wind”, Vol.5 “Rainfall and snowfall in Bulgaria”, and the monograph “The climate of Bulgaria”.

Sunshine regime

Table 6: Month and annual period of sun shining, hours

Month Period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	annual
1991 – 2001	86	116	147	185	278	319	362	325	224	150	99	79	2370,7
1961 - 1970	80	85	124	173	235	293	338	316	241	178	94	70	2227,0



Figure 7: Annual trend for the sun shining

Y – axis – hours

Cape Kaliakra, period of sun shining

The average multi-annual value for the shining of the sun in Kaliakra for the period 1991 – 2001 is 2370,7 hours (Table 6 and Figure 7). The shining of the sun in the region is highest in the summer and in July reaches 362 hours, and is the least in winter, getting down to 79 hours. For the last ten years the shining of the sun has increased by 6% in comparison with the former period (1961 – 1970).

Cloudiness regime

Table 7 Month and annual values for the cloudiness, tenths

Month Period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	annual
1991 – 2001	6,8	5,7	6,2	6,0	5,1	4,1	2,8	2,9	4,2	5,7	6,4	7,0	5,3
1961 – 1970	7,2	7,3	7,2	6,3	5,8	4,4	3,0	2,8	4,1	5,5	7,2	7,5	5,7

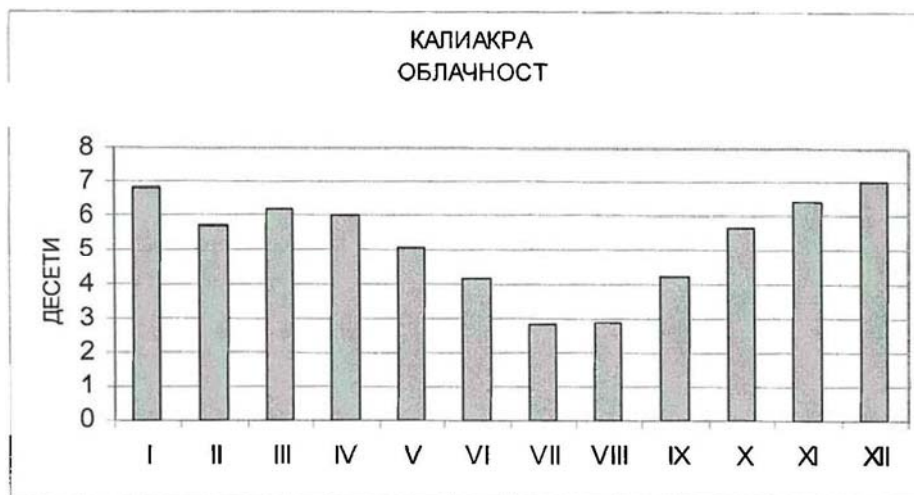


Figure 8: Annual trend for the cloudiness

Y – axis – tenths ; Cape Kaliakra, cloudiness

The average multi-annual value for the cloudiness in Kaliakra is 5,3 tenths (Table 7 and Figure 8) and it is the biggest in the cold six months (6-8 bala) and the smallest in the warm six months (3 – 5 bala). The same has decreased by 7% in comparison with the former period (1931 – 1970).

Air temperature regime

Table 8: Average month and annual temperature of the air (°C)

Month Period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	annual
1991 – 2001	2,4	3,2	5,3	9,7	15,3	20,2	22,9	23,1	18,9	14,3	8,4	3,8	12,3
1961 - 1970	0,8	2,2	4,3	9,0	14,6	19,6	22,3	22,5	18,9	14,2	9,4	4,4	11,8

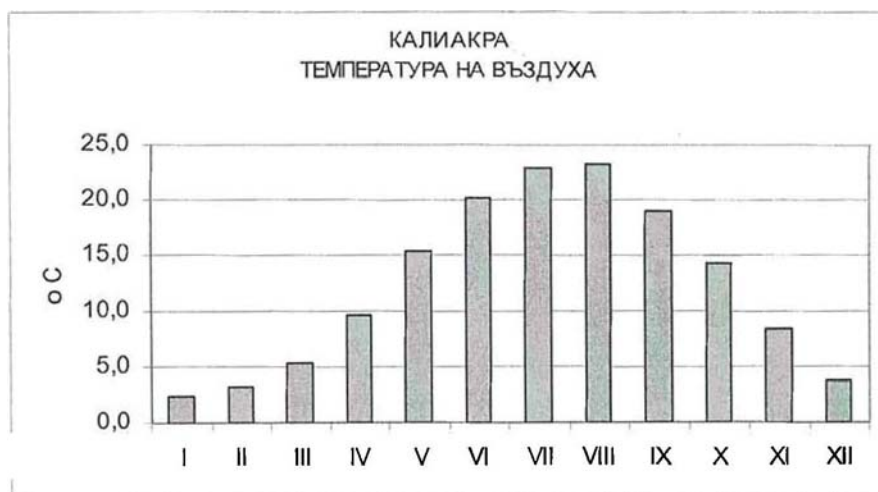


Figure 9: Annual trend for the temperature of the air

Kaliakra, Air temperature

The average multi-annual value of the temperature being 12,3°C, it is the highest in July and August reaching 23°C (average) and decreasing to 3,2°C in winter. In the course of the years the temperature of the air has increased by 4% in comparison with the period 1931 – 1970 (Table 8 and Figure 9).

Relative humidity

Table 9: Average month and annual relative humidity of the air, %

Month Period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	annual
1991 – 2001	81,0	77,1	78,2	80,6	76,5	74,8	72,2	71,5	72,8	76,6	78,1	81,0	76,7
1961 - 1970	85	84	84	83	84	79	74	73	75	79	84	85	83



Figure 10 Annual trend for the humidity of the air

Kaliakra, relative humidity

The relative humidity of the air in a multi-annual aspect is 76,7 % and changes from 85% in winter to 70% in summer. This is about 8% decrease of the humidity in comparison with the former period.

Rainfall and snowfall

The monthly distribution of the falls is presented in the next Table 10 and Figure 11. The average multi-annual value being 396,3 mm, the well expressed maximum is in September (60 mm) and there are two minimums in summer and winter.

The most drastic decrease in the quantity of the falls is in the last decade - with about 4% in comparison with the former period, the decrease being the greatest in the winter period – 22% (Table 10 and 11 and Figure 12).

Table 10 Seasonal sum of the falls, mm

Season Period	Winter	Spring	Summer	Autumn
1991 - 2001	87,0	91,1	81,8	136,3
1931 - 1985	112	89	86	124

Table 11: Month and annual sum of the falls, mm

Month Period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	annual
1991 – 2001	26,4	23,1	30,2	38,7	22,2	26,9	24,9	30,0	60,4	25,9	50,0	37,5	396,3
1961 - 1970	38	32	24	30	34	40	25	22	30	42	53	42	411,0

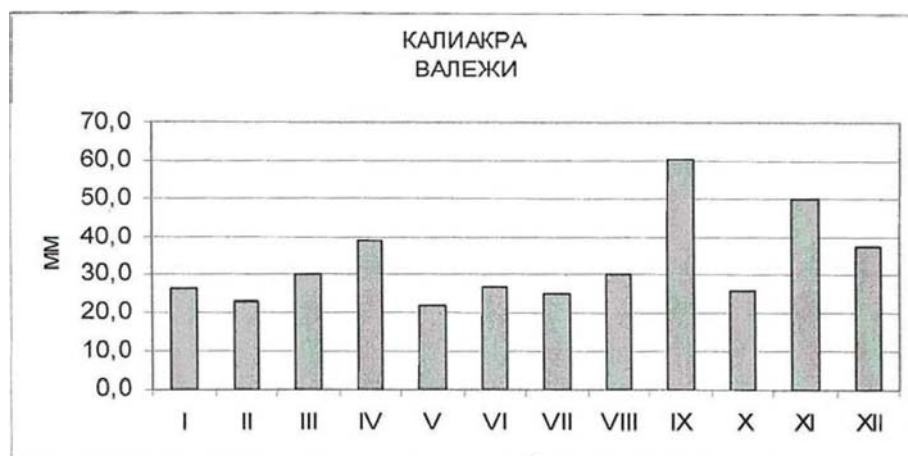


Figure 11: Annual trend for the rainfall and the snowfall

Kaliakra, falls

3.2.3. Climate of the wind

Predominating direction of the wind

The predominating direction of the wind at a certain place means the direction where the wind most often blows from. It is calculated for each direction as a % and the sum for all directions should be 100%. The frequency of observation is shown on the Y-axis of the

figures, and the directions are presented in degrees, like sectors of the horizon (Figures 12 – 14).

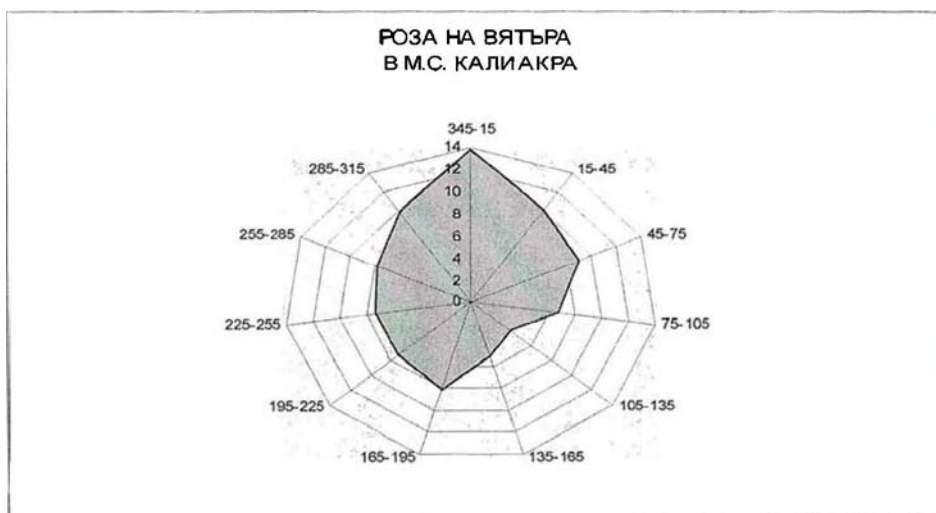


Figure 12 : Wind rose in the region of Cape Kaliakra
Wind rose at Kaliakra meteorological station



Figure 13 : Wind rose in the region of the wind farm

The predominating direction of the wind in the region of the wind farm is from the northern part of the horizon (Figure 13) and from the north it reaches 10 – 13%, similar to the region of Kaliakra, and from the east and west it decreases to 7 – 8%. From the south the frequency of the expected winds is about 8%. Unlike the former rose (Figure 12), the northeastern component here is better expressed.

Figure 14 presents the predominating direction of the wind and the direction of the energy – bearing winds for the region of the villages of Sveti Nikola and Rakovski, at the height of 60 m over the terrain. The direction of the energy – bearing winds (Figure 14) in the region of the wind farm is from the north and the north-west and practically these directions

coincide with those of the predominating wind. A certain difference could be observed in the east and south directions.

The north-eastern directions (sector 15 – 45 degrees) and the northwestern directions (sector 285 – 315 degrees) of the energy bearing winds in the region of the wind farm near the village of Rakovski are dominating with maximum values, 16,6% for the first and 13,5% for the second direction, at a height of 36-55 m above the ground. With the increase in height the part of the north-eastern direction decreased by several % at the expense of the others, especially the northwestern one.

Wind speed

Wind speed is determined by the value of the baric gradient. Its dependence on the character of the surface beneath is great.

The velocity of the wind in the region of Kaliakra (Table 12 and Figure 15) is the highest in winter and spring when it reaches 6,5 – 8 m/sec, and is the lowest in the summer and autumn – less than 5 m/sec. The average multi-annual velocity of the wind in Kaliakra has decreased on the average by 10% for the last decade in comparison with the period to 1970., the decrease being the greatest for the winter. In the region of the meteorological station at the level of the wind meter the buildings of the military outfit are an obstacle which reduces the velocity of the wind from the south of the horizon with about 10 – 15%.

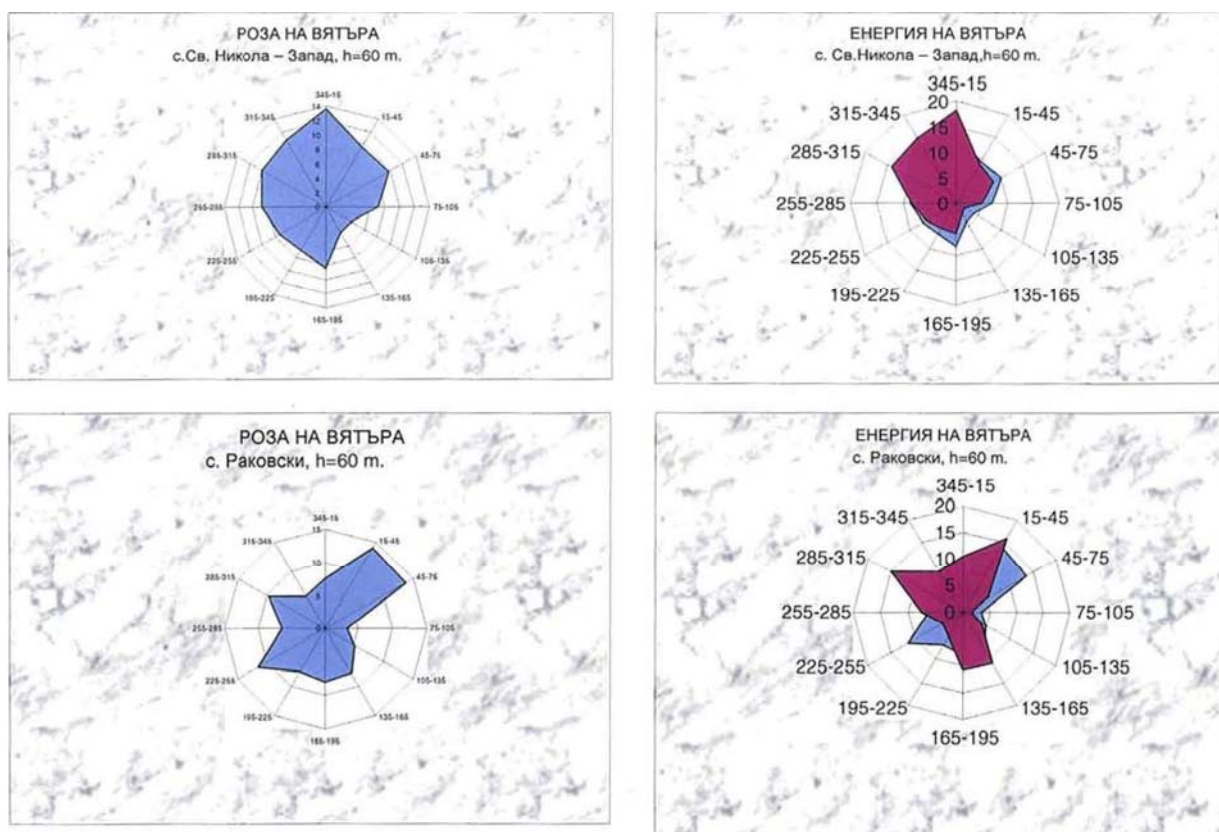


Figure 14: Predominating direction of the wind and direction of the energy bearing winds in the region of the wind farm near the villages of Sveti Nikola and Rakovski at the height of 60 m above the ground.

On the figure:

Wind rose, village of Sveti Nikola, west, h = 60 m (upper left)

Energy of the winds, village of Sveti Nikola, west, h = 60 m. (upper right)

Wind rose, village of Rakovski, h=60 m (lower left)

Energy of the winds, village of Rakovski, h = 60 m. (lower right)

Table 12: Average month and annual velocity of the wind in the meteorological station Kaliakra (m/sec)

Month Period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	annual
1991 – 2001	6,2	6,3	6,3	5,0	4,8	4,7	4,8	4,9	6,1	6,1	6,5	8,1	5,8
1961 - 1970	8,5	8,3	7,0	5,4	5,2	4,8	5,5	5,8	6,7	7,0	7,6	8,0	6,7



Figure 15: Annual wind speed trend (m/sec)

Figure 16 presents the average month velocities of the wind determined for the region of the wind farm at the village of Rakovski at the height of 50 m. It could be seen that the average velocity of the wind is the highest in the cold months (December – February, with velocities of 7,4 – 7,9 m/sec.) and the lowest in the warm months (June – August, with velocities of 5,8 – 6,1 m/sec).

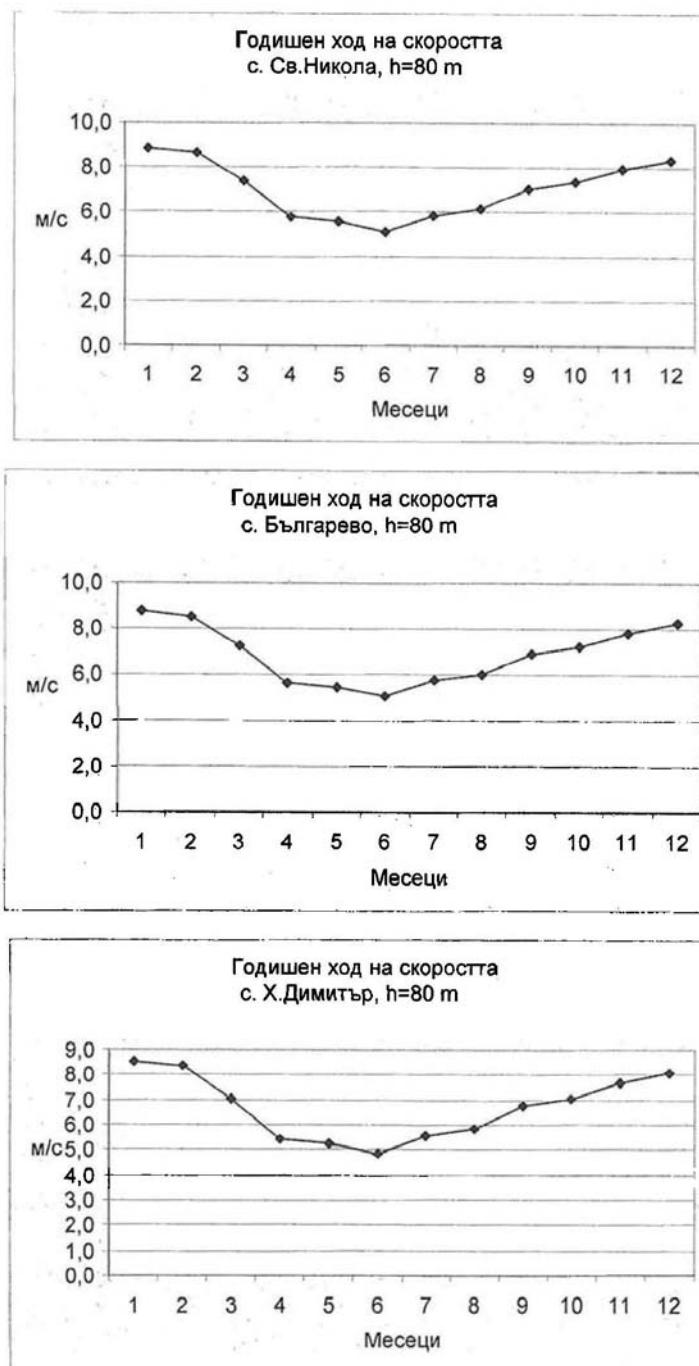


Figure 16: Annual trend of the velocity of the wind in several points of the investigated region, 80 m high above the ground

In the region of the wind farm in the villages of Sveti Nikola, Bulgarevo and Hadji Dimitar the velocity of the wind was studied at the level of the blades of the turbine (80 m) and it

appeared to be respectively 7.0 m/s, 6.9 m/s, and 6.7 m/s. The annual trend of the wind velocity in these areas is presented in Figure 16. Here we would like to notice, that for the more detailed determination of the parameters of the wind in the investigated region it is necessary to perform special observations on the direction and the velocity of the wind by means of specialized apparatus, installed on a mast and at the height of 30 - 50 m above the ground.

Figure 17 presents the number of hours in a year with different wind velocities for the height of 60, 80 and 100 m. It could be observed that with the increase of the wind as a whole the number of the hours decreases as well. On the other side, the increase of the height results in an increase of the velocity of the winds.

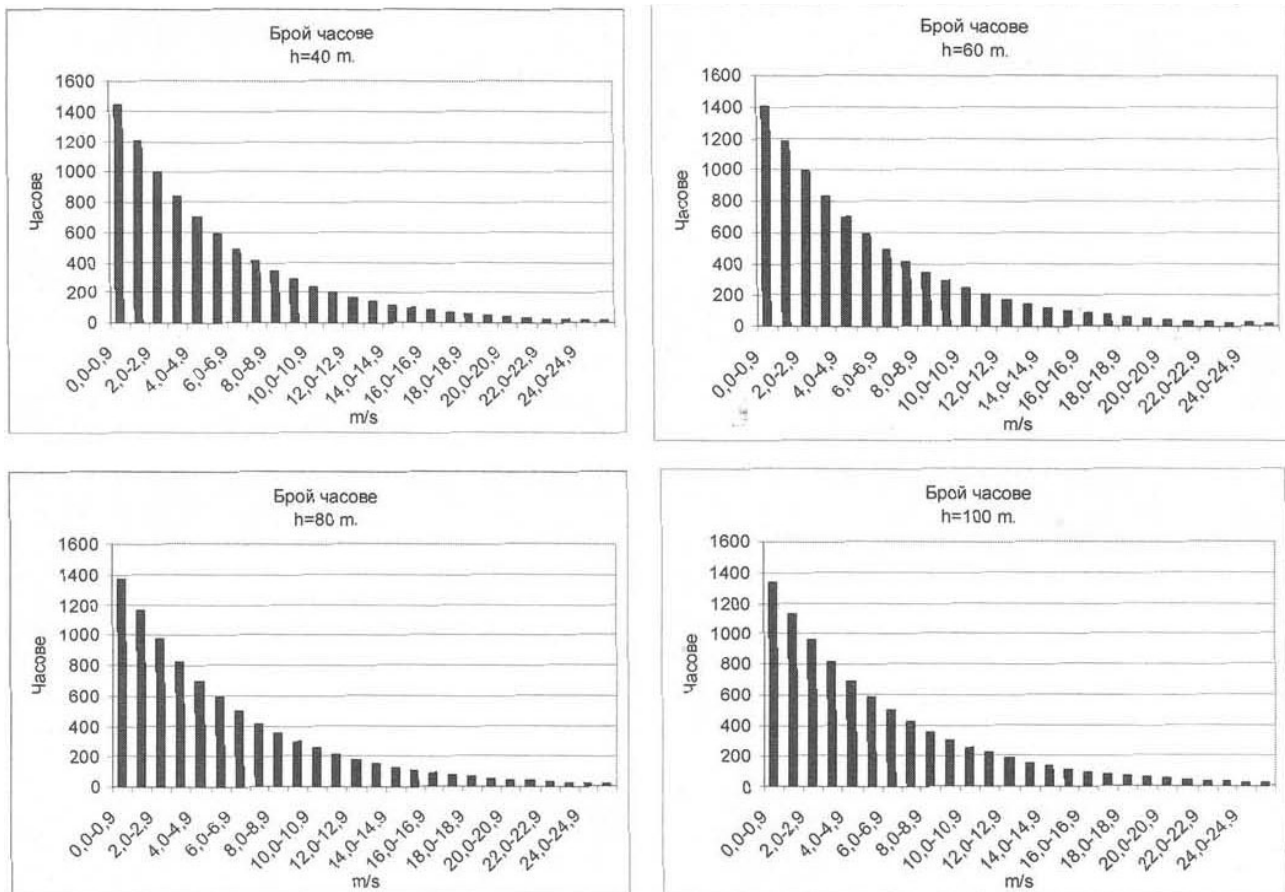


Figure 17: Number of hours with different velocities of the wind, determined for different heights above the ground.

The Y –axis - hours

Let us review in greater detail the profiles of the wind velocities and the flow density.

Figure 18 presents graphically the change in the velocity of the wind with the height in the region of the wind farm near the villages of Sveti Nikola, Bulgarevo and Hadji Dimitar. It could be seen that with the change of the height above the ground the velocity of the wind increases from 6.2 m/s to 7.3 m/s for the village of Sv.Nikola, from 6.4 m/s to 7.1 m/s for the village of Bulgarevo and from 6.7 m/s to 6.9 m/s for the region of Hadji Dimitar, for heights from 30m to 100 m. This is a manifestation of the effect of the topography near the surface, where in a hilly area the velocity increases as well as the turbulence of the air flow.

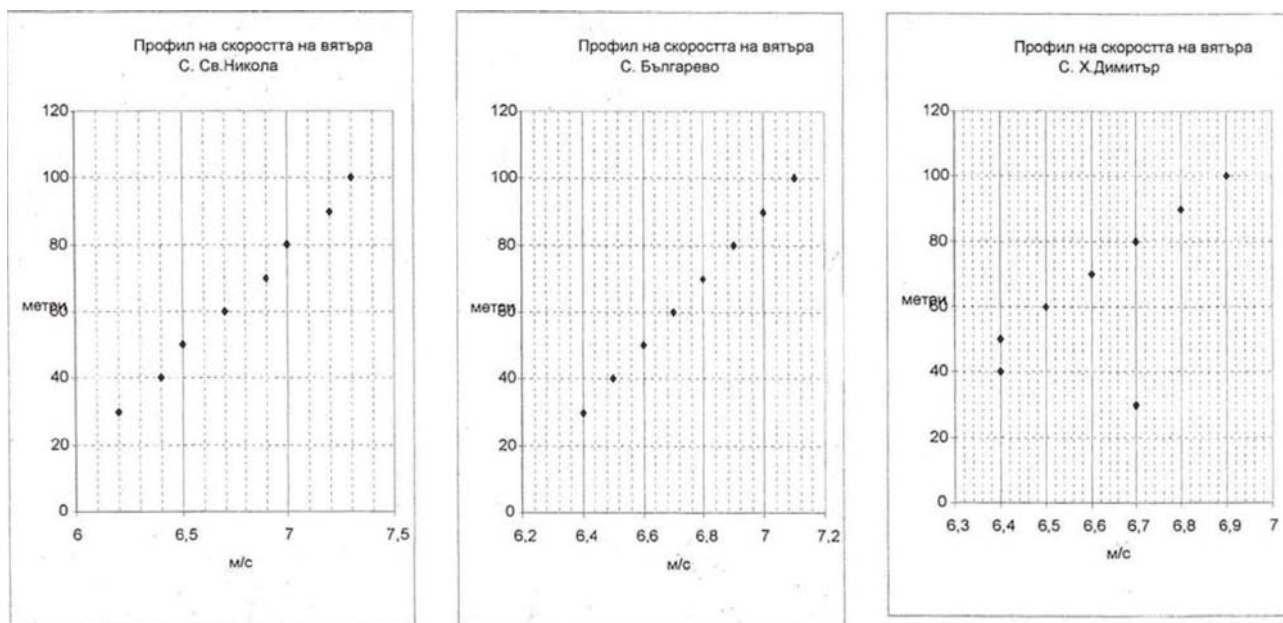


Figure 18: dependence of the wind velocity on the height above the ground in the investigated region

In the figure:

Wind speed profile in the region of Sv.Nikola

Wind speed profile in the region of Bulgarevo

Wind speed profile in the region Hadji Dimitar

This fact is still better expressed and illustrated in the next Figure 19, where the change of the density of the air flow with the height above the ground is presented for the same points and heights. So from 30 to 100 m the density changes from 562 W/m² to 794 W/m² for the region of Sveti Nikola, from 610 W/m² to 729 W/m² for the region of Bulgarevo and from 760 W/m² to 651 W/m² for the region of Hadji Dimitar. It is remarkable that with the increase of the distance from the shore (for instance, the village of Hadji Dimitar) the influence of the relief manifests itself more markedly on the velocity and the density, which are higher near the surface (Figures 18 and 19).

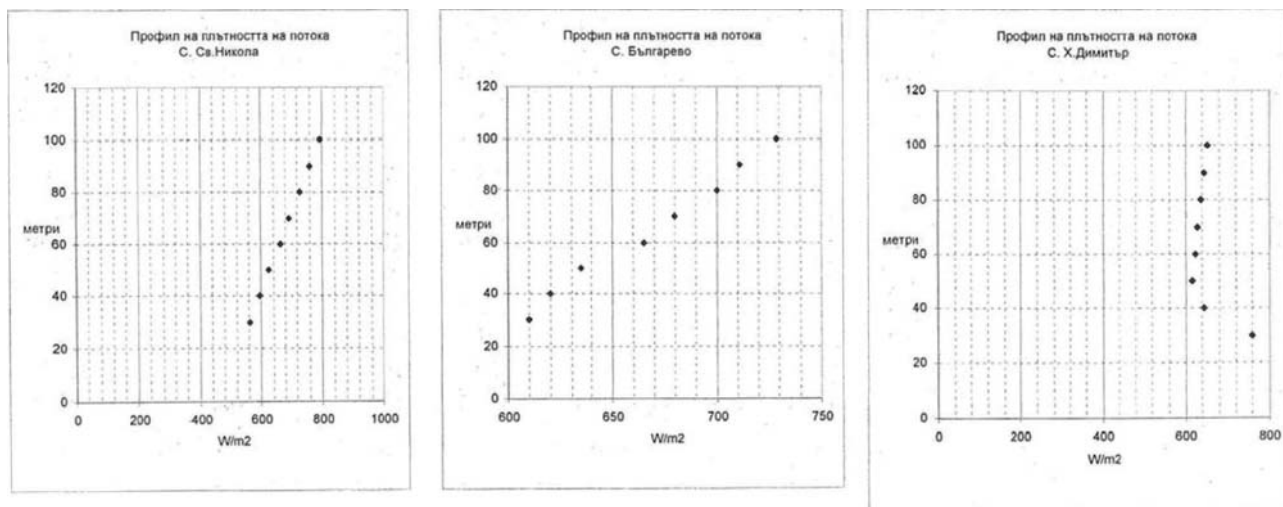


Figure 19: Dependence of the power of the air flow on the height above the ground in the region of the investigations.

In the Figure:

Profile of the power of the wind in the region of Sv.Nikola

Profile of the power of the wind in the region of Bulgarevo

Profile of the power of the wind in the region Hadji Dimitar

Dependence of the power of the turbine re Power Systems – 200 kW on the velocity of the wind

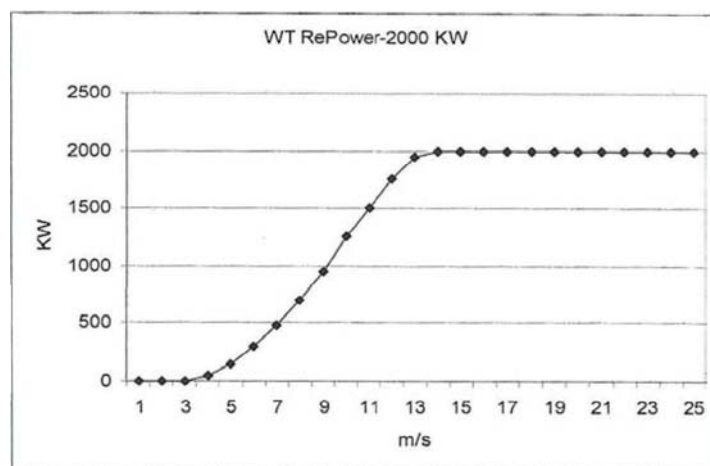


Figure 20: dependence of the power of the turbine re Power Systems – 200 kW on the velocity of the wind

Figure 20 presents the dependence of the power of the turbine Re Power Systems – 200 kW on the velocity of the wind. It could be seen that it starts operating at 3 m/s, it reaches its rated power at 14 m/s and it stops at 25 m/s. A characteristic feature of the turbine is the preservation of its power upon reaching the maximum speed of 25 m/s.

Dependence of the produced electric energy on the velocity of the wind

The next Figure 21 presents the dependence of the expected amount of electric energy on the velocity of the wind by Re Power Systems 200 kW for representative parts of the investigates region. It could be observed that the production is strongly dependent both on the turbine's parameters and the frequency distribution of the velocity of the wind. So a generator of the type Re Power Systems 200 kW will produce the largest amount of electric energy, about 400 000 kWh, at 10 – 15 m/s for the region of the villages Sveti Nikola and Bulgarevo, and below that value for the region of Hadji Dimitar.

Despite the fact that the turbine exhibits a steady and lasting preservation of its power after reaching its rated value (Figure 16), the amount of the produced energy decreases (Figure 21) because of the reduction of the hours with higher velocities (Figure 17).

Table 13 and Figure 22 present the production of electric energy by Re Power Systems 200 kW at 80 m above the ground, determined for various parts of the investigated region. The data show that the largest production could be expected near the sea shore where the velocity of the wind at the level of the axis of the blades is the highest and the percentage of the hours with higher velocities is also higher. So Re Power Systems 200 kW in the

region of Bulgarevo would produce 2% , and in the region of Hadji Dimitar – 7% less energy than that produced in the region of Sveti Nikola.

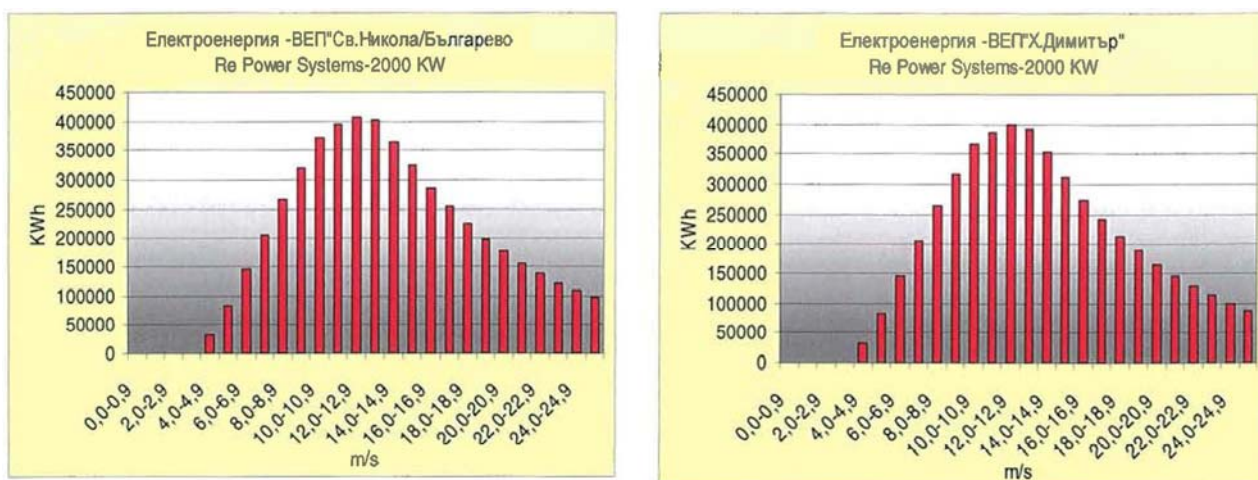


Figure 21: Dependence of the produced amount of electric energy by Re Power Systems 200 kW in the region of the wind farm near the villages of Sveti Nikola, Bulgarevo and Hadji Dimitar.

Table 13: Dependence of the velocity of the wind, the density of the air flow and the amount of produced energy by Re Power Systems 200 kW on the location of the generators (80 m above the ground)

Point	V, m/s	E, W/m ²	MWh/Yr
Sveti Nikola	7,0	727	5247
Bulgarevo	6,9	700	5140
Hadji Dimitar	6,7	637	4884

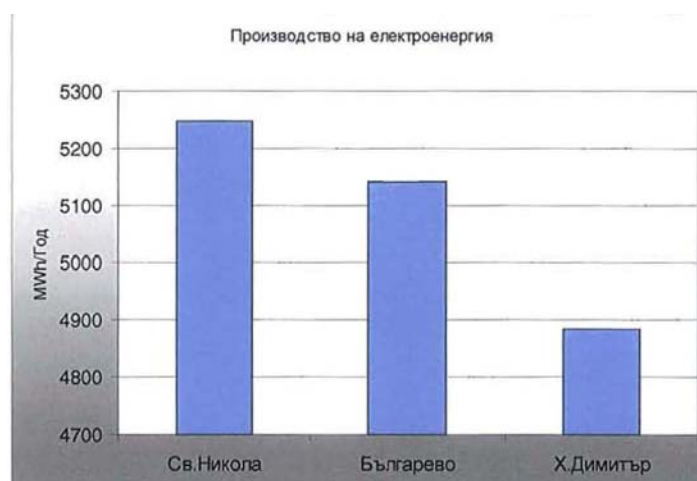


Figure 22: Production of electric energy by Re Power Systems 200 kW for the level of 80 m above the ground in different locations within the investigated region

In the Figure:

Production of electric energy - X-axis – Sv.Nikola, Bulgarevo, Hadji Dimitar; Y-axis – MWh/yr

The next Figure 22 presents the annual trend for the produced amount of electric energy by Re Power Systems 200 kW, from which it follows that 31,1% of the annual production could be expected in the winter (December – February), 22,1% - in the spring (March – May), 20,2% in the summer (June – August) and 26,7% in the autumn (September – November). So 57,8% of the energy could be produced in the cold season when the consumption of electric energy in Bulgaria is the highest, and the rest - in the other seasons.

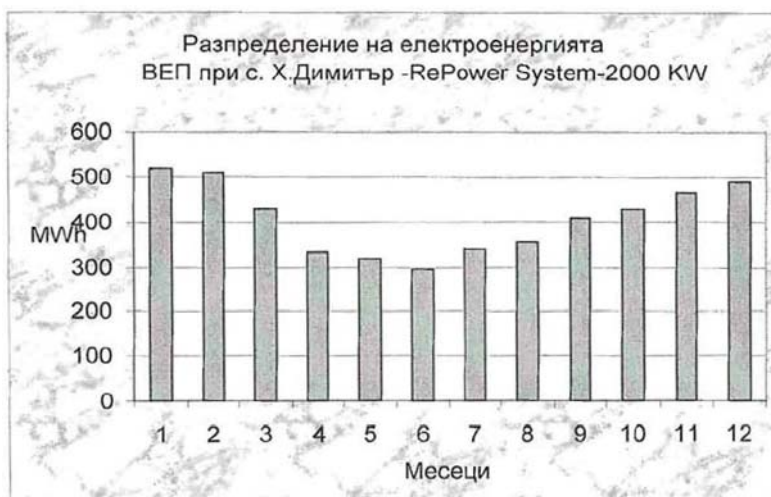
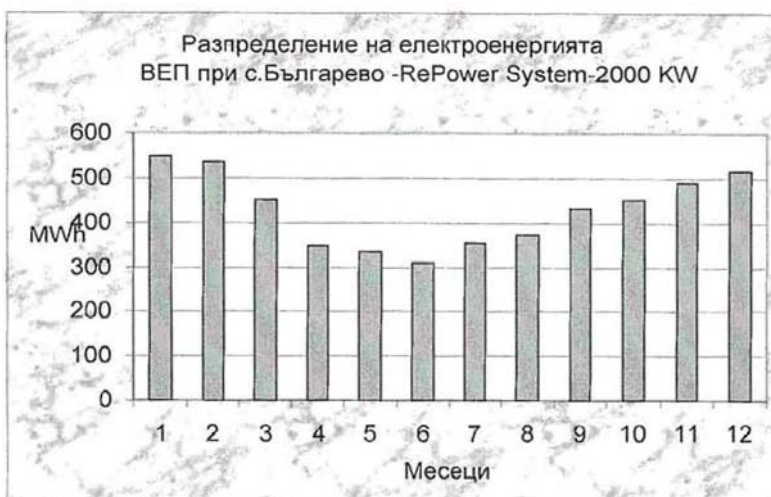
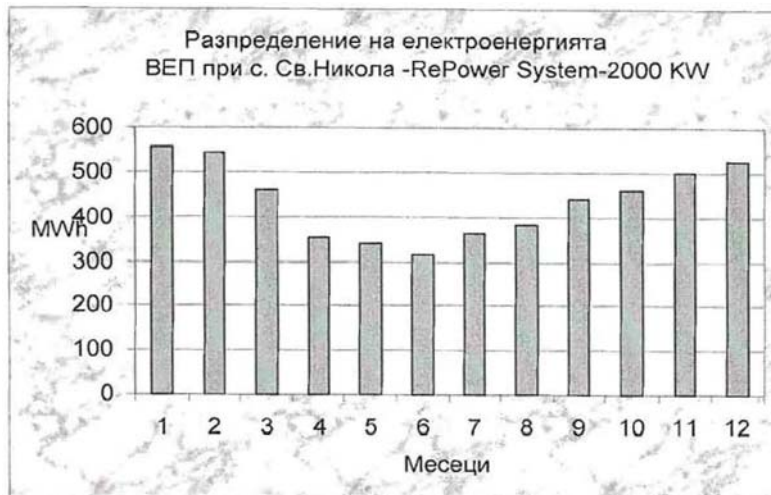


Figure 23: Annual trend of the produced electric energy

In the figure:

Distribution of the electric energy from the wind farm at Sv. Nikola - Re Power Systems 200 kW

Distribution of the electric energy from the wind farm at Bulgarevo - Re Power Systems 200 kW

Distribution of the electric energy from the wind farm at Hadji Dimitar - Re Power Systems 200 kW

Y – axis – MWh

X – axis

- months

3.2.4. Loading of the technical equipment by the wind

Installations like the wind generators are given dimensions taking into account the wind load. This is important for the dimensions of the structure and ensures their reliable operation.

Table 14 and Figure 24 present the maximum wind velocities which are probable once in 5, 10, 20, 30 and 50 years at a height of 10 m/s above the ground at 2 and 10 minute interval of taking the average of the velocity. It could be seen that these velocities change from 42 m/s to 51 m/s for the 2 and from 32 m/s to 39 m/s for the 10 minute interval of taking the average values.

Table 14: Annual maximal probable velocities of the wind with repeatability once in N years (m/s) , cape Kaliakra

Period, years	5	10	20	30	50
2 min	42	45	48	49	54
10 min	32	34	36	37	41



Figure 24: Maximal velocities of the wind with repeatability once in 50 years at 2 min and 10 min interval of taking the average value of the velocity

In the figure: Maximal velocities of the wind with repeatability once in 50 years at 2 min and 10 min interval of taking the average value of the velocity

Table 15 presents the maximal probable velocities of the wind (m/s) in the region of Kaliakra for the main geographical directions and the respective loads in kN/m² for the level of the wind meter. It could be seen that both the velocities of the wind and the loads are distributed anisotropically with regard to the geographical directions. They are the highest from the west reaching 54 m/s for the 2 min. and 41 m/s for the 10 min. interval of calculating the average value, and 1,788 kN/m² for the first and 1,018 kN/m² for the second interval. The lowest values are for the southwest direction. These results are representative for the investigated region as well.

Table 15: Maximal probable velocities of the wind (m/s), and wind loads (kN/m²) with repeatability of once in 50 years for the different directions, cape Kaliakra

	N	NE	E	SE	S	SW	W	NW
V, 2min, (m/s)	44	43	42	41	36	34	54	44
V, 10min, (m/s)	34	33	32	31	28	26	41	34
Q, 2min, kN/m ²	1,181	1,133	1,081	1,030	0,794	0,709	1,788	1,187
Q, 10min, kN/m ²	0,691	0,662	0,633	0,605	0,475	0,427	1,018	0,691

The above discussion on the climatic characteristics of the region where the investment proposal is to be implemented, subject of the present EIE report, leads to the following generalization: the investigated region proposed for the installation of 62 wind generators, type Re Power Systems – 2000 kW, covers the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chunchevo, the municipality of Kavarna and is characterized by the following climatic conditions:

- the average multi-annual values of the shining of the sun in the region of the park amount to 2370 hours in a year;
- the average multi-annual value of the cloudiness is about 5 tenths;
- the average multi-annual value of the temperature of the air is about 12°C;
- the relative humidity of the air is 77% from a multi-annual aspect;
- the average multi-annual value of the falls -s 396 mm;
- the predominating direction of the wind is from the north quarter of the horizon, and it reaches 10-13% from the north, decreasing from the east and the west to 7 – 8%. The north-eastern and the southeastern directions of the energy bearing winds in the region of the park are predominating. With the increase in the height above the ground the share of the north-eastern direction decreases with several % and the others increase;
- the velocity of the wind in the region of the park with the height above the ground increases from 6,2 m/s to 7,3 m/s in the region of Sveti Nikola, from 6,4 m/s to 7,1 m/s for the region of the village of Bulgarevo and from 6,7 m/s to 6,9 m/s for the region of the village of Hadji Dimitar for heights from 30m to 100 m. this is a manifestation of the influence of the topography of the surface, where in the hilly terrain the velocity of the wind increases as well as the turbulence of the air flow;

- changes in the climate have been observed in the investigated region for the last decade, included in the reference book on the climate, resulting from the global climatic changes, manifested mostly in the temperature of the air and the amount of the rainfall and the snowfall. These changes influence the other parameters like shining of the sun, relative humidity, velocity of the wind;
- the production of electric energy by the Re Power Systems – 2000 kW at the level of 80 m above the ground determined for the various parts of the investigated region, shows that the largest production could be expected in the region near the sea shore, where the velocity of the wind at the level of the axis of the blades is higher and the share of the hours of greater velocity is also greater. So the Re Power Systems – 2000 kW in the region of the village of Bulgarevo will produce 2 %, and in the region of Hadji Dimitar – 7% less than the production in the region of the village of Sveti Nikola.

3.2.5. Forecast on and evaluation of the eventual impacts on the environment

The construction and the operation of the wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chunchevo, the municipality of Kavarna, will not generate emissions which could affect the climate. The production of electric energy by wind generators is environmentally friendly. It is in this respect that it is not possible and it is not necessary to make forecast of the climatic changes and look for the territorial scope of a certain impact. The climate in the area of the wind farm will not change as a result of the implementation of the investment proposal and that is why no analysis is necessary of the environmental components and the effect of the climatic changes on them. It is for the same reason impossible to make a forecast on the effect of the climatic changes on objects and equipment which already exist or which are about to be constructed.

3.3. Surface and ground water

3.3.1. Surface water

The investment proposal for the construction of a wind farm covers an area of 60 km² on the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chunchevo, the municipality of Kavarna, the Dobrich region. In hydrological aspect this area is classified to the Black sea basin, hydrological sub-groups B-III-b and B-III –c of the Hydrological division of the country into regions. Due to the karst structure of the area the surface water, formed predominantly by the falls and karst springs, runs off quickly because of the natural inclination towards the sea. There are running water sources in the gullies and the ravines mainly during the falls and the snow melting. The snow falls form a smaller share in the total falls and respectively in the formed by them running water.

The investigated territory is dedicated to farming and other production activities on a family scale, according to the existing territorial-lay out. The properties on which wind farm is to be constructed, are agricultural lands in the plan of the land distribution. No procedure has been foreseen by now of changing the purpose of these lands. Annual plants are being planted at present.

There is a river running across the area of the wind farm and its close vicinity. Since the terrain consists mostly of agricultural lands, the surface water is readily absorbed or, in

case of saturation, runs off to the gullies. The water is arbitrary clean and it is not a pollutant of the final water receiver – the Black sea. The module of the annual run off from this area is 0,5 l/s.km². Due to the character of the installations which do not consume water, no additional qualitative and quantitative evaluations are necessary of the water resources on the territory of the site.

3.3.2. Potable water

The region where the wind farm is to be located is supplied with water from the ground water. The potable water is supplied through drill wells by pump stations to the residential areas chlorinated without any treatment. The territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chunchevo belong to the Kavarna water supply group. The pump station Bolata sends the water to the villages of Bulgarevo and Sveti Nikola and the Roussalka resort. The water pipes to the village of Sveti Nikola is included into the group at the distribution water pool above the resort. The asbestos cement pipes were replaced by black plastic pipes with diameter 200 mm. The pump station Gorun was constructed to assist the water supply of the villages Hadji Dimitar, Pourochik Chunchevo, Kamen Bryag, Gorun and Tyulenovo. The water from the two wells with bunker pump stations is sent to the water source of the main station. The quality of the potable water is controlled by the Regional Inspectorate for Preservation and Control of Public Health – Dobrich.

No water pipes cross the area planned for the construction of the wind farm (data from the Water and sewage company – Dobrich). No protected sanitary hygienic zones and guarded areas according to the Bulgarian legislation exist on the territory allocated for the implementation of the investment proposal.

The technology of the operation of the wind generators foresees complete automatic operation so no water will be necessary for drinking and sanitary purposes. So there will be no need for the construction of a water supply pipework. Water will be needed only during the construction of the foundations and the erection of the poles. The foundations will be constructed by ready concrete solution from the nearest concrete producing s\center and for the workers mineral water will be supplied in tanks.

During the operation of the wind generators the personnel; of the substation shall be supplied with water for drinking and for sanitary purposes. Mineral water will be supplied for drinking.

3.3.3. Waste water

The wind farm is located on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chunchevo, the municipality of Kavarna. There is no sewer system in the villages and no treatment equipment for the waste water. The treatment of the waste water is by cess-pits. The Roussalka resort possesses a sewer system and a treatment installation, but there are no data on the stage of treatment of the waste water.

At present the project does not foresee any water consumers and consequently no waste water is expected to be generated during the operation.

3.3.4. Quality characteristics of the potable water and the waste water

The potable water is supplied to the residential areas from the drill wells and the pump stations without any treatment. According to Ordinance No 9 from 2001 on the quality of the water for drinking and sanitary purposes (SG, no 30 from 2001), the water for drinking purposes of the municipality of Kavarna is subjected only to chlorination.

The quality of the potable water is controlled by the Regional Inspectorate for Preservation and Control of Public Health - Dobrich. Periodically sampling is performed at the pump stations, the private water sources and the consumers. The samples are analyzed by:

- some physical and chemical parameters – odour, colour, taste, transparency, pH, oxidizability, ammonia, nitrites, nitrates, chlorides, etc.;
- some microbiological parameters – total number of microorganisms and coli forms.

According to the investment proposal, there is no generation of waste water on the territory of the wind farm so there is no sense in the study of the quality of the waste water and the permissible concentrations of harmful and dangerous substances in the waste water discharged to water objects, the discharge of industrial waste water into the sewer system of the residential places and the resorts, and the type of the treatment installations.

3.3.5. Prognostic evaluations on the possible impacts on the surface and potable water

The investment proposal for the construction of a wind farm on the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chunchevo, does not include the utilization of technologies resulting in the pollution of the surface and potable water on the sites, where the wind generators are to be located. That is why the investment proposal does not lead to any changes of the state of the surface water, and does not exert any impact on them.

During the construction of the foundations and the installation of the poles it is possible to generate conditions for a negative impact on the surface and ground water due to the waste oils from the transportation and loading equipment, used in the supply and erection of the poles and also due to the sanitary wastes of the construction workers.

Observing the foreseen measures during the construction, laid out in item 5 of the present EIE report, should prevent the negative impacts on this environmental component – the water.

3.3.6. Ground water – characteristics of the hydro-geological conditions and factors, affecting the quantity and the quality of the ground water

According to the hydro-geological regions of Bulgaria, the investigated area belongs to the Varna artesian basin – part of the Lower Danubian artesian region. The different in type and character ground water comply with the water containing structures.

- pore ground water in the non-linked and poorly linked Neogene's sediments as well as in the quaternary deposits;
- karst and crack-karst water in the irregularly cracked and carbonate rocks spread on a wide area.

3.3.6.1. Water in the quaternary deposits

The quaternary deposits are spread everywhere in North-east Bulgaria. These are presented by different genetic types: proluvial, delluvial, colluvial, alluvial and mixed by type deposits as well as by different Eolithic formations.

The Eolithic loessial and loess-like deposits were established on part of the area where the wind generators are to be established. These overlap with rocks, different in lithology and stratigraphical scope. The thickness of the loessial and the loess – like deposits is up to 10 – 15 m. The loess complex is characterized by considerable vertical permeability, which facilitates the infiltration of the rainwater. In the basis of the loessial deposits old-quaternary gravels and rocks with clay filler to clay with rocks were established, which are characterized by values of the coefficient of filtration up to 3.0 – 5.0 m/d. The ground water formed in this region is pore, non-pressured in character, and it does not form a common water horizon but only separate water flows. The direction of their movement is according to the natural inclination of the relief and is towards the river – gully system, predominantly to the north – north-west. The increase of the water below the loess is exceptionally through the infiltration from the rainfalls and the draining – through the descending springs with various debits. A considerable part of the ground water is drained along the low-lying crack – karst water horizons and complexes. By its infiltration characteristics the loess complex is poorly water bearing and that is why it was not presented in the hydrological map of Bulgaria.

3.3.6.2. Water in the Neogene's sediments

Ground water in the Miocene (sarmat)

The Miocene sediments on the territory of the investigated region overlap with a transgressively varying by lithology and stratigraphy rock bed (Figure 25).

In most of cases these are represented by typically transgressive shore facieses of Crime - Caucasian type. In the basis somewhere there are basal polygene conglomerates, sandstones and clays, more rarely – marls. Over them there follow sands of different grain sizes, different lime-stones – sandy, biogenic, limy clays and again lime-stones. Litho-stratigraphically these belong to the Galata suite (with Botev's term), the Oder, Topolovo and Karvuna suites. The total thickness of the Miocene sediments varies from 10 – 15 m to 300 – 400 m. The borders between the separate lithological types are approximate and relative, due to the unbroken transition among them without establishing and regularities horizontally and vertically. The Miocene's sediments are almost horizontal with a poor regional inclination of 1 – 5 degrees to the east to the southeast and the northeast. These overlap on a wide area in the investigated territory with loess sediments of varying power. The Miocene's carbonate sediments of the different suites are characterized by their karst morphology. In the faults with almost plane-like relief karst forms were established – kars, kar fields, karst widened cracks, linked to different carbonate levels and linked with each other in a common channel network.

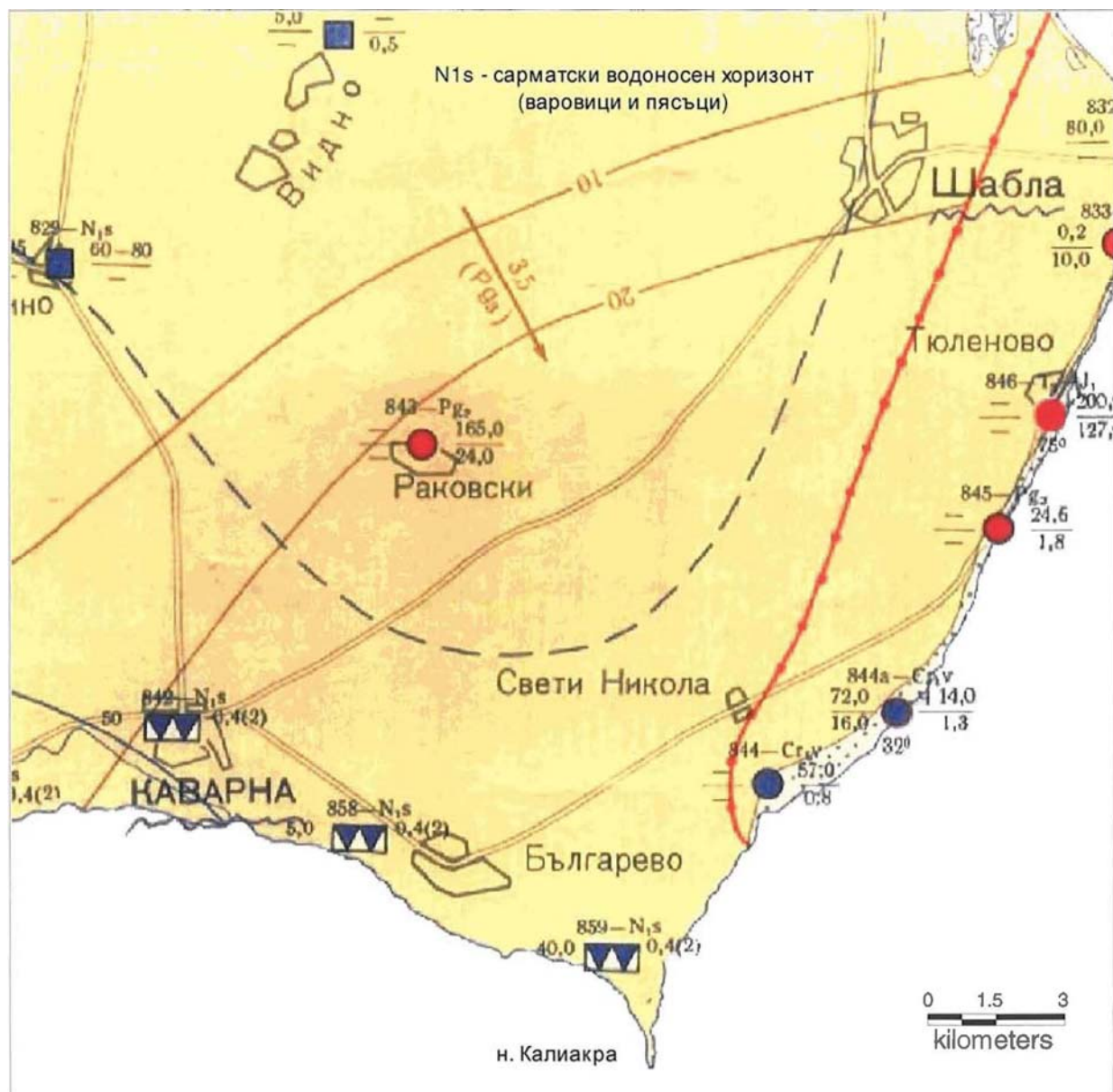


Figure 25: Hydrological map of the region.

On the figure:

N 1 s – sarmat water bearing horizon (lime-stones and sands)

Part of the karst forms are filled with smaller deposits (covered karst), and others are open (bare karst). The processes of karst denudation take place with various speeds – from 0,4 mm/1000 years to 30 mm/1000 years. This results in the quick and almost complete direction of the rainwater and the surface water flows deep downwards and surface water flows practically do not exist.

In the Miocene's poorly linked and non-linked sands, cracked sandstones and karst lime-stones, cracks were formed, crack-karst to pore-crack-karst by type, and predominantly non pressured to pressured in character ground water. The lithological variety of the sediments, the continuous sequence and wedge-like water-proof and water-permeable sediments, determine the water saturation of certain lenses and layers with a complex

hydraulic link between them. This determines the formation of a common water bearing complex with different water-conductive and water containing properties, characterized by anisotropy along the vertical and the horizontal directions which in turn determines the presence of different in type and possibilities for location in different levels of ground water flows.

In the basis of the Miocene (sands and lime-stones from the Galata suite and its Botev's term) pore-crack by type and pressured by character ground water flows were formed (the so called Chokrak water carrying horizon). For the lower water base there are water proof clays and marls from the Paleogene and the lower Cretaceous period or denser Miocene's deposits.

In the sands and the marls of the Oder suite predominantly crack-karst by type, non – pressured by character ground water flows were formed (lower sarmat water carrying horizon) which are separated from the lower lying ground water flows by the clays of the Evksinovgrad suite.

In the lime-stones of the Karvuna suite crack-karst to karst by type and non-pressured by character ground water flows were formed (upper sarmat water carrying horizon) whose lower base are the clays of the locally developed Topolovo suite or other relative water bases from the Miocene's profile.

Between the separate water –carrying parts of the complex there exist different hydraulic links, due to their similar or equal in value piezometric levels and the common direction of the water flows. The filtration characteristics of the water bearing complex are exceptionally varying. The filtration coefficients are from 1,0 – 3,0 m/d to 140 – 160 m/d; the conductivity of some parts reaches 1500 – 2000 m²/d, and in certain individual cases (near Shabla and Kavarna) – up to 4000 – 5000 m²/d . The water transition coefficient varies from 0.02 – 0.05 to 0.10 – 0.15, and the level transition – from $5 \cdot 10^{-2}$ to $3 \cdot 10^{-4}$ m²/d. By data from the sampling of the water from individual wells the relative debits vary from 0.1 – 0.5 l/s.m to over 10,0 l/s.m. This characterizes the Miocene's deposits like moderately water bearing. The average module of the ground flow is about 2.0 l/s. km² - Figure 26.

The area of increase of the ground water almost coincides with the territorial distribution of the Miocene's sediments. The increase is extremely through the infiltration of rainwater and surface water facilitated by the steady geomorphological and tectonic conditions, the climatic characteristics of the region and the considerable karst formation over the sediments and the cracking of the sediments

The infiltration coefficient of the faulty areas varies from 8 – 10% to 22 -23%. The draining of the Miocene's water flows takes place by the river – gully system, the sub-course flows from the larger gullies near the shore and the many descending springs and groups of springs with different debit.



Figure 26: map of the prognosticated operation resources of the fresh ground water

Key:

I. MODULES OF THE OPERATION RESOURCES OF THE GROUND WATER
A. MODULES EVALUATED BY THE AREA OF DISTRIBUTION OF THE WATER BEARING HORIZONS



- from 3 to 2

II. WATER CONDUCTIVITY [$M^2/24 H$]



- from 4000 to 2 000.



- from 200 to 100



- from 100 to 50.

VI. CHARACTERISTICS OF THE OPERATIONAL DRILLINGS IN ACCORDANCE WITH THEIR DRILLING DEPTH AND PRODUCTIVITY

A. debit l/s.

More than 10 l/s

B. Depth of drilling – [m]



more than 200

V. Other signs



Karst

Large water collectors for underground water with overall debit of – [dm^2/s]



from 200 to 50.

Sectors of distribution of underground water with non-conditional qualities for the supply of potable water.



- water with increased mineralization (more than 1 d/dm^3).



- water with increased temperature (more than 20°C).

3.3.6.3. Water in the lower Cretaceous sediments

The Malm-Valanginian sediments are presented by carbonate facieses – in the basis dolomite-modified, limy dolomites, dolomitized and aphanite lime-stones, (lower dolomite zone), alternation of organogenic, Oolitic, interclastic lime-stones with dolomites and dolomite-modified lime-stones (middle, transition zone) and fragmentation, on the average to micro-grain lime-stones with rare layers of dolomite-modified lime-stones (upper lime-stone zone).

The carbonate Malm-Valanginian sediments are much cracked and irregularly karst-modified. The stage of cracking is by three almost mutually perpendicular systems but the vertical layer surfaces are significant. The karst modification is by kars, hollows, ponors, well-like whirlpools.

In the cracked and karst-modified Malm-Valanginian sediments ground water has formed which is crack – karst to karst by type, non-pressured to highly pressured by character, forming a water-carrying horizon. It is mostly argillites, aleurolites, sand-stones and clays, denser lime-stones and dolomites that serve as a perfect base of the horizon. The depth of

the base is about 400-500 m to over 1200 m. The function of an upper isolation layer is performed by mergels and clayey lime-stones or denser carbonate rocks.

With the “sinking” of the Malm-Valanginian water carrying horizon the ground water is tempered (up to 35 - 55°C) and increase its mineralization, forming thermo-mineral water flows.

The filtration characteristics of the Malm-Valanginian water carrying horizon are exceptionally varying which underlines its irregularity which is typical for the crack-karst material. The values of the local conductivities vary from 8,0 - 10,0 m²/d to over 2000 - 3000 m²/d; the coefficient of filtration is from 0.5 - 0,6 m/d to over 10 m/d, the relative debits are from 0,5 - 1,0 l/s.m to over 10 - 60 l/s.m, which characterizes the Malm-Valanginian sediments as moderately to strongly water-bearing. The coefficient of level transition is about 10 4 m²/d for the non-pressured part and about 10 5 m²/d for the pressured part. The values of the gravitational water transition are within the interval 0,02 - 0,10, and of the elastic water transition (for the pressured part) - 0,01 - 0,03. The supply with water of the Malm-Valanginian water carrying horizon is performed through the infiltration of rain water from its surface faults but of a main significance is the influention of water from the rivers. The draining of the water-carrying horizon is naturally and artificially.

3.3.7. Qualitative characterization of the ground water objects

In a part of the water in the loess complex there is a concentration of sulphate and sodium ions, which give a slightly bitter taste to the ground water. The mineralization varies from 0,340 to 1,160 g/l. The temperature of the ground water is from 8.0 to 16°C.

The crack-karst and karst ground water flows in the Miocene and lower Cretaceous sediments by their quality characteristics are almost of the same type. The difference between them, as far as it exists, is determined by the depth of the layers and the connected with it changes in the gas composition and the temperature. These are water flows from the infiltration genetic cycle, almost exceptionally hydro-carbonate - calcium - magnesium to hydro-carbonate - magnesium - calcium by their chemical composition, neutral by character (pH = 7,0 - 8,0). Their mineralization is from 0.3-0,4 g/l to 0,9 - 1,0 g/l, predominantly 0,6 - 0,8 g/l. The average annual temperature is 12 - 14°C and the amplitude of the change is ± 2,0 - 3,0°C., that is, these are predominantly fresh cold water flows. With the increase of the depth of the layers and the decrease of the water-exchange processes, the contents of the sodium ions on the whole increases (for the Malm-Valanginian water flows to the hydro-carbonate calcium-magnesium water flows); their alkalinity (up to 9,0 - 9,5), mineralization (up to 0,9 - 1,1 g/l) and their temperature (for the Miocene - to 16 - 19°C, for the Malm-Valanginian water flows - from 20 -22°C to 50-55°C in the shore area). The ground water is moderately hard to hard, with predominating hardness of 6.0 - 9,0 mgE/l. It is characterized by good irrigation parameters, semi foam-forming, semi-corrosive, with a big hard scale, non-aggressive to the concrete, altogether suitable for drinking and sanitary water supply, industrial application and irrigation.

The qualitative characterization of the ground water leads to the following general conclusion: the ground water in the Quaternary and Neogene deposits could be used directly for irrigation, for industrial and technical water supply and for sanitary purposes. A considerable part of the ground water complies completely with the requirements of Regulation NO 9 on the water supply for drinking and sanitary purposes. Another part (containing mostly insignificant amounts of ammonia, nitrites, nitrates, or which is of a higher temperature) is suitable for use after chlorination or after mixing with other pure

water flows, or belongs to the thermo-mineral water flows. A third part is suitable for the said purposes only after treatment.

3.3.8. Forecast on and evaluation of the expected changes in the ground water as a result of the implementation of the investment proposal

The implementation of the investment proposal will be based on the wind power generator produced by the German company Re Power System. The chosen model has the following advantages:

- lack of any leakage of oils and lubricants due to the protected with additional baths plate structure;
- closed system for greasing of the mechanisms.

The multi-layer finish complying to ISO 12944 protects all the parts of the generator from corrosion.

No generation of wastes like lubricants and oils is expected during the operation of the wind farm, which in case of raining or snowing could infiltrate into the ground water.

The geological survey of the investigated region down to 10,0 m depth from the surface has not established ground water flows. During the construction the foundations are planned to be laid to the depth of 1,30 m , that is, there is no need of taking measures to lower the ground water level.

The effect of the construction of the wind generators will not exert any negative consequences for the state and quality of the ground water.

3.4. Geological environment

3.4.1. Characterization of the state of the geological environment

Within the investigated region neogene sediments are widely spread, represented by the Galata, Oder, Karvuna and Topolovo suites, and Eolithic quaternary formations (Figure 27). The older formations were established after drilling for petroleum and natural gas and during the investigation of the Dobrudja coal basin.

Neogene sediments

The neogene in the region is represented only by the Miocene's series to which the following litho-stratigraphic units are related:

Galata suite (qN1t-kg)

Introduced by Popov, Kuyumdjieva (1987), the Galata suite is developed in the south-eastern part of the studied region, where it was established only by drilling (Figure 27). The suite lies transgressively over older rocks and is covered normally by the Evksinograd suite. It is represented by 50 – 60 m sands with sand, lime-stone and clay layers in a complex alternation.

Botev's term of the Galata suite (q/bN 1kg)

It was separated by Popov, Kuyumdjieva (1987). In the only known fault at the village of Kamen bryag, it is represented by 1,7 m white to grey sandy lime-stones which overlap transgressively with a dilution of the organogenic lime-stones of the Oder suite.

Oder suite (odN 1s)

It was separated by Popov, Kuyumdjieva (1987). In the studied region it lies transgressively over the Botev's term of the Galata suite. The sediments of the Oder suite have a fault at the surface of the region in a strip along the sea shore between cape Kaliakra and the village of Tyulenovo. It is represented by whitish and yellowish strong lime-stones, most often detritus- shell –like and Oolythic with layers of sands and clays. The reefs by cape Kaliakra belong to the Oder suite (Figure 27). Its thickness varies from several meters to 40 – 50 m.

Topolovo suite

It was separated by Popov, Kuyumdjieva (1987). The suite lies normally over the clays of the Evksinograd suite and overlaps normally with the lime-stones of the Karvuna suite. It is represented by grey to white thin layer, clayey-carbonate plastic rocks, the lighter layers being mainly chemical sediments and the darker – lime-stone clays. These appear at the surface in the upper parts of the slope from Obrochishte – Albena to cape Kaliakra. Their overall power is 45 – 80 m.

Karvuna suite (kvN1s)

It was introduced by Popov, Kuyumdjieva (1987). The suite lies over the Topolovo suite. It consists of dense, strong or porous, often shelly lime-stones. In the south faults of the suite among the lime-stones there are also layers of clay or stripped clay-carbonate materials. The lime-stones are strongly karst-modified and at the surface there are many small karst forms. The intensive karst modification, according to the data from investigation drilling, reaches 80 – 90 m depths and the overall volume of the karst hollows is 10 – 14%. The thickness of the suite is from 25 to 50 m.

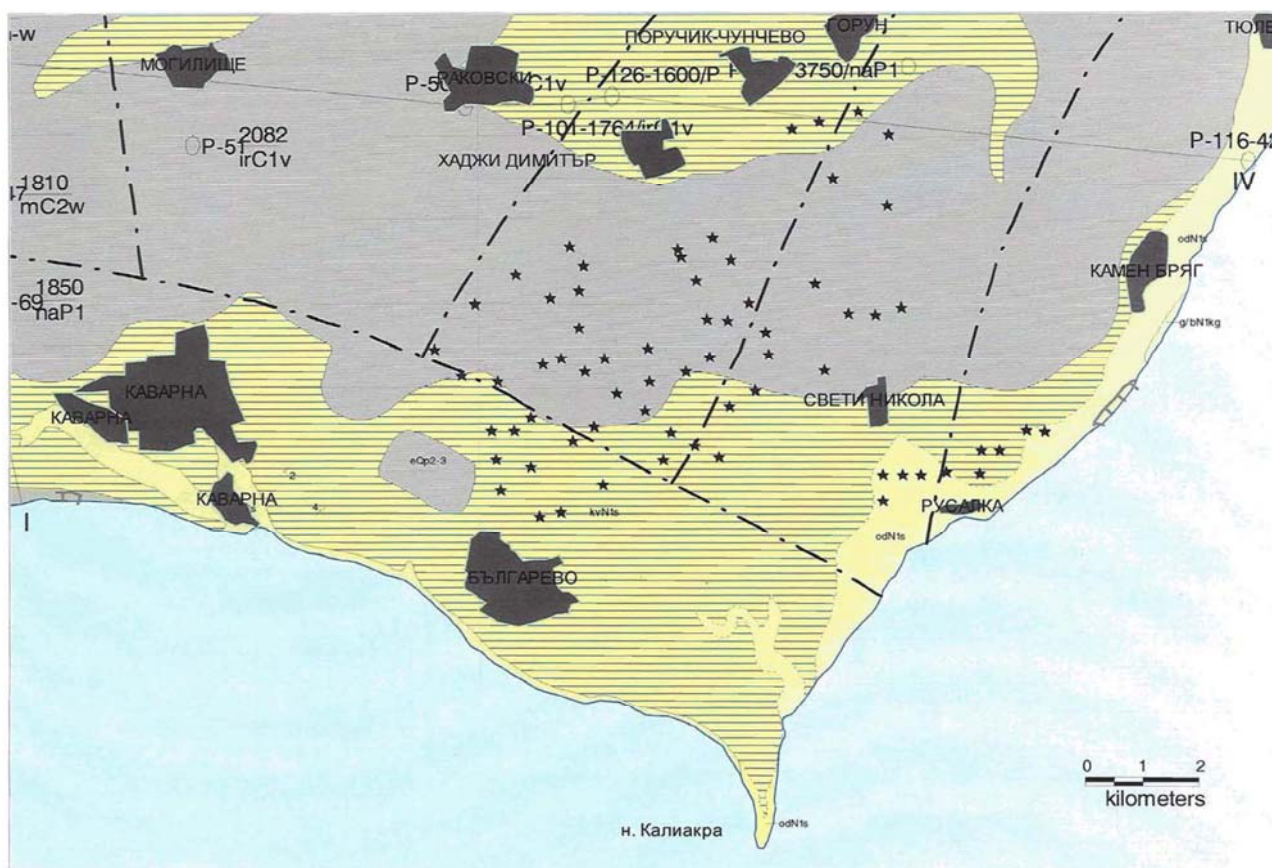
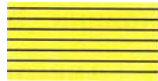


Figure 27 – Geological map of the region with the project location of the wind generators.



toN1s
Topolovo suite
Thin-strip carbonate clays



kvN1s
Karvuna suite
Dense or porous, frequently shell-like limestone



g/bN1kg
Galata suite – Botev's term
Sandy limestones in places with conglomerate view



odN1s
Oder suite
Detritus-shell-like and Oolythic limestones with layers of sands and clays



eQp2-3
Eolythic formations
Loam

Borders



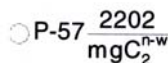
1. Normal lithostratigraphic; of quaternary formations
 - a) established
 - b) assumed
2. Discordant (transgressive)



More significant buried fault



Landslide



Drilling
(R-rotor, S-structured) with its number, length from the surface (in the numerator) and index of the lithostratigraphic unit (in the denominator)



Profile line

Quaternary formations

Eolythic formations (eQp2-3)

The loam belongs to this genetic type, which represents pale yellow porous loose rock full of lots of lime concretions ("loess dolls"). It is built-up of clayey mass along with terrigenous component. Its thickness is 10 – 15 m.

3.4.2. Tectonic characteristics of the region

The region under investigation belongs to the Mizia platform (the eastern slope of the North-Bulgarian arc). The lithostratigraphic units from the Tectonic point of view are grouped in the following structural complexes: Paleozoic (Herzine) and Meso-Caynozoic (Alpine). Carbon and Perm structural strata are distinguished in the Paleozoic structural complex. The Alpine structural complex is divided into Triassic, Jurassic - lower Cretaceous, upper Cretaceous – Paleogene and Neogene – Quaternary. These structural strata in a regional scale are grouped in two structural plans – Pre-Jurassic and Post-Jurassic distinguished for their structural characteristics.

The Pre-Jurassic structural stratum includes the Carbon, Perm and Triassic structural strata. Plicative Tectonics is characteristic of Carbon structural stratum and Perm and Triassic strata are distinguished for fractured tectonics (manifested after the Perm and the Triassic). Mosaic of blocks preserved from the Post-Jurassic structural plan was created as a result of this in the Pre-Jurassic structural plan. Two horst structures are distinguished in it. Vranin's and Nanev's horst. Shabla-Bulgarevo graben zone. Bezvodie graben-shaped block is located in the wester direction from Vranin's horst. The hereinabove enumerated blocks border to the north with the southern slope of Dobroudja massif and to the south by fracture they are limited by Balchik decline.

Vranin's horst along the upper part of carbonate segments is intensely inclined to southwest. These sediments build up a fragment of a vast synclinal structure. It is separated from Bezvodie graben block situated on the west through Trigor fracture along which the subsidence is over 1000 m. The subsidence along Rakovski fracture separating it from Shabla – Bulgarevo graben zone is about 1000 – 2000 m. In southern direction the horst is limited by Bezvodie – Selchen fracture, through which it is separated from Balchik decline.

Nanev's horst is spread out in the water space of the Black Sea. Its upper Carbon surface in it is at the depth of 1680 m.

Shabla – Bulgarevo graben zone is located between the hereinabove mentioned two horst structures. Its western part is situated on the land and the eastern one – in the water space of the Black Sea. The zone is formed by thick Triassic and Perm rocks.

Bezvodie graben-shaped block is with big collapse in its upper parts and thick Perm and partially Triassic rocks were preserved there. It is established that its eastern part is step-like lifted toward Vrana horst.

Balchik decline was formed predominantly by Perm and partially Triassic sediments.

Post-Jurassic structural plan. Its nearly monoclynal sinking to the east and south thus forming Varna monoclynal is characteristic of it. The block tectonics from its support helps the formation of local, lava fractured and over-fractured structures.

Two horst structures – Tulen and Bulgarevo – were formed in the region under consideration.

The Tulen structure is a complicated horst limited to the west by shears-like fault with amplitude along the valange up to 600 m to the south and 100 m to the north. The fault passes through the village of Shabla – the village of Gorun - the village of Bulgarevo. The horst is with length of over 22 km and width 3 – 7 km complicated by a number of smaller faults along which differently raised blocks were formed. Deep graben synclinal filled up with Oligocene and neogenic precipitations was developed to the west of Tulen horst, along submeridial faults.

Bulgarevo structure is formed per faults with direction east – west and represents a comparatively elevated block inclined to the sea and continuing along it. The amplitude of the faults leveling it from the east, north and west is from 60 to 120 m.

3.4.3. Engineering – geological conditions for foundation of wind generators

Further to engineering – geological research conducted for the clarification of the conditions for foundation of the wind generators, 7 nos. of investigative drillings were made on the territory of the village of Sveti Nikola and 1 no. on the territory of the village of Bulgarevo, municipality of Kavarna. The research drillings were put up to depth of 10 m from the surface of the terrain.

On the grounds of the investigative drillings made within the region of the village of Sveti Nikola it was established that the territory under research was built up of sediments of Karvuna suite which are covered by weak soil layer – 0.2 – 0.5 m. Limestone was discovered, white, weathered, intensely karsted, whose thickness was not passed up to the end depth of the drillings.

The geologo – lithological varieties passed along a drilling way up to depth of 10,0 m from the surface of the terrain are reflected in the detail in the drawn up lithological columns of the drillings (fig. 28 – 33).

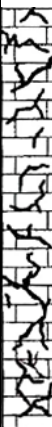
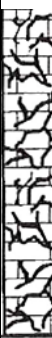
The conditional calculating loadings of the lithological varieties are determined on the grounds of their physical – mechanical properties, in compliance with the Norms on Design for Flat Foundation. For the engineering – limestone, weathered, intensely karsted, the conditional calculating loading, R_0 is 0.50 MPa.

The research drilling passed into a site designated for construction on the territory of the village of Bulgarevo, municipality of Kavarna is also with depth of 10 m. Geologically the terrain was built up from utmost above of a soil stratum (layer 1) with thickness of 0.70 m, light brown to red brown clay and kernels of weathered limestone (layer 2) with thickness 5.7 m, sandu clay white, limy with red brown strips and angular limestone pieces (layer 3) with thickness 1.5 m and white limestone, weathered, cracked (layer 4), whose thickness is not fully passed up to the end depth of the drilling (fig. 34).

For layer 2 – the conditional calculating loading R_0 is 0.21MPa and for layer 4 – the conditional calculating loading R_0 is 0.50MPa.

DRILLING COLUMN
S 1:50

C.p. 69.60 m

Geological age	Layer base elevation	Terrain depth (m)	Power of layer (m)	Lithological description			Hydrogeological description	Samples taken from	Water level (m)
	69.30	0.30	0.30	Soil layer			Dry	1401 ○	
kv N ₁ ^S	65.20	4.40	4.10	White limestone, quartz with caverns filled up with red clay			Dry		
	64.80	4.80	0.40	Cavern filled up with small caverns filled up with red sandy clay			Dry		
	63.40	6.20	1.40	White limestone, quartz with small caverns filled up with red clay			Dry		
	62.60	7.00	0.80	Cavern filled up with quartzed and clayed sand			Dry		
	59.60	10.00	3.00	Limestone with red orange spots			Dry		

Compiled by: /Sgd. III./
/Eng. N. Popova/

Figure 28

DRILLING COLUMN

S 1:50

C.p. 64.50 m

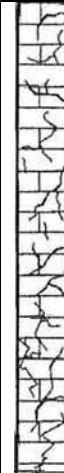
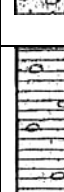
Geological age	Layer base elevation (m)	Layer depth (m)	Power of layer (m)	Lithological description			Hydrogeological description	Samples taken from	Water level (m)
	64.00	0.50	0.50	Soil layer			Dry		
kv N ₁ ^s	63.00	1.50	1.00	White-orange limestone, karsted			Dry		
	62.60	1.90	0.40	Weathered limestone, red brown			Dry		
	60.20	4.30	2.40	White-orange limestone, karsted			Dry		
	58.50	6.00	1.70	Cavern filled up with coarse-grained limy and small-sized gravel and pieces of oolythic white orange limestone			Dry	1402 ○	
	54.50	10.00	4.00	Weathered white orange limestone			Dry		

Compiled by: /Sgd. III./
/Eng. N. Popova/

Figure 29

DRILLING COLUMN
S 1:50

C.p. 68.50 m

Geological age	Base Layer Elevation	Depth of terrain (m)	Power of layer (m)	Lithological description			Hydrogeological description	Samples taken from	Water level (m)
	68.00	0.50	0.50	Soil layer			Dry	1403 ○	
kv N ₁ ^s	67.30	1.20	0.70	Cavern filled up with pieces of limestone mixed with coarse limy sand					
	67.10	1.40	0.20	White limestone, with orange spots, karsted			Dry		
	66.80	1.70	0.30	Cavern filled up with pieces of limestone and sand			Dry		
				White limestone, with orange spots, karsted			Dry		
	63.00	5.50	3.80						
	62.60	5.90	0.40	Cavern filled up with powder gravel sand			Dry		
	62.10	6.40	0.50	Limestone with red orange spots, karsted			Dry		
	61.90	6.60	0.20	Cavern filled up with sand, coarse-grained limy and small pieces of limestone			Dry		
	60.70	7.80	1.20	Cavern filled up with sandy clay brown-tobacco, with small pieces of limestone			Dry	1404 ○	
	59.30	9.20	1.40	Cavern filled up with coarse sand limy, clayed with pieces of brown rusty limestone			Dry		
	58.50	10.00	0.80	Limestone with orange spots, karsted (low part of cavern)			Dry		

Compiled by: /Sgd. III./
/Eng. N. Popova/

Figure 30

DRILLING COLUMN

S 1:50

C.p. 61.40 m

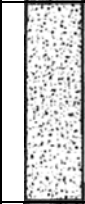
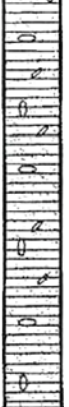
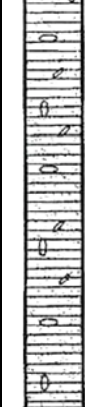
Geological age	Layer base elevation	Depth of terrain (m)	Power of layer (m)	Lithological description			Hydrogeological description	Samples taken from	Water level (m)
	61.20	0.20	0.20	Soil layer			Dry	1406 ○	
kv N ₁ ^s	60.30	1.10	0.90	White and red limestone, cracked and karsted			Dry		
	59.80	1.60	0.50	Cavern with sandy filler			Dry		
	59.40	2.00	0.40	Limestone with imprints of clams, cracked and karsted			Dry		
	58.50	2.90	0.90	Cavern with coarse-grained limy sand			Dry		
	57.60	3.80	0.90	White limestone with imprints of clams, cracked and karsted			Dry		
	56.60	4.80	1.00	Cavern filled up with coarse-grained and medium-grained limy sand			Dry		
	56.40	5.00	0.20	Karsted white, orange, red limestone			Dry		
	55.60	5.80	0.80	Cavern filled up with coarse-grained sand, white-creamy to brown			Dry		
	51.40	10.00	4.20	Cavern filled up with pieces of limestone and coarse limy sand			Dry		

Compiled by: /Sgd. III./
/Eng. N. Popova/

Figure 31

DRILLING COLUMN
S 1:50

C.p. 56.50 m

Geological age	Base layer elevation	Depth of terrain (m)	Power of layer (m)	Lithological description			Hydrogeological description	Samples taken from	Water level (m)
	56.30	0.20	0.20	Soil layer			Dry		
kv N ₁ ^s	55.20	1.30	1.10	White pink limestone, cracked and karsted			Dry		
	54.70	1.80	0.50	Cavern filled up with red brown clay and small-sized gravel			Dry		
	53.00	3.50	1.70	White limestone, karsted with orange-red spots			Dry		
	51.40	5.10	1.60	Cavern filled up with coarse-grained and medium-grained limy sand			Dry		
	50.60	5.90	0.80	White limestone with orange spots, karsted			Dry		
	50.20	6.30	0.40	Cavern filled up with pieces of limestone and coarse-grained limy sand			Dry		
									
	46.50	10.00	3.70	Cavern filled up with bright red clay with limestone pieces, sandy			Dry		
								1407 ○	

Compiled by: /Sgd. III./
/Eng. N. Popova/

Figure 32

DRILLING COLUMN

S 1:50

C.p. 52.80 m

Geological age	Layer base elevation	Depth of terrain (m)	Power of layer (m)	Lithological description			Hydrogeological description	Samples taken from	Water level (m)
	52.50	0.30	0.30	Soil layer			Dry		
kv N ₁ ^s							Dry		
	47.80	5.00	4.70	Cavern filled up with sandy clay and pieces of limestone			Dry		
	47.30	5.50	0.50	White limestone, karsted			Dry		
	42.80	10.00	4.80	Cavern filled up with sandy clay and pieces of limestone			Dry		
								1408 ○	

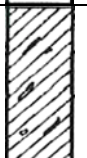
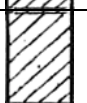
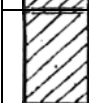
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/Eng. N. Popova/

Figure 33

DRILLING COLUMN

S 1:50

C.p. 79.53 m

Geological age	Layer base elevation	Depth of terrain (m)	Power of layer (m)	Lithological description			Hydrogeological description	Samples taken from	Water level (m)
e-aQ _p ¹	78.83	0.70	0.70	Soil layer			Dry	307 ○ 308 ○ 309 ○	
	76.23	3.30	2.60	Clay, light brown with limy elements and kernes of weathered limestone			Dry		
	74.73	4.80	1.50	Dark brown clay with rusty red strips and coarse sand grains			Dry		
	73.53	6.00	1.20	Red clay			Dry		
	72.03	7.50	1.50	Sandy clay, white, limy with reddish strips and angular limy pieces			Dry		
	69.53	10.00	2.50	White limestone, weathered, shell-like with lots of imprints of clams			Dry		

Compiled by: /Sgd. III./
/Eng. N. Popova/

Figure 34

Engineering – geological investigations for each facility separately must be obligatorily conducted in view of the fact that the design location of the wind generators, respectively the foundation will be performed in various and significantly remote from each other sites.

3.4.4. Physical geological phenomena and processes

The following adverse for the construction processes are characteristic from the physical – geological phenomena within the region of the area under investigation and in its proximity: karst (X), landslips (▲), landslides with periodical activation of their individual parts (.....) – Figure 35.

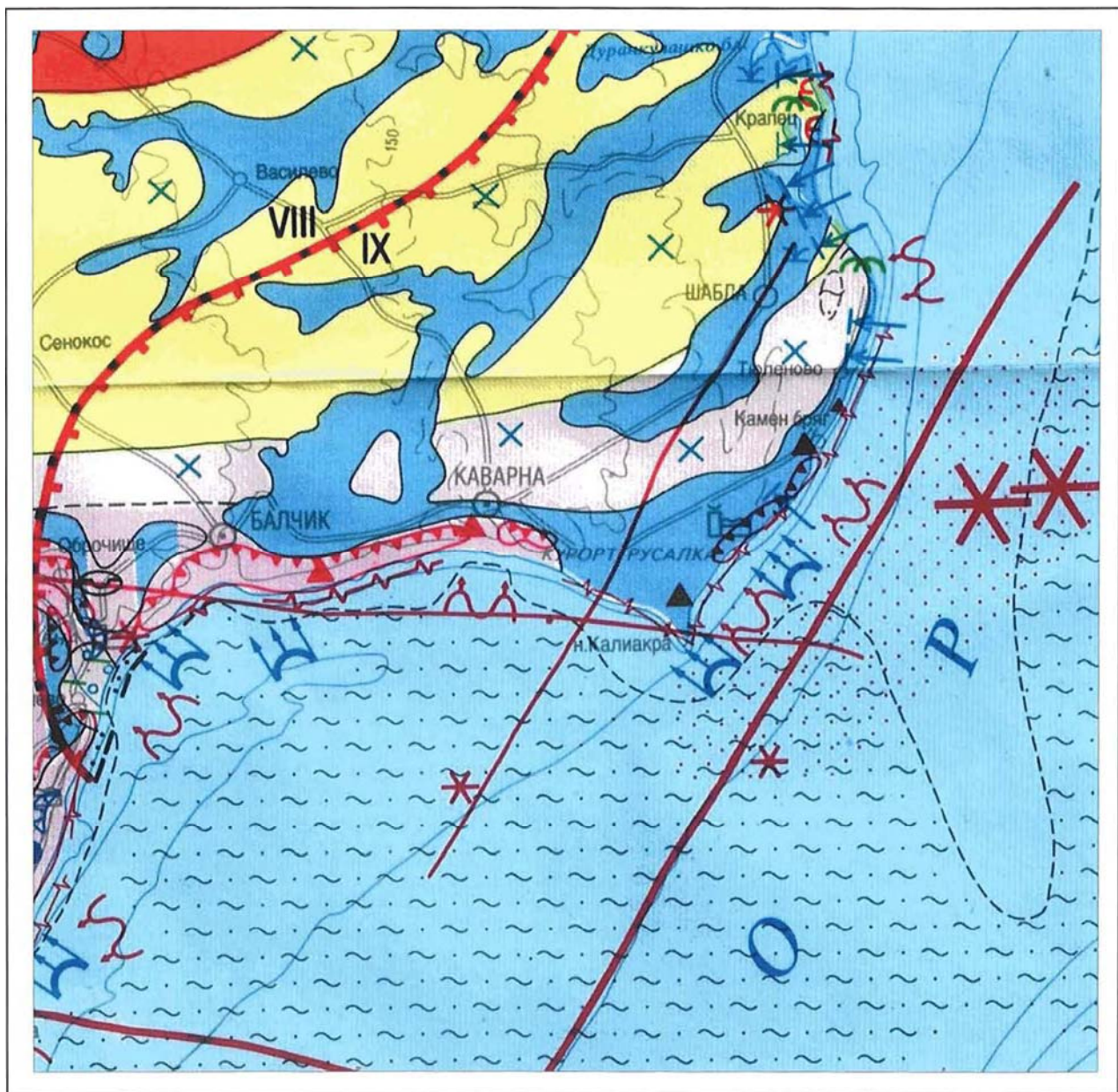


Figure 35: Map of geological hazard

- Karst processes (karst) – they are related to the limestone deposits of neogenic segments. Kars, karst fields (the so called “kayraks”), karst expanded cracks

and courses to hollows. During the engineering – geological investigations on the territory of the village of Sceti Nikola (at about 200 – 800 m to the north – northeast from the road for Rousalka resort complex a multitude of caverns are passed, at various depth from the surface – fig 28 – 33. Data about covered karst are reflected also in the map of geological hazard (fig 35).

- Landslides and landslips. They are characteristic of the cliff types of Black Sea Coast such as the coast to the southeast is, at about 1.5 km from the design location of a part of the wind generators. Linear block landslide with an area of about 300 dka and length of about 3.0 km was established in the territory around Rousalka resort complex. The main reasons for the appearance of the landslides are the particularities of the geological structure and the lithological composition of the rocks, the active sea abrasion and the impact of underground waters.

3.4.5. Seismic characteristics

Geodynamically the region of the site falls within the so called Shabla seismic zone. According to the seismic division of Bulgaria into regions the investigated terrain belongs to the earthquake power of IX degree on the scale of Medvedev - Shponhoer - Karnik and $K_c = 0.27$ ("Seismic division of Bulgaria into districts", 1987). Additional encumbering factors for the area, which the wind generators will be located in, are the proximity of lines (one of which Shabla – Kaliakra is) of active seismicity and sensitivity, along which some of the most intensive and destructive earthquakes occurred in the near past.

Pursuant to Art. 10, Para. 1 of the "Standards for the design of buildings and equipment within zones of seismic regions", the engineering – geological conditions on the site could be classified as favorable from a seismic point of view because of the water level deeper than 4 m and the land basis of IInd and IIIrd seismic group.

3.4.6. Forecast and assessment of the expected changes of the condition of the geological environment from the implementation of the investment project

Each of the foundations of the wind generators occupies a small area, due to which it may be accepted that the impact over the geological foundation will be local with small depth scope.

Owing to the great remoteness of the wind generators from the site, the same will not be affected by landslide and landslip processes.

3.5. NATURAL UNDERGROUND RESOURCES

3.5.1. Characteristics of the deposits of the underground resources

There are the following natural underground resources in the proximity of the area under investigation.

Oil and gas

Tulen oil-gas deposit is located in Mizia platform and more precisely in Shabla – Bulgarevo graben zone of Varna monoclynal. It is related to Turlen horst structure and the mineral resource was put into the upper part of Kaspichan suite. The gas bed is bound to the sandstone of Deklitash suite/

A deposit was discovered at the village of Bulgarevo for yield of natural gas. The deposit is bound to the sandstones of Deklitash suite.

Quarry materials

The limestones of Oder and Karvun suites are used as construction material. Quarry for yield of fractured and crushed stone of limestone was opened on the territory of the village of Bulgarevo.

3.5.2. Forecast and assessment of the measures needed for preservation of underground resources

The construction of a wind farm on the territory of the Municipality of Kavarna is related to the production of energy from renewable natural source – the wind. It is characteristic of the renewable energy sources of the earth (oil, gas and others) and does not provoke the accumulation of hazardous waste matter.

The project location of the wind generators affects only the agricultural lands and does not fall within the borders of any concession areas for yield both of oil and gas and for production of fractured and crushed stone.

The planned activities in the implementation of the project will not affect the extraction of any natural resources from the territory of the region and will not exert any adverse effect on them.

This is confirmed by the coordination of the location of the individual generators with Directorate “Bowels of the Earth and Underground Resources” with the Ministry of Environment and Water (letter with Ref. No ZDOID – 8128 dated 17.06.2006, Annex III).

3.6. LANDS AND SOILS

3.6.1. Types of soil, dissemination

The territory anticipated for the construction of a wind farm comprises parts of the territories of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna. The soil cover here is not distinguished for great diversification. The reason for this is in the comparatively homogeneous factors of soil formation: the relief is predominantly flat, very slightly segmented; the soil formation rocks are presented by loess and loess-like materials, carbonate clayey deposits and delluvial deposits; climatically the region falls within the Northern climatic sub-area with certain sea influence; the vegetation is steppe and forest steppe, consequently displaced by cultural vegetation. The soil cover is represented nearly fully by varieties of the Chernozems type – carbonate, typical, leached, slightly, medium and intensely, the greater part of which are characterized by high soil fertility (Fig. 36). Further to them insignificant soil from the soil difference: delluvial – meadow soils are also found in the territory under consideration:

1. Carbonate black earth, with no erosion or poor erosion
2. Carbonate black earth, karasoluk, powerful
3. Carbonate black earth, with erosion
4. Carbonate black earth, average power
5. Carbonate black earth, karasoluks, with no or poor erosion
6. Carbonate black earth, average erosion
7. Black earth, shallow, with poor or average erosion
8. Black earth, shallow, with strong erosion
9. Black earth, poorly leached, powerful (accumulated)
10. Black earth, poorly leached, with no or poor erosion
11. Black earth, averagely leached, powerful and with average power
12. Black earth, averagely leached, powerful (accumulated)
13. Strongly leached black earth, powerful

14. Averagely leached meadow black earth, powerful
15. Averagely leached black earth – karasoluks, powerful
16. Strongly leached black earth, karasoluks, powerful
17. Diluvia – meadow soils, powerful
18. Rocks, gullies and ravines

The largest distribution on the territory of the future wind farm have the averagely leached black earth, with average power and powerful soils (No 11 of the soil map).q which include about 60% of the whole territory. The profile of these soils is powerful, consisting of humus-accumulative horizon A with a significant power (70 – 80 cm) and a transition horizon B with 30 – 40 cm power. The mechanical content is heavy sandy – clayey. The silt fraction predominates (particles with dimensions < 0,001 mm) as well as the physical clay (particles < 0,01 mm). In the ploughed soils their contents is respectively 32 – 35% and 54 – 58%. The soil reaction changes from slightly acid in the ploughed area to alkali in the transition horizon. The carbonates are to be found below 90 cm. These soils are distinguished for their favorable nutrition regime. They have comparatively high humus contents in the ploughed areas – up to 3 – 4%, and the power of the humus layer (humus content > 1%) is significant (90 – 100 cm). The overall nitrogen reserve is poor to average, and that of overall phosphorus – from average to good. The reserve of potassium is also good. The soils are characterized by good water –preserving ability and favorable general physical and mechanical properties. These soils, due to their heavy mechanical composition are strongly flattened by strong rainfalls and after drying they form a thick crust, unlike the carbonates and the typical black earth. When ploughed in a dry state, the soil separates into big rough pieces.

On the second place there come the averagely leached black earths, powerful (accumulated) – No 12 in the soil map. These have a powerful profile of 110 – 125 cm (overall power of the A and B horizons). They have powerful humus – accumulative horizon (95 – 100 cm), and the humus contents over 2% reaches 3.6% in the ploughed areas. By their mechanical composition these soils are heavy sandy – clayey. The amount of the physical clay in the ploughed area is from 52.5 to 59%, and in the underneath layer – 54 to 59%. The silt fraction predominates (particles with dimensions < 0,001 mm) as well as that of the physical clay (particles < 0.01 mm). Their amount is from 32 to 35% for the silt and 54 – 58% for the physical clay. The soil reaction in the humus – accumulative horizon changes from weakly acid to in the ploughed area (pH in K from 5.1 to 5.6) to neutral in the last sub-horizon. The carbonates are washed below 105 – 110 cm. The reserve of overall nitrogen is from poor to average, and that of overall phosphorus – from average to very good. As for the water preserving ability, the overall physical and mechanical properties, these soils are analogous to the former. As a whole their fertility could be described as a little higher than that of the previously discussed, because of the bigger power of their soil profile.

The strongly leached powerful black earths come on the third place (No 13 from the soil map). These also have a heavy sandy – clayey mechanical composition. The amount of physical clay in the ploughed area is 51.1 to 59.8%, and in the sub-layer – 57 to 60.7%. These are also powerful soils – the humus accumulative horizon reaches depth of 90 – 100 cm, the soil-generating rock is uncovered at depth of 130 – 135 cm. the humus content is high – from 3.1 – 3.3% in the ploughed soils. The soil reaction in the surface horizon is weakly acid and neutral in the sub horizon. Besides being favorable for most of the cultural species, these soils have good reserves of overall and assimilative potassium, overall nitrogen and phosphorus. Their water –preserving ability is good and the mechanical and physical parameters are favorable as well.

The typical black earth with average power (No 4 on the soil map) are on the fourth place. By their mechanical composition they are heavy sandy – clayey. The silt fraction

predominates with the physical clay – in the ploughed soils respectively 31.0% and 52.5%, and in the sub-horizon – 29-36% and 48 – 55.6%. The soil reaction in the ploughed soils is neutral and alkali in the rest of the soil horizon. The carbonates are uncovered at the depth of 30 – 35 cm. the reserve of humus is average – 2.1 – 2.6% at a depth of up to 50 cm. The typical black earth is characterized by a bit lower water preserving ability and lower volume density than the leached black earth.

The fifth soil type on which the wind generators will be constructed is that of the carbonate black earth, with no or weak erosion (No 1 on the soil map). These are near the borders of the Bulgarevo village. They have normally shaped soil profile which is less powerful than the soils reviewed above (75 – 80 cm), consisting of surface humus – accumulative horizon Ak with power of 35 – 45 cm, under which there is a transition horizon ABk. The mechanical composition is sandy – clayey. The silt fraction and the coarse sand (0.01 – 0.05 mm) predominate – 32.5% and 30.7% respectively in the ploughed soils and 33 – 37% and 31 – 32% in the sub-horizon. The contents of physical clay in the humus – accumulative horizon is 57.3 – 57.5%, and in the sub-layer – 55.8%. The contents of carbonates in the ploughed soils is 1.3% and in the sub-layer – up to 3.6%. The soil reaction along the whole profile is alkali. The humus content in the ploughed soil is 2.7% and in the sub-horizon – 1.6%, which corresponds to average reserves of overall nitrogen and phosphorus.

The carbonates and the typical black earth formed over loess are very sensitive to additional loads. They are also vulnerable by water and wind erosion, the latter having a dominating significance in the region in question, especially in the autumn and spring when the rains are weak. The suitable measures for limiting the erosion processes include the strengthening of the soil structure by a vegetation cover, of the surface of the soils. Especially suitable is the belt agriculture and the placing of grass buffers.

The other types of soils are presented by significantly smaller areas and on them, according to the submitted plan of the wind farm, no wind generators will be installed. That is why they will not be reviewed here. Besides, by their properties and contents, as well as fertility, they do not differ significantly from the soils described above.

3.6.2. Characteristics of the state of the soils – the broken lands, the erosion, the super – moistened soils, the salty areas, the polluted areas with harmful and dangerous substances

On the territory of the future wind farm in the bordering areas of the villages Bulgarevo, Sveti Nikola, Rakovski, Hadji Dimitar and Porouchik Chounchevo, there is no broken land and there is no evidence for the degradation processes from eventual super moistening, acidifying or saltiness. As for the erosion, it must be noted that the soils available here are vulnerable to that degradation process. Due to the flat profile these are not strongly subjected to the activity of the water erosion and in the region of the WPP there are no traces from the latter. These soils are, however, subjected to wind erosion in the periods, when their surface is not covered with vegetation and their moisture content is low. The greatest part of these soils (averagely and strongly leached black earth) as the analysis showed, are not affected by this degradation process. We have discovered prerequisites for this in the soil properties (heavy sandy-clayey mechanical composition, good reserves of organic substance), and in the geographical and physical properties of the relief – flat country, low amounts of rainfall, low frequency of intensive rainfalls. A little poorer resistance to erosion demonstrate the carbonate black earth soils – there in the borders of the territory of the park there are traces of weak erosion.

Near the investigated region there are no industrial enterprises, nor big traffic arteries, no depots for liquid or solid industrial wastes and other sources of technogene pollution. There is no reason and there is no data in the information materials of MOEW, EAEW, The

Ministry of Health, etc. about the presence of pollutions with heavy metals, petroleum products and other harmful and dangerous substances in the investigated soils.

3.6.3. Space distribution of the rich areas and soils, suitable for agriculture activities. Changes in the soil fertility

The agricultural lands of the future WPP in the territory of the villages Bulgarevo, Sveti Nikola, Rakovski, Hadji Dimitar and Porouchik Chounchevo, are represented by soils with high natural fertility and 95% of them are 1 growth class, 2 growth class category in case of non irrigation.

The categorization of the agricultural lands was performed by a Method of work with the cadastre of the agricultural lands in the republic of Bulgaria (1988). The determination of the growth class ratings was based on data of the relief of the soil –forming rocks, the climate and the biological characteristics of the main cultures for our country. The results of this categorization are the following:

The averagely leached black earth, with average power and powerful (No 11 in the soil map) have average growth class rating of 86.6 and belong to the 1st growth class group, 2nd growth class group in the case of no irrigation. The most suitable cultures for these are wheat, maize, soy, sunflower, sugar beet, tomatoes, apples, cherries, grapes (Tables 16 and 17). For all these the soils have a field growth class number of over 80.

Table 16: Calculating the soil rating of the main cultures of the averagely leached black earth with average power (No 11 in the soil map) in the territory of the village of Bulgarevo, Kavarna municipality

Soil parameters																						
	wheat	maize	rice	soy	sun flower	Sugar beet	Tobacco	Tobacco	Cotton	Flax	Tomatoes	Pepper	Potatoes	Alfalfa	Pastures, meadows	apples	pears	Peaches	Cherries	plums	Red berries	Grapes
Mechanical composition – contents of physical clay -ploughed soil – 55% -subhorizon – 56%	100	100	2 x 80	100	100	100	60	100	100	80	100	100	2 x 60	100	100	100	100	80	2 x 90	100	60	2 x 80
Power of the humus horizon 90 cm	100	100	-	100	100	100	2 x 5	100	100	100	100	100	100	100	100	100	100	-	-	100	100	100
Power of the soil profile: 110 cm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texture coefficient 1,01	100	100	60	100	100	100	-	100	100	100	100	100	90	100	70	2 x 100	2 x 90	100	90	2 x 90	100	95
Soil reaction pH = 5.8	90	90	100	100	100	80	100	90	90	100	90	90	2 x 100	80	950	100	100	100	80	100	3 x 100	80
Humus content 3.5%	100	100	100	100	100	90	2 x 40	80	90	100	100	100	100	100	100	-	-	-	-	-	-	100
Level of ground water > 30 m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil rating	98	98	84	100	100	96	41.6	94	96	96	98	98	87.1	96	93	100	96	93.3	87.5	96	93.3	89.2

Table 17: Calculating the average growth class rating and establishing the growth class of the soil averagely leached black earth, with average power (No 11 in the soil map) in the territory of the village of Bulgarevo, the municipality of Kavarna

Culture	Soil rating	Correction coefficients for							Field growth class number
		Climate	Erosion/accumulation	Presence of stones	Presence of marshes	Saltiness	Techogene pollution	Irrigation	
Wheat	98	1.0	1.05	1	1	1	1	1	102.9 x 3
Maize	98	0.85 x 1	1.05	1	1	1	1	1	87.5
Rice	84	0.4	1.05	1	1	1	1	1	33.6
Soy	100	0.77	1.05	1	1	1	1	1	80.95
Sunflower	100	0.7	1.05	1	1	1	1	1	73.5
Sugar beet	96	0.85	1.05	1	1	1	1	1	85.7
Tobacco	42	1.0	1.05	1	1	1	1	1	39.9
Tobacco	94	0.7	1.05	1	1	1	1	1	69.1
Cotton	96	0.7	1.05	1	1	1	1	1	70.6
Flax	96	0.8	1.05	1	1	1	1	1	80.64
Tomatoes	98	1.0	1.05	1	1	1	1	1	102.9
Pepper	98	1.0	1.05	1	1	1	1	1	102.9
Potatoes	87.1	0.2	1.05	1	1	1	1	1	18.3
Alfalfa	96	0.8	1.05	1	1	1	1	1	80.6
Pastures, meadows	93	0.6	1.05	1	1	1	1	1	61.4
Apples	100	0.9	1.1	1	1	1	1	1	94.5
Pears	96	0.9	1.05	1	1	1	1	1	90.7
Peaches	93	0.8	1.05	1	1	1	1	1	78.1
Cherries	87.5	1.0	1.05	1	1	1	1	1	91.9
Plums	96	0.8	1.05	1	1	1	1	1	80.6
Red berries	93	0.4	1.05	1	1	1	1	1	39.1
Grapes	89	1.0	1.05	1	1	1	1	1	89.1
Average growth class rating = (102.9 x 3 + 87.5 + 85.7 + 80.6 + 102.9 + 18.3 + 80.6 + 94.5 + 91.8 + 89.1) : 12 = 86.6									
Growth class category - II									

The agricultural lands represented by the averagely leached black earth, powerful (accumulated), No 12 in the soil map, are characterized by a little higher fertility and also fall into the II growth class category – very good lands. Their average growth class rating is 86.8. We have to note here, that the reason these soils to be in the II and not in the I growth class category is the non quite favorable climatic conditions in the region and the lack of irrigation conditions. These soils are ideal for growing wheat (soil rating 99 with 100 the maximum), maize (soil rating 99), sugar beet (soil rating 97), soy (100), sunflower (97), tomatoes and pepper (98), etc. (Tables 18 and 19).

The agricultural lands represented by the strongly leached black earth, powerful (No 13 in the soil map) have an average growth class rating of 86.7 under non-irrigation conditions (Tables 20 and 21) and also fall into II growth class category – very good lands.

As we can see from the supplied results, the main part of the territory of the WPP is represented by highly fertile lands. In order to follow the so called low limit of the soil fertility in the areas in question, the evaluation of the carbonate black earth was also made which have

no or poor erosion though their area is smaller. As we can see from Tables 22 and 23 their average growth class rating does not differ considerably from the other main representatives of the soil within the borders of the future WPP. They also fall into I growth class category - very good lands, but at the lower limit. They could be successfully used for growing soy, tomatoes, pepper, wheat, alfalfa, sunflower, cherries, grapes, maize.

3.6.4. State of the elements of the irrigation system

The agricultural lands in the reviewed territory are used without conditions for irrigation. There is no irrigation system.

3.6.5. Forecast and assessment of the expected changes in the soils as a result of the changed manner of permanent use by the implementation of the investment proposal

As a result of the implementation of the investment proposal the destruction of the soils will take place only on a very limited area of 12 ha or 0.15% of the total area. In its main part this is the sum of the areas for the foundation of the generators. The construction of the wind generators does not impose a change in the permanent use of the agricultural lands. They could be used in the future as well for agricultural purposes and it would not be necessary to change these purposes only if the recommendations for their protection during the construction of the park and the recultivation measures after the construction and installation works were taken into account. In case the lands are used for permanent cultures, there shall be servitude limitations around each generator according to the Waste management act. In the growing of crops this would not be necessary and this way of use could be considered preferable as more rational. Such is the practice in Germany (along the highway Berlin – Hamburg) and in Austria.

Table 18: Calculating the soil rating of the main cultures of the averagely leached black earth accumulated (No 12 in the soil map) in the territory of the village of Bulgarevo, Kavarna municipality

Soil parameters	wheat	maize	rice	soy	sunflower	Sugar beet	Tobacco	Tobacco	Cotton	Flax	Tomatoes	Pepper	Potatoes	Alfalfa	Pastures, meadows	apples	pears	Peaches	Cherries	plums	Red berries	Grapes
Mechanical composition – contents of physical clay -ploughed soil – 53% -subhorizon – 54%	100	100	2 x 80	100	100	100	60	100	100	80	100	100	2 x 60	100	100	100	100	80	2 x 90	100	60	2 x 80
Power of the humus horizon 100 cm	100	100	-	100	100	100	2 x 5	100	100	100	100	100	100	100	100	100	100	-	-	100	100	100
Power of the soil profile: 130 cm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texture coefficient 1,02	100	100	60	100	90	100	-	100	100	100	100	100	90	100	100	2 x 100	2 x 90	90	90	2 x 90	100	95
Soil reaction pH = 6.8	100	100	90	100	95	95	100	90	100	90	100	100	2 x 60	100	100	80	80	80	100	80	3 x 70	100
Humus content 2.65%	95	95	100	100	100	90	2 x 40	90	90	80	90	90	80	90	100	-	-	-	-	-	-	90
Level of ground water > 30 m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil rating	99	99	82	100	97	97	41.6	98	98	90	98	98	72.9	98	94	96	92	86.6	92.5	92	78.3	90.8

Table 19: Calculating the average growth class rating and establishing the growth class category of the soil averagely leached black earth, powerful (No 12 in the soil map) in the territory of the village of Bulgarevo, the municipality of Kavarna

Table 20: Calculating the soil rating of the main cultures of the strongly leached black earth, powerful (No 13 in the soil map) in the territory of the village of Rakovski, Kavarna municipality

Soil parameters																						
	wheat	maize	rice	soy	sun flower	Sugar beet	Tobacco	Tobacco	Cotton	Flax	Potatoes	Pepper	Potatoes	Alfalfa	Pastures, meadows	apples	pears	Peaches	Cherries	plums	Red berries	Grapes
Mechanical composition – contents of physical clay -ploughed soil – 51.1% -subhorizon – 59%	100	100	2 x 80	100	100	100	60	100	100	80	100	100	2 x 60	100	100	100	100	80	2 x 90	100	60	2 x 80
Power of the humus horizon 95 cm	100	100	-	100	100	100	2 x 5	100	100	100	100	100	100	100	100	100	100	-	-	100	100	100
Power of the soil profile: 120 cm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texture coefficient 1,15	100	100	60	100	100	100	-	100	100	100	100	100	90	100	70	2 x 100	2 x 90	100	90	2 x 90	100	95
Soil reaction pH = 6.1	90	90	90	100	100	80	90	90	90	100	90	90	2 x 100	80	100	100	100	100	80	100	3 x 100	80
Humus content 3.29%	100	100	100	100	100	100	2 x 5	80	100	100	100	100	100	100	100	-	-	-	-	-	-	100
Level of ground water > 30 m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil rating	98	98	82	100	100	96	30	94	98	96	98	98	87.1	96	94	100	96	93.3	87.5	96	93.3	89.2

Table 22: Calculating the soil rating of the main cultures of the carbonate black earth without erosion (No 1 in the soil map) in the territory of the village of Bulgarevo, Kavarna municipality

Soil parameters																						
	wheat	maize	rice	soy	sun flower	Sugar beet	Toba cco	Tob acco	Cot ton	Flax	Toma toes	Pep per	Pota toes	Alfalfa	Pastures, meadows	apples	pears	Pea ches	Cher ries	plums	Red berries	Grapes
Mechanical composition – contents of physical clay -ploughed soil – 57.3% -subhorizon – 56.5%	100	100	2 x 80	100	100	100	60	100	100	80	100	100	2 60 x	100	100	100	100	80	2 90 x	100	60	2 x 80
Power of the humus horizon 70 cm	100	100	-	100	100	100	2 x 5	100	100	100	100	100	100	100	100	100	100	-	-	100	100	100
Power of the soil profile: 70 cm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texture coefficient 0.97	80	70	20	100	80	80	-	70	70	100	100	100	100	60	50	2 x 80	2 x 80	90	100	2 x 70	100	100
Soil reaction pH = 7.2	100	100	90	100	90	95	100	100	100	100	100	100	2 x 60	100	100	80	80	80	100	80	3 x 70	100
Humus content 2.6%	95	95	100	100	95	90	2 40 x	90	90	90	90	90	80	90	100	-	-	-	-	-	-	90
Level of ground water > 30 m	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil rating	95	93	74	100	93	93	41.6	92	92	98	98	98	74.3	92	90	88	98	83.3	95	84	78.3	91.6

Table 23: Calculating the average growth class rating and establishing the growth class category of the soil carbonate black earth , without erosion (No 1 in the soil map) in the territory of the village of Bulgarevo, the municipality of Kavarna

Culture	Soil rating	Correction coefficients for							Field growth class number
		Climate	Erosion/accumulation	Presence of stones	Presence of marshes	Saltiness	Techogene pollution	Irrigation	
Wheat	95	1.0	1.05	1	1	1	1	1	95 x 3
Maize	93	0.85 x 1	1.05	1	1	1	1	1	79.1
Rice	74	0.4	1.0	1	1	1	1	1	29.6
Soy	100	0.77	1.05	1	1	1	1	1	77
Sunflower	93	0.7	1.05	1	1	1	1	1	65.1
Sugar beet	93	0.85	1.05	1	1	1	1	1	79.1
Tobacco	42	1.0	1.05	1	1	1	1	1	42.0
Tobacco	92	0.7	1.05	1	1	1	1	1	64.4
Cotton	92	0.7	1.05	1	1	1	1	1	64.4
Flax	94	0.8	1.05	1	1	1	1	1	75.2
Tomatoes	98	1.0	1.05	1	1	1	1	1	98.0
Pepper	98	1.0	1.05	1	1	1	1	1	98.0
Potatoes	74.3	0.2	1.05	1	1	1	1	1	14.9
Alfalfa	72	0.8	1.05	1	1	1	1	1	73.60
Pastures, meadows	90	0.6	1.1	1	1	1	1	1	54.0
Apples	88	0.9	1.1	1	1	1	1	1	79.2
Pears	88	0.9	1.05	1	1	1	1	1	79.2
Peaches	83	0.8	1.05	1	1	1	1	1	66.4
Cherries	95	1.0	1.05	1	1	1	1	1	95.0
Plums	84	0.8	1.05	1	1	1	1	1	77.3
Red berries	78.	0.4	1.05	1	1	1	1	1	31.2
Grapes	92	1.0	1	1	1	1	1	1	92.0
Average growth class rating = (95 x 3 + 79.1+79.1 + 75.2 +98.0 +14.9 + 73.6 +79.2 +95+92.2) :12 = 80.93									
Growth class category - II									

3.6.6. Changes and evaluation of the expected changes as a result of the different extent of degradation (inclusive of pollution) following the implementation of the investment proposal

The construction of the wind farm in the project borders according to the supplied investment intention, would not result in the pollution of the soil and therefore to changes in the chemical composition and the chemical properties of the soil, and respectively changes in the natural fertility and the ecological state of the soil. the chosen type of generators does not suppose any leaks and spills of oils and lubricants due to the protection with additional containers and the planned closed system of greasing the mechanisms. The construction of the foundations of the wind generators will bring about the physical destruction of soils but on minimal areas (62 x 200m².) Besides, the soil material from the excavations shall be

accumulated in the neighboring soils so that its destruction will not be total. A partial destruction of the soil cover is expected to take place in the zones neighboring the foundations of the generators as a result of the construction and the installation works. It is possible a partial secondary compaction of the soil by the used construction and installation technique to take place as a result of the use of heavy technique, especially if the excavation and the construction works take place at a greater humidity of the soil ($> 50 - 60\%$ of the W_{ppv} – the limit field humidity). The secondary compaction would in turn result in a decrease of the overall porosity and to worse water – air properties of the black earth found here, so in the end this would result in a decrease of the soil fertility. The secondary compaction of the soil as a result of the use of heavy machinery could be limited and its consequences – overcome by proper recultivation measures after the end of the construction period. The investment proposal does not foresee the construction of a new or a replacement of the existing infrastructure

Local pollutions by oil products are possible (fuel and lubricants) in case of eventual accidents with the construction and installation technique. It is supposed that they would be considerably limited by nature and having in mind the property of self cleaning, no significant changes could be expected in the composition and the properties of the soil.

3.6.7. Determining the territories affected by the construction and installation works and the soils needing recultivation after the end of the construction

During the construction some areas will be affected by the excavations for the foundations of the generators, the construction and then installation works, with overall territory of 12 ha, as well as areas from those properties, through which the access to the temporary construction sites from the third class roads will be made. No permanent transportation system was planned in connection with the operation of the generators. Their location was chosen in such a way, as the soils to be affected to a minimum – as close as possible to the third class roads. It is expected after the construction is over that some changes in the physical, mechanical and water properties of the soils will take place in the zones, affected by the construction and installation works (the mentioned types of black earth have heavy sandy – clayey mechanical composition).

According to the documentation of the investment proposal the excavated earth from the foundations to be used for covering of the temporary sites and roads. Before that it is obligatory these temporary sites and roads to be recultivated. The recultivation activities in this case include the use of meliorative deep breaking of the soil to the depth of 50 – 70 cm, preferably by dynamic devices with deep action. This will result in improving the general physical, water and air and especially the filtration properties of the soil, affected during the construction of the WPP. As a compromise during the first 2 – 3 years after the construction is

over, profiling deep ploughing at 30 -35 cm with turning of the layer shall be applied in combination with the application of natural fertilizer. It is recommended during the first years cultures with deeply penetrating root systems to be grown on these lands like wheat, maize, sunflower, rapeseed, alfalfa, which will result in better aggregation of the soil. It is of extreme importance the deep meliorative breaking of the soil (as well as the deep ploughing) to be performed when the humidity of the soil is suitable – 50 – 60% of W_l. The most suitable are the summer and the autumn. The unfavorable treatment is when the soil is dry because this could result in wind erosion.

The excavation works for the foundations of the wind generators would require the further use of 24 304 m³ of earth (62 generators x 392 m³). This earth is planned to be laid near the temporary construction sites. Since the depth of the excavations is considerable (2 m), the excavations will reach the soil forming rock layer which in this type of soils is uncovered below 1 m. That is why the excavation works shall be performed selectively – the soil substrate of the humus – accumulative horizon and the previous one shall be separated from that of the soil forming rock. The excavated earth from the surface 100 cm in compliance with Ordinance No 26, art.7, has to be preserved and reused. The excavated masses from the rock however, could be used, if necessary, for backfilling of the constructed foundations to not more than 1 m below the soil surface. The surplus amounts shall be transported and stored at specially chosen places (depots). Otherwise changes in the chemical composition and the properties of the soil may take place, because the substrate of the soil forming rock whose quantity is not negligible, is of a higher carbonate content and this will unfavorably affect the grown crops, and as a whole will result in the decrease in the fertility of the soil, though on limited areas.

The second type phytocenosis within the territory of the object is represented by the forest belts, which were set up 50 years ago. By data from the forest plans of the State Game-Breeding Station – Balchik, there are 36 forest belts within the territory of WPP. These belts, against the 60 km² of the park, make 0,6 per km² - an acceptable density of distribution.

What is most important is that the construction of the belts was connected with the construction of a whole network of main and secondary belts. By its construction, the belts are compact and when the vegetation is green, no light passes through them. The belt system forms rectangular areas of agricultural lands with sides 1200 – 1500 m x 500 -600 m. the width of the belts is 10 – 20 m, 16 m being the predominant width, and their height varies between 10 – 15 m.

During the construction of the WPP the soil along the ground electric power transmission lines will be partially affected which means narrow pieces of land whose overall length will be specified at the stage of the technical design. According to Ordinance No 20, art 8(3) the humus layer from these areas shall be used for the recultivation of the excavations. The backfilling shall be

selectively performed in the reverse order, the sequence of the horizons being the same as that before the excavation, preserving as much as possible the construction of the soil profile.

The insignificant changes of the soil cover only within the areas of the foundations of the wind generators will not result in changes of the other components of the environment. There exists a direct dependence only with the vegetation (natural and cultural), the consequences of which will not be negative, if the recommendations about the necessary recultivation activities, the use of the humus soil material and the organization of the construction and the installation works are taken into account

3.6.8. Need of changing the statute of the agricultural lands

The implementation of the investment proposal will affect only a limited part of the whole area of the future WPP – about 12 ha or 0.15%. In its main part it includes the sum of the areas of the foundations of the generators, areas about 1 000 m² about each generator and the terrain on which the substation is going to be constructed.

By the opinion of the experts who have elaborated the EIE report, the construction of the generators does not necessitate the change in the purpose of the permanently used agricultural lands. These could be used for this purpose in future and it is not to be allowed to change that purpose, which requires the strict observation of the recommendations about the protection of the soils during the construction of the WPP and the recultivation measures after the construction is over. The eventual use of the lands for perennial plants will force the imposition of servitude limitations around the generators in compliance with the Waste management act. In case of field crops this would not be necessary and it is this kind of use of the land that is preferable in this case as being more rational.

The regional directorate Agriculture and forestry – Dobrich, in its answer to the letter of the Investor, asking for an opinion on the investment proposal, recommends the sites to be constructed taking account of the main purpose of the land in the area – the agricultural production (Letter No RD-13-681/17.03.2006)

It will be necessary to start a procedure of changing the purpose of the land only for the area of construction of the substation and eventually, the foundations of the generators. The Investor has prepared a set of documents in compliance with art.40 of the Regulation on the preservation of the agricultural lands – about the change in the purpose of these lands and these documents are to be submitted to the regional directorate Agriculture and forestry – Dobrich.

3.6.9. Need of elaboration and implementation of a project for the recultivation of the affected lands

As it was pointed out hereinabove, some destruction of the soil cover in the areas neighboring the foundations of the wind generators during the construction and installation works is to be expected. It is possible these works, especially with the use of heavy machinery, to result in a secondary compaction of the soils, as they are performed at high humidity of the soil. During the construction of the WPP the soil along the ground power transmission network will also be affected along a narrow band whose length will be specified further in the stage of the technical design.

In the course of the construction and installation works the existing third class roads will be used to the maximum, in order not to pollute and compact the neighbouring agricultural lands. Since it will be necessary to have access to each site for a wind generator, these areas also have to be recultivated.

During the construction of the substation the soil cover of an area of 4500 m² will be permanently affected – this is the area on which the building and the equipment of the substation will be located. On the rest of 1500m² of this site the soil cover will be only partially affected.

According to Ordinance No 26/1966 on the recultivation of affected territories, the improvement of poorly productive lands, the taking off and the use of the humus layer, (promulgated SG No 89/1996, amended and supplemented No 30/2002), after the construction of the wind generators, the substation and the ground cable network, it is necessary to perform certain recultivation activities. That is why a project must be elaborated and implemented for the recultivation of the affected lands.

The recultivation activities for the areas around the wind generators include meliorative deep braking of the soil down to 50 – 70 cm, preferably by dynamic devices with deep action. This will improve the overall physical, water and air and especially the filtration properties of the soil, affected during the construction of the WPP. As a compromise deep ploughing could be applied down to 30 – 35 cm with turning the layer and using natural fertilizer. In the first years after the construction it was recommended to grow cultures with deeply penetrating root system like wheat, maize, sunflower, rapeseed, alfalfa, which will result in better aggregation of the soil. The best seasons for this treatment are the summer and the autumn, when the humidity of the soil is most suitable – 50 – 60% of the Wlfh. Such treatment shall not be performed when the soil is dry in order not to intensify the wind erosion.

The partially affected areas along the ground cable network must be recultivated as well. According to Ordinance No 26, art. 8(3) the humus layer from this piece of land shall be used for the recultivation of the excavations. The backfilling must be performed selectively, that is the reverse order to that of the excavation, preserving as much as possible the construction of the soil layer.

The thus indicated activities with regard to recultivation are those which should at the opinion of experts who developed this part of the EIA Report be anticipated during the elaboration of a project for recultivation of the disturbed terrains. The project itself should be developed in a working phase of implementation of the investment proposal and is not subject-matter of this EIA Report.

3.7. VEGETATION

The wind farm falls within the area of the Northern Black Seaside – lower Danubian soil sub-area – Danubian – Dobroudja Province in conformity with the division of Bulgaria into districts in compliance with Mihaylov, 1982, Koukoularov and Ninov, 1997 for the coil geographic division of Bulgaria. The site falls within an area characterized by the fact that no erosion is manifested there, but there is wide area deflation (surface carrying away of the soil layer by the hot dry winds). There is specific mezophyte and xero-mezophyte vegetation is available on the type of variety of soils dominating here – chernozem.

The present condition of the existing vegetation is determined mainly by two types of phytocoenoses. The first and most widely spread out type of phytocoenoses are agro- phytocoenoses (cultivable agricultural areas), which arose over the place of former forest, oak plantations. Mainly wheat species, soya, beetroot, coriander and others are mainly sowed over these territories which are now fully used for agricultural cultures. The agricultural lands have very high natural fertility and the building up of the wind power generators is anticipated on a part of them. They, however, will take about 0,15 % of the total area of the territory which is designated for the wind farm, which in practice is neglectfully insignificant. What is essential is that the future operation of the wind farm will not be an obstacle for its main designation – agricultural areas. The changes in the species composition of the agro- phytocoenoses will be fully subordinated to the conducted vegetation technologies and related to the creation of one-year cultures and alternation of crop-rotations.

The second type of phytocoenoses located within the scope of the site are represented by the created here nearly 50 years ago wind protective vegetation zones. According to data from the forest structural plans of VAT – Balchik, the availability of 36 nos. of belts is reported within the scope of the wind farm (WPP). These zones referred in relation to the total territory of the wind farm, which is about 60 km², this makes 0,6 nos. per 1 km², which as a degree of density is within reasonable limits.

What is essential for these forest shelter belts is that their building up is related to the creation of an overall network of main and secondary belts or zones. Per their structure the belts are of the type thick belts which in leaved condition are almost without open spaces in the entire profile. The field protecting network forms rectangular fields of cultivable land with longitudinal sides every

1200 – 1500 m and transverse sides every 500 – 600 m. In their structure in width the belts vary between 10 – 20 m, their predominant width now being about 16 m and height about 10 – 15 m.

The main ligneous species of which the belts are built up and which occupy the first stratum of the plantations are oak-trees *Quercus* (summer – *Quercus pedunculata*, winter – *Quercus sessiliflora*, hairy – *Quercus pubescens*, red – *Quercus rubra* and – *Quercus cerris*). The participation of the following is reported in the belts as well: acacia (*Robinia pseudoacacia*), three-thorned acacia (*Gleditschia triacanthos*), ash-tree (*Fraxinus oxycarpa*), small-leaved elm-tree (*Ulmus minor*), walnut-tree (*Juglans regia*) and others.

The following are reported as associated species in the second stratum of the belts: lime (*Tilia argentea* and *Tilia grandifolia*), maple (*Acer campestre*), Tatarian maple (*Acer tataricum*), sycamore (*Acer negundo*), machaleb cherry (*Prunus mahaleb*), wild plum (*Prunus cerasifera*) and others.

A significant number of bush species are accommodated in the lowest stratum of the belts. They are represented predominantly by sumach (*Cotinus coggygia*), oleaster (*Elaeagnus angustiflora*), common privet (*Ligustrum vulgare*), lilac (*Syringa vulgaris*), prick wood (*Euonymus europaeus*), amorpha (*Amorpha fruticosa*), black elder (*Sambucus nigra*) and others.

The correlation between the main species, the associated and the bushes is in medium correlation 33 : 29 : 38 %. Per their functions and creation the forest shelter belts as plantations represent public state-owned property with special designation. All this imposes their overall maintenance and preservation. The wind generators allowed for building up in the investment proposal will not result in damage to the plantations.

It may be noted after the stated herein that:

- the availability of centuries-old or remarkable trees as well as of medicinal plants mentioned in the Medicinal Plans Act is not reported within the scope of the wind farm

- there are no conservationally significant species and their habitats here.

In conclusion it may be said that the activity of the wind generators does not threaten the existing phyto-diversity and the defining of zones requiring special interference is not indispensable.

The forest shelter belts are the biggest value within the scope of the wind farm, from the point of view of the long-lived and most of all wood – bush vegetation. On the one hand the afforestation of the area is increased by them. On the other hand, as landscape – ecological structures these belts were created on typical agricultural lands, turning in practice the agrarian landscape into a

forest-agrarian landscape. Further to that the shelter belts not only modify the meteorological conditions but they also contribute to the increase of the crops. It is known that they provide for the protection of both grain and earthed-up crops. They also render assistance with their vegetation composition to the improvement of the bees collecting pollen and the bee pollination of the plants.

Proceeding from the analysis made so far the generalizing forecast and valuation of the changes anticipated in the relevant phytocoenoses are fully into a positive aspect. This means that the anticipated 62 nos. of wind generators will not exert a negative impact both on the growing up of the agricultural crops and on the existence of the artificially created vegetation shelter belts. Their availability will remain significant means for the increase of the bio-climatic potential in this area of the coastal Dobroudja lands and will cooperate for the active regulation within the quadrant of lands of the town of Kavarna – the village of Bulgarevo – the village of Sveti Nikola – the village of Porouchik Chounchevo.

Finally in a forecast aspect, proceeding from the continuous investigations over the composition and the structure of the vegetation forest shelter belts in this area of Dobroudja coast the conclusion is reached that the oak-tree and the three-thorned acacia are the most appropriate species for afforestation in Dobroudja. Also the most stable for icebreakers are the belts of walnut-trees, oak-trees, red and summer oak-trees. This is why there may not be any anticipated changes over the condition of significant vegetation species and the main attention is to be focused at the hereinabove mentioned species which for a 50-year time period manifested the best practical results.

3.8. ANIMAL WORLD

The territory designated for the building up of a wind farm in the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovsji and Porouchik Chounchevo represents cultivable agricultural lands with forest shelter belts and dirt roads. This type of artificial agro-ecosystems maintains low biological diversity. The forest shelter belts play the role of natural corridors and sole appropriate habitats of some of the representatives of the fauna within the area.

In view of the fact that the birds are the most vulnerable of the building up of similar facilities they were paid more special attention. The data about the ornithofauna in the place for construction of the wind power facilities are from the conducted terrain monitoring investigations made in 2004 and 2005 (reports with ref. No 227 – RD – 08 dated 10.06.2005, No 301 – RD – 08 dated 02.08.2005 and No 479 – RD – 08 dated 22.12.2005), published literature and personal information. The remaining components of the animal world are described from collected data during the terrain investigations and literary sources about the area.

3.8.1. Characteristics of the condition of the fauna – species diversity, threatened, protected and extinct species, habitats.

Southern Dobroudja is a region with intensely expressed changes in the landscape structure in consequence of the anthropogenic interference in the last few decades. The biodiversity here is intensely reduced, and a limited number of species find appropriate conditions for existence in the artificially created agro-ecosystems.

The forest shelter belts play significant corridors for the entrance of the birds and the mammals into the extensive agricultural areas. Some of them are 40 to 50-year-old and offer good conditions for existence of species of animals more closely connected to the forest vegetation complexes.

We established 139 species of birds during the conducted terrain investigations within the region anticipated for the construction of the wind farm. This is more than 1/3 than the species established for the country (Nankinov, 1992) (Table 24). They belong to 16 classes. The signing birds are the most numerous in number – class Passeriformes. Birds of prey are richer in species (class Falconiformes) and the representatives of class Plovers (Charadriiformes) as well. A great part of them pass through the region solely during migration.

Table 24: Species composition and natural protective status of the birds in the territory of the villages of bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna

Species			Natural protective status					
No	Latin name	English name	Biological Diversity Act	RB	Bern	Bonn	SPEC	ETS
1	Accipiter brevipes	Levant sparrow hawk	+	Thr	II	II	2	R
2	Accipiter gentilis	Northern goshawk	+	Thr	II	II		S
3	Accipiter nisus	Sparrow hawk	+	Thr	II	II		S
4	Acrocephalus palustris	Marsh warbler	+		II	II	4	S
5	Alauda arvensis	Sky lark	+		III		3	V
6	Anas platyrhynchos	Mallard	-		III	II		S
7	Anser albifrons	Great white-fronted goose	-		II	II		S
8	Anthus campestris	Tawny pipit	+		II		3	V
9	Anthus cervinus	Red-throated pipit	+		III			(S)
10	Anthus trivialis	Tree pipit	+		III			S
11	Apus apus	Common swift	+		III			S
12	Apus melba	Alpine swift	+		II			(S)
13	Aquila clanga	Greater spotted eagle	+	R	II	II	1	E
14	Aquila pomarina	Lesser spotted eagle	+	Thr	II	II	3	R
15	Aquila nipalensis	Steppe eagle	+	R	II	II	3	V
16	Ardea cinerea	Gray heron	+		III			S
17	Asio flammeus	Short-eared owl	+	R	II		3	(V)
18	Athene noctua	Little owl	+		II		3	D
19	Bubo bubo	Eagle owl	+	Thr	II		3	V
20	Burhinus oedecnemus	Stone curlew	+	Thr	II	II	3	V
21	Buteo buteo	Common buzzard	+		II	II		S
22	Buteo rufinus	Long-legged buzzard	+	Thr	II	II	3	(E)
23	Calandrella	Great short-	+		II		3	V

Species			Natural protective status					
No	Latin name	English name	Biological Diversity Act	RB	Bern	Bonn	SPEC	ETS
	brachydactyla	toed lark						
24	Caprimulgus europaeus	European nightjar	+		II		2	(D)
25	Carduelis cannabina	Linnet	+		II		4	S
26	Carduelis carduelis	Goldfinch	+		II			(S)
27	Carduelis chloris	European greenfinch	+		II		4	S
28	Carduelis spinus	Siskin	+		II		4	S
29	Ciconia ciconia	White stork	+		II	II	2	V
30	Ciconia nigra	Black stork	+	Thr	II	II	3	R
31	Circaetus gallicus	Short-toed eagle	+	Thr	II	II	3	R
32	Circus aeruginosus	Marsh harrier	+	Thr	II	II		S
33	Circus cyaneus	Northern harrier	+	R	II	II	3	V
34	Circus macrourus	Pallid harrier	+	R	II	II	3	E
35	Circus pygargus	Montague's harrier	+	R	II	II	4	S
36	Coccothraustes coccothraustes	Hawfinch	+		II			S
37	Columba livia f. Domestica	Rock dove (Rock pigeon)	-					
38	Columba palumbus	Woodpigeon	-		III		4	S
39	Coracias garrulus	European roller	+		II	II	2	D
40	Corvus corax	Common raven	+					(S)
41	Corvus corone cornix	Hooded crow	-					S
42	Corvus frugilegus	Rook	-					S
43	Corvus monedula	Eurasian jackdaw	-				4	(S)
44	Coturnix coturnix	Common quail	-		III	II	3	V
45	Crex crex	Corncrake	+	Thr	II		1	V

Species			Natural protective status					
No	Latin name	English name	Biological Diversity Act	RB	Bern	Bonn	SPEC	ETS
46	Cuculus canorus	Cuckoo	+		III			S
47	Cygnus olor	Mute swam	+	Thr	III	II		S
48	Delichon urbica	House martin	+		II			S
49	Dendrocopos major	Great spotted woodpecker	+		II			S
50	Dendrocopos syriacus	Syrian woodpecker	+		II			(S)
51	Emberiza citrinella	Yellowhammer	+		II		4	(S)
52	Emberiza hortulana	Ortolan bunting	+		II		2	(V)
53	Emberiza melanocephala	Black-headed bunting	+		III		2	(V)
54	Erithacus rubecula	Robin	+		II	II	4	S
55	Falco cherrug	Saker falcon	+	Thr	II	II	3	E
56	Falco columbarius	Marlin	+		II	II		S
57	Falco peregrinus	Peregrine falcon	+	Thr	II	II	3	R
58	Falco subbuteo	Eurasian hobby	+	Thr	II	II		S
59	Falco tinnunculus	Eurasian kestrel	+		II	II	3	D
60	Falco vespertinus	Red-footed falcon	+	R	II	II	3	V
61	Ficedula hypoleuca	Pied flycatcher	+		II	II	4	S
62	Ficedula parva	Red-breasted flycatcher	+		II	II		(S)
63	Fringilla coelebs	Chaffinch	+		III		4	S
64	Fringilla montifringilla	Brambling	+		III			S
65	Galerida cristata	Crested lark	+		III		3	(D)
66	Garrulus glandarius	Eurasian jay	+					(S)
67	Grus grus	Common crane	+	E	II	II	3	V
68	Heraaetus pennatus	Booted eagle	+	Thr	II	II	3	R

Species			Natural protective status					
No	Latin name	English name	Biological Diversity Act	RB	Bern	Bonn	SPEC	ETS
69	Haematopus ostralegus	Eurasian oystercatcher	+	Thr	III			S
70	Hippolais icterina	Icterine warbler	+		II	II	4	S
71	Hippolais pallida	Olivaceous warbler	+		II	II	3	(V)
72	Hirundo daurica	Red-rumped swallow	+		II			S
73	Hirundo rustica	Barn swallow	+		II		3	D
74	Lanius collurio	Red-backed shrike	+		II		3	(D)
75	Lanius minor	Lesser grey shrike	+		II		2	(D)
76	Larus cachinnans	Caspian gull	+		III			(S)
77	Larus fuscus	Lesser black-backed gull	+				4	S
78	Larus melanocephala	Mediterranean gull	+	R	II	II	4	S
79	Larus minutus	Little gull	+		II		3	D
80	Larus ridibundus	Black-headed gull	+	R	III			S
81	Lullula arborea	Wood lark	+		III		2	V
82	Luscinia megarhynchos	Nightingale	+		II	II	4	(S)
83	Melanocorypha calandra	Calandra lark	+		II		3	(D)
84	Merops apiaster	European bee-eater	+		II	II	3	D
85	Miliaria calandra	Corn bunting	+		III		4	(S)
86	Milvus migrans	Black kite	+	Thr	II	II	3	V
87	Motacilla alba	Pied wagtail	+		II			S
88	Motacilla cinerea	Gray wagtail	+		II			(S)
89	Motacilla flava feldegg	Black-headed wagtail	+		II			S
90	Muscicapa striata	Spotted flycatcher	+		II	II	3	D
91	Nycticorax nycticorax	Night heron	+		II		3	D
92	Oenanthe	Black-eared	+		II	II	2	V

Species			Natural protective status					
No	Latin name	English name	Biological Diversity Act	RB	Bern	Bonn	SPEC	ETS
	hispanica	wheatear						
93	Oenanthe isabellina	Isabelline wheatear	+		II	II		(S)
94	Oenanthe oenanthe	Northern wheatear	+		II	II		S
95	Oenante pleschanka	Pied wheatear	+		II	II		(S)
96	Oriolus oriolus	Golden oriole	+		II			S
97	Otus scops	Common (Eurasian) scops owl	+		II		2	D
98	Pandion haliaetus	Osprey	+	Thr	II	II	3	R
99	Parus caeruleus	Blue tit	+		II		4	S
100	Parus major	Great tit	+		II			S
101	Passer domesticus	House sparrow	-					S
102	Passer hispaniolensis	Spanish sparrow	+		III			(S)
103	Passer montanus	Tree sparrow	+		III			S
104	Pelecanus crispus	Dalmatian pelican	+	Thr	II	I&II	1	V
105	Pelecanus onocrotalus	Great white pelican	+	E	II	I&II	3	R
106	Perdix perdix	Gray partridge	-		III		3	V
107	Pernis apivorus	European honey-buzzard		Thr	II	II	4	S
108	Phalacrocorax aristotelis	Shag	+	Thr			4	S
109	Phalacrocorax carbo	Grand cormorant	+	Thr	III			S
110	Phasianus colchicus	Ring-necked (Common) pheasant			III			S
111	Phoenicurus ochruros	Black redstar	+		II	II		S
112	Phoenicurus phoenicurus	Common redstar	+		II	II	2	V
113	Phylloscopus Ilcollybita	Chiffchaff	+		II	II		(S)
114	Pllhyloscopus	Wood warbler	+		II	II	4	(S)

Species			Natural protective status					
No	Latin name	English name	Biological Diversity Act	RB	Bern	Bonn	SPEC	ETS
	sibilatrix							
115	Phylloscopus trochilus	Willow warbler	+		II	II		S
116	Pica pica	Magpie	-					S
117	Podiceps nigricollis	Eared grebe	+	Thr	II			S
118	Porzana porzana	Spotted crane	+		II	II	4	S
119	Regulus ignicapillus	Firecrest	+		II	II	4	S
120	Regulus regulus	Goldcrest	+		II	II	4	(S)
121	Riparia riparia	Sand martin (Bank swallow)	+		II		3	D
122	Saxicola rubetra	Whinchat	+		II	II	4	S
123	Saxicola torquata	Stonechat	+		II	II	3	(V)
124	Scolopax rusticola	Woodcock	-	R	II	II	3	V
125	Streptopelia decaocto	Collared dove	-		III			(S)
126	Streptopelia turtur	Turtle dove	-		III		3	D
127	Sturnus vulgaris	European starling	-					S
128	Sylvia atricapilla	blackcap	+		II	II	4	S
129	Sylvia borin	Garden warbler	+		II	II	4	S
130	Sylvia communis	Greater whitethroat	+		II	II	4	S
131	Sylvia curruca	Lesser whitethroat	+		II	II		S
132	Sylvia nisoria	Barred warbler	+		II	II	4	(S)
133	Troglodytes troglodytes	Winter wren	+		II			S
134	Turdus merula	Blackbird	+		II	II	4	S
135	Turdus philomelos	Song thrush	+		II	II	4	S
136	Turdus pilaris	Fieldfare	+		III	II	4	S
137	Turdus viscivorus	Mistle thrush	+		III	II	4	S

Species			Natural protective status					
No	Latin name	English name	Biological Diversity Act	RB	Bern	Bonn	SPEC	ETS
138	Upupa epops	Eurasian hoopoe	+		II			S
139	Vanellus vanellus	Lapwing	+		III	II		(S)

Key:

BDA – Biological Diversity Act

+ species included in attachments 2 and 3

- species included in attachments 4 and 6, under regime of preservation and regulated use

RB – Red Book of Bulgaria:

Thr – threatened species

R – rare species

E – extinct species

Bern – Convention on Conservation of European Wildlife and Natural Habitats:

II – species included in attachment II, as strictly protected

III – species included in attachment III of the convention

Bonn – Convention on the Conservation of Migratory Species of Wild Animals;

I – species threatened with extinction

II – species needing international cooperation for their preservation

SPEC – species with international natural protective status

1 – European species with global significance

2 – European species with unfavorable natural protective status in Europe

3 – Non-European species with unfavorable status in Europe

4 – European species with favorable natural protective status

ETS – degree of threatening of bird

E – threatened species

V – vulnerable species

R – rare рядък вид

D – decreasing species

S – stable species

() – the status is temporary

The nesting birds are significantly fewer in number and they may be divided into birds nesting in the forest shelter belts and such inhabiting the agro-systems. We established 37 species of nesting birds in the forest shelter belts between the villages of Kamen Bryag, Bulgarevo and Hadji Dimitar. From them 6 species were not observed in the belts up to the reproduction season of year 2005. At the total area of 52,8 hectares we mapped (Mapping method) 314 couples belonging to 8 classes. The species composition of the nesting birds in the agrocoenosis is rather poor. In the seven types investigated by us various monocultures we established a total of 1 species of birds. This is an indicator that the artificial agro-ecosystems have a limited composition of vegetation and animal components and weak mechanisms for self-regulation.

The fields sown with wheat are inhabited by the biggest number of species: three species of skylarks – the field-lark (*Alauda arvensis*), the thick-beaked (*Melanocorypha calandra*) and the crested (*Galerida cristata*), the yellow wagtail (*Motacilla flava*), the quail (*Coturnix coturnix*) and the partridge (*Perdix perdix*). The field-lark is encountered in all types of monocultures and is the dominating type in them (Karaivanov, 2004).

The bats are a riskier group from the remaining representatives of the fauna class Chiroptera, which would also have a direct contact with the facilities (Table 25). During the autumn of year 2004 we performed observation over the species composition of the bats through detector of type "Pettersson D 240" and sound recording equipment SONY.

The computer analysis was made with the help of specialized software "BatSound 3.10".

Table 25: Composition of vertebrates (without birds) and their national natural protective status on the territory of the wind farm

No	SPECIES		Natural protective status	
	Latin name	English name	BDA	RB
	Amphibian class			
1	Bufo viridis	Frog	3	
2	Hyla arborea	Hylidae	2.3	
3	Pelobates syriacus balkanicus	Balkan spadefoot toad	2.3	Thr
4	Pelobates fuscus	Ordinary spadefoot toad	2.3	
	Reptiles class (Reptilia)			
1	Coluber jugularis	Whip snake	3	
2	Elaphe longissima	Aesculapian snake	3	Thr
3	Elaphe quatuorlineata sauromates	Grass-snake	2.3	

No	SPECIES		Natural protective status	
	Latin name	English name	BDA	RB
4	Lacerta trilineata	Lizard		
5	Lacerta viridis	Green lizard		
6	Ophisaurus apodus	European legless lizard	3	Thr
7	Podarcis muralis	Wall lizard		
8	Podarcis taurica	Crimean lizard		
9	Testudo graeca	Greek tortoise	2.3	
10	Testudo hermanni	Hermann's tortoise	2.3	
11	Vipera ammodytes	Vipera	4	
12	Natrix tessellata	Dice snake		
Mammals Class (Mammalia)				
1	Eptesicus serotinus	Serotine bat	2.3	
2	Pipistrellus nathusii	Nathusius's pipistrelle	2.3	
3	Pipistrellus pipistrellus	Pipistrelle bats	2.3	
4	Pipistrellus pygmaeus	Pipistrelle bats		
5	Rhinolophus ferrumequinum	Greater horseshoe bat	2.3	
6	Rhinolophus hipposideros	Lesser horseshoe bat	2.3	
7	Myotis sp. P.	Myotis sp.		
8	Erethaceus concolor	Eastern European hedgehog	3	
9	Talpa europaea	European mole		
10	Crocidura leucodon	bicolored shrew		
11	Crocidura suaveolens	Lesser White-toothed Shrew		
12	Spermophilus citellus	European hamster	2	
13	Glis glis	Myoxus glis		
14	Nanospalax leucodon	Ehrenberg's mole rat		
15	Mus sp.	Home mice		
16	Rattus norvegicus	Gray rat		
17	Apodemus sp.	Forest mice		
18	Microtus arvalis	Field-mouse		
19	Mesocricetus newtoni	Romanian hamster	2.3	R
20	Lepus europaeus	European hare		
21	Mustela putorius	Polecat	4	
22	Vormela peregusna	Vormela	2.3	Thr
23	Putorius evermanni	Ferret	2.3	R
24	Mustela nivalis	Weasel	3	
25	Martes foina	Marten		
26	Meles meles	Badger		
27	Vulpes vulpes	Fox		
28	Canis aureus	Jackal	4	

No	SPECIES		Natural protective status	
	Latin name	English name	BDA	RB
29	<i>Felis silvestris</i>	Wild cat	4	
30	<i>Sus scrofa</i>	Wild-boar		
31	<i>Cervus elaphus</i>	Red deer		
32	<i>Capreolus capreolus</i>	Doe		

Key:

BDA – Biological Diversity Act, species included in attachments 2, 3 and 4

RB – Red Book of Bulgaria:

Thr – threatened species

R – rare species

We established seven species of bats on the territory of the municipality of Kavarna and the region above the cliff rich in rock niches, cracks and caves:

- *Rhinolophus hipposideros*. The species is widely spread out within the region.
- *Rh. ferrumequinum*. It is frequently encountered along with the *Rhinolophus hipposideros*.
- *Myotis sp.* Single species were registered of the small kind of class *Myotis*.
- Serotine bat (*Eptesicus serotinus*). Single species were registered both within the region of the rock corollas and over the open steppe territories.
- Common pipistrelle bats (*Pipistrellus pipistrellus*). Hunting species were established beside isolated trees in the uncovered steppe territories.
- Soprano pipistrelle bats (*Pipistrellus pygmaeus*). The species is frequently encountered in the regions of the humid zones along the Black Seaside. It is deemed as scarce species for the territory of Bulgaria. It was established in the proximity of the rock corollas.
- *P. nathusii*. Migrating species. It is registered with great number during the autumn time period and very high nutrient activity along the entire Black seaside.

During a visit to three of the caves within the region of Rusalka we observed active *Rhinolophus hipposideros* and observed recent traces probably of a reproductive colony. The traces of guano on the stratification of the cave witnessed that this was a shelter during the spring-summer time period. The territory for construction of the wind farm is at u1087 over 4 – 5 km from the sea

coast, respectively the cliff which assumes that the species diversity and number of bat here will be lower.

The construction of the wind generators would not exert pernicious influence over the remaining representatives of the fauna.

4 species are encountered from the amphibians within the region. These are land frogs related to more open-air spaces. The green common toad (*Bufo viridis*) is a common and frequently encountered species. All species are protected by the Biological Diversity Act and the Balkan spadefoot toad (*Pelobates syriacus balkanicus*) is in the Red Book of Bulgaria.

The reptiles are 12 species. Two species of terrestrial tortoises, 5 species of snakes and 5 species of lizards. The *Ophisaurus apodus*, the *Coluber jugularis* and the viper (*Vipera ammodytes*) are frequently encountered.

A great part of the birds established within the region of the area is protected by our national legislation (Annex 2 and 3 of the Biological Diversity Act). The hunting sites (Annexes 4 and 6 of the Biological Diversity Act) make an exception, the house sparrow (*Passer domesticus*) and some crow birds. The grey-eyed golden eye or stone curlew (*Burhinus oedipnemos*), *Crex crex*, *Ciconia nigra*, a great part of the birds of prey and others are included in the Red Book of the Republic of Bulgaria in the category of threatened or rare species. According to the international natural protective status 3 species are in the category SPEC 1: *Aquila clanga*, *Crex crex* and *Pelecanus crispus*. These are species of global significance. 11 species are in SPEC 2, i.e. these are kinds with unfavorable natural protected status in Europe. Twenty-two species are with degree of threatening vulnerable (V), in conformity with the Birds of Europe (Tucker, Heath, 1994) and 7 species are in the category scarce. The saker falcon (*Falco cherrug*), the pallid harrier (*Circus macrourus*), the long-legged buzzard (*Buteo rufinus*) and the spotted eagle are threatened species with decreasing European populations.

From the established 32 species of mammals 11 species are protected by the Biological Diversity Act and 3 species are included in the Red Book of Bulgaria. The hamster, the mole and the Dobroudja black-bellied hamster are with an international protected natural status as vulnerable species. They are encountered within the region but predominantly in the steppe habitats.

Solely the mole enters mainly the belts and the field boundaries amongst them though more seldom.

3.8.2. Significant places with regard to nutrition, nesting, reproduction. Seasonal presence, migrations

The territory anticipated for realization of the investment proposal comprises two main biotopes. These are cultivable areas with monocultures and artificially planted forest shelter belts. As it was indicated hereinabove, the permanent species of the fauna are too limited. The nesting birds in the belts add up to 37 in number and in the agrocoenosis their number adds up to barely 7 species.

Significantly more species are encountered during migration, some of them also being directly threatened by the construction of the wind generators. During the monitoring exercised in autumn, 15 August – 15 November of years 2004 and 2005 we established within the region and its associated territories respectively 103 and 102 species of birds. We observed 88 species on the same territory during the spring migration. We registered 68 of them in the steppe habitats and 72 species in the cultivable areas and the forest shelter belts. Thus we established in aggregate 139 species of birds during the three seasons of observation. 27 species of the wandering and birds of prey migrate through the region.

It may be said that in autumn the diversity in species is bigger and the autumn migration is more intensive than the spring one.

21 species of the migrating wandering and birds of prey passed through the region in the autumn of 2005. Of them 8 species were not established during the spring monitoring.

The levant sparrow hawk (*Accipiter brevipes*), the steppe eagle (*Aquila nipalensis*), the common crane (*Grus grus*), the black stork (*Ciconia nigra*) and others are amongst them. The main direction of migration in August and the beginning of September was to the south-west and at the end of September and October – to the northwest. This was the main direction for the small-sized and singing species of birds. The direction was almost always opposite to the wind and the birds flew against it.

The white storks (*Ciconia ciconia*) are the main migrants during the autumn migration at the beginning of the time period, the second half of the month of August. In total for year 2005 about 3400 storks passed through the region of the municipality of Kavarna, between the sea coast and the road Kavarna – Shabla (E 87) and in 2004 their number was higher – about 4500. The main direction of the migration is from northeast to southwest and the height about 300 m (between 150 and 500 m). We noticed the peak of migration with this species on 23 and 24 August 2005, when over 2500 birds migrated and last year (2004) the main flow passed on 21 – 23 August. The migrating storks during that autumn adhered to 5 to 10 km inside the land avoiding the more distant eastern coastal territories. Their direction and location coincided with the road from Sveti Nikola for Bulgarevo. A part of the flocks observed from Rousalka followed the costal line after which they set off for the west to the village of

Bulgarevo and crossed the sea in the direction of Golden Sands maximally close to the coast. The main flow of white stocks passed in this manner during the autumn of year 2004.

The direction of the autumn flight of pelicans and black storks is the same – from northeast to southwest. We observed small groups of black storks over the cultivable areas between Bulgarevo and Sveti Nikola fly to the northwest at the end of September.

No flocks of wandering birds were established over the territory under investigation in the spring of 2005.

We reported the biggest values of migration after 20 September 2005.

Then the weather sharply deteriorated with abundant precipitations and decrease of temperatures. This might be one of the reasons for the mass migration of the birds of prey (class Falconiformes) which took place between 22 September and 1 October. On 22, 23 and 24 September the main migrants were the European honey-buzzard and the Common buzzard. The European honey-buzzards predominated forming loose flocks of 70 to 80 birds. The main flow of them passed to the southwest of the territory under investigation, following the line of the cliff from Kaliakra Cape to Kavarna. By wandering flight they gathered height of 500 – 600 m and planned into a western and northwestern direction crossing the line Balchik – Kavarna and continuing inside the mainland. After 25 September, probably due to the strong to gusty northern wind the birds flew through Kaliakra Cape and a little to the north of it entering inside the mainland. European honey-buzzards significantly decreased, the buzzards and March harriers (*Circus aeruginosus*) increased in number. We reported the highest values of migration on 25 and 26 September. Over 3500 individuals of 14 species of wandering birds passed over Kaliakra Cape during these 2 days. Most birds flew to northwest coming from the sea and overcoming the strong northern wind.

The main direction during the peak of the migration – 26 September was from the cape inside the mainland to the northwest. Thus they passed the line of the road Bulgarevo – Sveti Nikola and passed over the territory under investigation in northwestern or north – northwestern direction. Owing to the thermals over the cape and the gathered height they passed through the region at altitude of over 200 m. These mainly were buzzards, black storks, lesser spotted eagles, small hawks and short-toed eagles. Over 860 buzzards, over 100 small hawks, 15 lesser spotted eagles, 10 short-toed eagles were registered for two hours. The birds flew uniformly during all the time in loose non-compact flocks.

From the wandering but non-predatory birds over 1100 Great white pelicans also flew over the region during the same day. This is the most mass migration of the species during the autumn monitoring. The birds came from the

north, from the direction of the village of Tyulenovo and adhering to the coastal strip, with a planning flight they flew to the southern direction over the steppe territories and Kaliakra Cape at height of 200 – 300 m over the mainland. We also observed flocks of migrating pelicans on 24, 27 and 28 September but with a significantly smaller number.

We watched pelicans over the agricultural areas between Bulgarevo, Sveti Nikola and Hadji Dimitar solely on 27 September. Fifty pelicans of this species flew from northeast to southwest and reaching the cliff they turned into the direction of the town of Kavarna at a height of about 150 m.

After 27 September main migrants in the region were the buzzards and the small hawks but with lower number. After 1 October the intensity of migration sharply fell down.

In 2004 the mass migration at these species of birds though with weaker intensity was displaced one month later on – after the middle of October. The main migration directions within the region of the Municipality of Kavarna added up to two in number, from northeast to southwest following the sea coast and reaching Kaliakra Cape. Most bird flow in this direction over the steppe territories entering inside the mainland at Rousalkata complex and the locality of Yaylata. From Kaliakra Cape most birds of prey fly into the northwestern direction entering inside the mainland. In this direction they fly over the cultivable areas and the forest shelter belts in the territories under our investigation between the villages of Bulgarevo, Sveti Nikola and Hadji Dimitar. The average height of the flight at wandering birds: storks and pelicans passing through the region is 150 – 350 m and 200 – 400 m with birds of prey.

From the small-sized and singing species of birds - mass migrants through the regions are swallows, pied wagtails, European bee-eaters, chaffinches, skylarks and others. The direction of the flight in spring with them is from southwest to northeast, following the coastal line. In autumn the direction in singing birds coincides with the main direction of the birds of prey – to northwest. Thus they overcome the strong northern winds and enter inside the mainland. We established peaks in the migration of these species registered through the transect method in the middle of September and about 10 October.

Some of the birds of prey remained longer in the region and went hunting both over the steppe and over the agricultural areas. In these events the birds flew lower, 50 – 100 m, and by an active flight. The harriers (cl. Circus), as well as some hawks in search of prey frequently fly directly over the land surface.

3.8.3. Biological diversity

The zoocenoses in the artificially created by human beings agroecosystems are poor in species. They have a more limited composition of vegetation and animal components and weak mechanisms for self-regulation.

The availability of forest shelter belts and coastal steppe territories contributes to the increase of the biological wealth within the region.

The class of amphibians is poorly presented, due to the absence of reservoirs and the dry karst terrain.

The reptiles are richer in species – 12, of the 36 species established for the kind. Birds are 139 species of 16 classes (categories) or over 34 % of the species announced for the country.

The mammals are 32 species or nearly 1/3 of the mammal fauna of Bulgaria.

It is seen that all the classes of vertebrates are well represented with the exception of the amphibians. The number of some of the taxons is rather low or single individuals were observed. In Class Birds the biological diversity is richer but this is due predominantly to the species migrating through the species migrating through the region.

The nesting birds as it was noted are solely 43 species (fewer than 10% of the ornithofauna of Bulgaria) – 32 species in the belts and 7 species in the cultivable areas. During the investigations conducted the density of the ornithocenoses in the individual habitats was established. The total density of the nesting birds in the agrocenosis is 8,93 couples/10 ha, and in the forest shelter belts about 70 couples/10 ha. During migration the forest shelter belts play a significant role for species as flycatchers, warblers, whitethroats and others. In spring the number of the birds in them reaches 84,62 individuals per 10 ha, and in autumn 53,85 individuals per 10 xa.

3.8.4. Determination of the risk zones with regard to the fauna

The zones where the concentration of birds and animals is higher shall be defined as risk. With regard to the autochthonic representatives of the fauna these are the forest shelter belts, the roadside sections, gullies overgrown with bushes and so forth.

Risk zones during the spring and autumn migration of the birds are all the territories as well as local particularities of the relief determining the formation of thermals used by the wandering or hovering migrating birds. There are such predominantly in the steppe coastal habitats, in particular over the cliff and the border of the sea and the dry land.

No similar permanent thermals were observed in the agro-eco-systems on the territory under research.

The activities related to the damage to the forest shelter belts and destruction of the habitats of some species may be determined as risk zones during the implementation of the investment proposal.

3.8.5. Condition and threats for conservationally significant species and their habitats

The species dominating in the individual types of habitats as well as such characteristics of a given biotope may be determined as conservationally significant. In most events these are species included in a number of European Conventions ratified by our country.

Of the vertebrates these are the Balkan spadefoot toad, *Ophisaurus apodusp* terrestrial tortoises, the mole and others for the territory under research between the villages of Bulgarevo and Sveti Nikola.

As conservationally significant representatives of the ornithofauna we may indicate species included in Annex 1 of Directive 79/409 (Directive on Birds) of the Council of the European Economic Community. Of the nesting birds these are two species of shrikes, two species of skylarks, tawny pipit, European roller, stone-curlew and long-legged buzzards. The two species of pelicans, the white storks (*Ciconia ciconia*), three species of harriers, the common crane (*Grus grus*) and others fall in this category from the migrating species of birds. These are species, subject-matter of special natural protective measures referring to their habitats to guarantee their survival and reproduction in their spheres of dissemination.

3.8.6. Potential for use of territories for the development of hunting and fishing

The territories, which the site for the construction of the wind farm is located on, is used by the local hunting parties during the permitted hunting season for hunting migrating birds. Flocks of quails (*Coturnix coturnix*) spend their nights and eat here during the autumn migration, which are subject of hunting (annex 4 of the Biological Diversity Act). As richer nutrient base is offered by the stubble-fields and the agricultural areas here, some species of game prefer them.

3.8.7. Forecast and valuation of the effect over the fauna, ensuing from the realization of the investment proposal

Undoubtedly the construction of the win power park and the infrastructure there will be certain negative effect over the fauna within the region, in particular with non-observation of the recommendations given. In view of the poor species diversity in the agrocenoses the structure of the facilities will not impose significant changes in the populations of the affected animal species. During the

operation solely the birds and the bats will turn out to be directly affected. We established during the monitoring investigations during migration that the birds migrating throughout the region fly at a height of over 150 m so that they are not expected to have a direct negative contact with the facilities. The richness in species and number of bats on this territory is with low values and the eventual negative effects over them will be within the limits of the admissible. Their developed sensor system for orientation will be a supplementary condition for the localization and avoidance of the propellers of the generators.

The building up of the wind power facilities could have a certain negative effect over the species of skylarks during their reproduction period in view of their characteristics ethological particularities.

In relation to the decision of the Regional Inspectorate of Environment and Waters – Varna (Ref. No 2172/06.04.2006) the following should be noted:

In view of the fact that the facilities fall in cultivable areas, the degree if biodiversity is very low. All wind power facilities are anticipated to be built up over cultivable agricultural areas. The types of natural habitats which the agroecosystems do not enter into are indicated in Annex 1 of the Biological Diversity Act and due to this reason no coordination with the Ministry of Environment and Waters should be made. The forest shelter belts which were artificially planted in the forties and the fifties of the 20th century also did not enter Annex 1. They will not be damaged, cut down or changed in any manner whatsoever during the construction and the operation of the facilities. Naturally, at close location of the generators next to the belts, there may be a chasing away effect for some representatives of the fauna and decrease of the density of the zoocenoses as it was noted in the Report on the Environmental Impact Assessment.

As it was already indicated, solely 7 species of birds nest on this territory. Solely the Calandra lark falls in Annex 2 of the Biological Diversity Act but it is with much lower number than in steppe habitats both during the time period of reproduction and during hibernation. These territories were artificially created by management and should not be examined as natural habitats in conformity with Annex 1 of the Biological Diversity Act.

3.8.8. Expected changes in the behavior, dissemination, the number, the migrations

Chasing away of some animal species during the building up of the facilities is possible. In view of the high mobility of most mammals and birds, and their ecological plasticity, after the completion of the construction works they would return to the region. Decrease of the parameters of the zoocenoses around the generators in consequence of noise and vibrations may be anticipated. The behavior of the migrating birds would not change. There may be

a change in the nutrient behavior of some birds of prey and mammals in view of avoiding the proximity to the facilities. The greater distance of the wind generators would decrease this negative effect.

3.8.9. Forecast and valuation of the expected changes over the condition of the conservationally significant animal species and their habitats

The conservationally significant species in the agrocenoses are solely the skylarks, the partridge and the quail. From them the Calandra lark is with high degree of protection by the international legislation but its number in the agricultural areas is much lower than in the steppe habitats, barely 0.43 couples/10 ha. Changes may be expected in the behavior and the decrease of the density of these species in the immediate proximity around the facilities.

With regard to the inclusion of the territory in Natura 2000 and the form presented by the Ministry of Environment and Water

The experts are acquainted with the materials presented by the Ministry of Environment and Water about the condition of the birds and the environment within the framework of the project territory of Kaliakra, included under Project Natura 2000. The area under consideration is very big, more than 16000 hectares and includes the steppe territories, sea water space, sheer coastal precipices, deciduous forests, moist zones, protected territories and others, 74 species of birds are included from Annex 1 of the Directive on the Conservation of Wild Birds (Directive 79/409/EEC) and 48 species of migrating birds which are not on this Annex.

In fact we established from the investigations conducted during migration on the territory anticipated for the construction of the wind farm 39 species of birds which are included in Annex 1 of Directive 79/409/EEC. These are mainly migrating birds of prey, most species of which are registered a single time and with single specimens. The same refers to the *Pelecanus crispus*, *Nycticorax nycticorax* and *Crex crex*. These are species whose appearance within the region is incidental and by chance. The farm areas are not characteristic habitats for them and they avoid them during migration.

Most species indicated in Annex 1 of the Directive on Birds are hydrophilous species and birds closely connected with water basins and moist zones. Their availability is determined by the big area of the project territory of Kaliakra including water space and two moist zones close to the sea coast – Bolata and Taukliman. In fact these species do not enter inside the land. *Phalacrocorax aristotelis* belongs to them, which nests solely here in our country. It is closely connected with the sea and the rocky coasts and is exceptionally rarely observed enter a few kilometers inside. The territory anticipated for a wind farm is located at 3 – 4 km from the sea shore.

Branta ruficollis may also be rarely observed in winter on this territory. From our observations conducted during the winter of 2005 – 2006, hibernating flights of geese, mainly *Anser albifrons* rarely fly over this territory and do not use it as a nutrition base.

Solely one species from the kinds of birds nesting the the agricultural cultivable lands which will be directly affected by the construction of the wind power facilities falls in Annex 1 of the Directive on Birds - *Melanocorypha calandra*.

Two species of magpies - *Lanius collurio* and *Lanius minor*, the *Emberiza hortulana*, the *Picoides syriacus*, also known as *Dendrocopos syriacus* and *Falco vespertinus* are the species nesting in field protective belts. They, as noted hereinabove, shall not be harmed during the construction and the operation of the facilities.

Thus from the species which nest on the territory of the wind farm of GEO POWER LTD solely 6 species enter Annex 1 of Directive 79/409, only one species nests in the cultivable areas - *Melanocorypha calandra*.

The regularly encountered species of birds migrating through the territory but not included in Annex 1 of Directive 79/409 are four species of birds of prey (*Accipiter nisus*, *Buteo buteo*, *Falco tinnunculus* and *Falco subbuteo*) out of the enumerated in the form 48 species for the overall territory. We may also include the swan here, small groups, of which (5 to 10 birds) we have observed several times for the four seasons of the conduct of the monitoring.

3.8.10. Valuation of the degree of risk of clash of birds with the wind turbines

The data about the ornithofauna in the place for building up of the wind power facilities are from the terrain monitoring investigations conducted in 2004 and 2005 (reports with ref. No 227 – RD – 08 dated 10.06.2005, No 301 – RD – 08 dated 02.08.2005 and No 479 – RD – 08 dated 22.12.2005), published literature and personal information.

The fourth season of monitoring of the site for the wind farm described in the Report on the Environmental Impact Assessment is being conducted at the moment. In spring the intensity of the migrating through this territory birds is very low. More birds are observed during autumn migration. Specifically the frequency of flying of the birds through the territory of the site is low as compared with other neighboring regions.

The species composition as well as the direction and the height of the flight of individual species of birds during individual time periods of migration are

described in detail in the previous items of this section of the Report. We shall point out here in synthesis once more the main conclusions of the exercised monitoring of the site of the wind farm.

139 species of birds are encountered within the region during migration. This is more than 1/3 of the species established for the country. The nesting birds are significantly fewer in number, being divided into birds nesting in the forest shelter belts and such inhabiting the agrosystems. We established 37 species of nesting birds in the forest shelter belts between the village of Kamen Bryag, the village of Bulgarevo and the village of Hadji Dimitar. The species composition of birds inhabiting the agroecosystem is rather poor. We established in total 7 species of birds in the 7 types of various monocultures investigated by us. This is an indicator that the artificial agroecosystems have a limited composition of vegetation and animal components and weak mechanisms for self-regulation. 4 species of the amphibians are encountered in the region. These are terrestrial frogs related to more open spaces. The reptiles add up to 12 species. Two species of terrestrial tortoises, 5 species of snakes and 5 species of lizards. The mammals are 32 species or nearly 1/3 of the mammalian fauna of Bulgaria. Solely the bats could have direct contact with the movable parts of the facilities out of them. The richness in species and their number on this territory are with low values and the eventual negative impacts over them will be in the limits of the admissible. Their developed sensor system for orientation will be a supplementary condition for the localization and avoidance of the propellers of the generators.

The information refers to the specific region and is on the grounds of the conducted monitoring observations by the Institute of Zoology with the Bulgarian Academy of Science in the spring of 2005 and in the autumn of 2004 and 2005. The supplementary information about the birds and the fauna within the region is from terrain investigations and scientific data gathered in the last 10 years. It is due to this reason that we are of the opinion that the information in the Report on the Environmental Impact Assessment about the birds and the fauna is original and topical.

The directly affected and disturbed territories will be solely the agroecosystems. As we noted down, they are very poor in relation to the nesting birds. During migration the species composition repeatedly increases. We established at the monitoring investigations during migration that the birds migrating during the region fly at a height of over 150 m so that no direct negative contact with the facilities is expected. With periodic control over the around 20 wind generators built up within the region we have not established collision of birds with them so far. The observations are conducted both during intensive migration and during poor weather conditions (fog, snow, strong wind). Owing to this reason we consider that the transmission of data about the assessment of the risk of collision with similar kind of facilities on the basis of interpretation of literary sources will be inaccurate and misleading. It will be possible to make

such a real assessment after developing an all-year monitoring over the effect of the wind generators over the ornithofauna and it will be possible to assess the eventual losses commensurate with the number of populations and their annual growth.

At establishing during the conflict seasons of high concentration of birds migrating in a narrow front within the area of the wind farm, the facilities shall be switched off.

With observation of the recommendations and the measures for decrease of the negative consequences over the fauna within the region we consider that the adverse effects will be within reasonable admissible limits.

The territory anticipated for the construction of a wind farm on the territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna, partially falls within potential Natura 2000 protected zone. 40 nos. of the wind generators anticipated for construction and the substation with them fall within it. Two spring and two autumn monitorings over the migration of the birds. The information collected up to this time will serve for assessment of the degree of the risk of collision of the birds with the generators.

During the conducted terrain investigations within the region anticipated for the construction of the wind farm we established 141 species of birds of 16 orders. This is more than 1/3 of the species established for the country. Two species: *Anthropoides virgo* and *Ardea purpurea* were established in the spring of year 2006.

The nesting birds are significantly fewer in number and they may be divided into birds nesting in the forest shelter belts and such inhabiting the agro-systems. We established 37 species of nesting birds in the forest shelter belts between the villages of Kamen Bryag, Bulgarevo and Hadji Dimitar. 6 species of them were not observed in the belts up to the reproduction season of year 2005.

The species composition of the nesting birds in the agrocenosis is rather poor. We established in total 7 species of birds in the seven types of various monocultures investigated by us. This is an indicator that the artificial agro-ecosystems have limited composition of vegetation and animal components and weak mechanisms for self-regulation.

Significantly more species are encountered during migration. We established respectively 103 and 102 species of birds during the monitoring conducted in autumn, 15 August – 15 November of 2004 and 2005 within the region and its associated territories. During the spring migration on the same territory we observed 88 species in 2005 and 113 species in 2006. Thus in

aggregate we established 141 species in birds during the four seasons of monitoring.

It may be said that in autumn the species diversity is bigger and the autumn migration is more intensive than the spring one.

In spring the intensity of migrating birds through this territory is very low. More birds are observed during autumn migration. Specifically the frequency of flying of the birds through the territory of the site is low as compared with other neighboring regions.

We established at the monitoring investigations during migrations that the birds migrating through the region fly at altitude of over 150 m, so that their direct negative contact with the facilities is not expected.

An insignificant number of flights of day-time migrating roaming bird passing above the territory under investigation was reported during the spring period. The migration of the species (orders) potentially threatened by the construction of the wind generators was with very low intensity.

The main migration directions during the autumn migration within the region of the municipality of Kavarna are two in number. From northeast to southwest following the sea coast and reaching Kaliakra Cape. Most birds fly in this direction above the steppe territories at Rousalka complex and the locality of Yaylata. The second direction is from Kaliakra Cape to northwest, entering inside the inland. Most of the birds of prey fly in this direction above the cultivable areas and the forest shelter belts in the territories under our investigation between the villages of Bulgarevo, Sveti Nikola and Hadji Dimitar. The average altitude of the flight with roaming birds: storks and pelicans passing through the region is 150 – 300 m and with birds of prey from 200 to 400 m.

From the information stated hereinabove and taking the following factors into consideration: frequency of flying of the birds over the site, species composition and altitude of the flight, visibility of the turbines, their number, the manner of arrangement and dimensions of the propellers, the assessment of the risk of collision of the birds with the generator is as follows:

The average altitude of the migrating roaming birds is above the maximal height of the propeller.

The migration of the potentially threatened roaming and predatory species is with low intensity above the observed territory, i.e. the “frequency of flying” over the site is low.

The flat terrain and the amount of the wind generators is a prerequisite for their being noticed from a distance of several kilometers and successfully avoided.

The turbines occupy a territory of about 64 km² between the villages of Bulgarevo, Sveti Nikola and Hadji Dimitar. Their arrangement is not strictly differentiated though certain direction northeast – southwest is observed. This creates a higher risk for the territory of the site itself and a zero one for its surroundings. The availability of a passage or a corridor between the generators is useless as the birds would not use it. Rather the distance between the individual wind generators should be sufficiently big 350 – 400 m so that the birds could avoid them in events of adverse atmospheric conditions.

Solely the agrocenoses would be directly affected. As we noted, they are very deficient in relation to nesting birds. Their species composition increases during migration. With periodical control over the about 20 wind generators built up within the region, we have not stated any collision of birds with them so far. The observations were conducted both during intensive migration and during adverse weather conditions (fog, snow, strong wind). Accumulations solely of *Larus cachinnans* (silvery sea-gulls) were observed solely during agricultural events. No other factors causing accumulations of birds were established.

The criteria applied for the specific territories with regard to Natura 200 do not correspond for this territory, the degree of collision with the wind generators is minimal. Birds would successfully avoid them and no conflict would be reached between them and the vanes of the turbines. Such a real assessment may be given after the development of continual all-year-round monitoring of the impact of the wind generators over ornithofauna and it will be possible to assess the eventual losses, commensurate with the number of populations and their annual growth.

3.9. LANDSCAPE

The region of the wind farm in conformity with the geo-morphological division into districts of Bulgaria falls within the region of Mizia plane, sub-region of Ludogorie – Dobrudja elevation of Prichernomore region.

In accordance with the landscape division into districts the wind farm refers to the Northern Bulgarian zone region of the Danube Lowland (A), Southern Dobrudja sub-region (III) in Balchik-Kaliakra region.

In conformity with the division of the landscapes into subsystems and regions, the Project of the wind farm belongs to the Black Seaside landscape subsystem (X), respectively to the Northern Black Seaside landscape region.

This kind of landscape region is distinguished for its flat relief and poor spread out of natural forest vegetation. According to the leading signs for classification of the landscapes they may be determined as follows:

A) In conformity with the degree of the leading human activity. The wind farm fully refers to the so called cultural landscapes formed of typical agricultural activities, partially modified by the availability of protected vegetation belts. In this event this landscape is the result of the specific agro-forestry activity, which commenced here as early as in the middle of last century.

B) In conformity with the reflection of the human activity the Project may be referred to the group of the so called Harmonic Landscapes. The established here relative unity on the one hand with the abiotic factor and on the other hand with the relevant components created by the human being – settlements, infrastructure and others provide us with grounds for that.

The main thing is that the impact of the anthropogenic factors has not resulted in violation of the conformities with the law for the existence of natural components.

The visual commitment of the territory is characterized by specifics of the landscape – its flat appearance. It has emphasized seasonal dynamics. The visual frames in the future wind farm will be defined mainly by the road communication connections. In linear scope they are about 5 – 7 km and practically for a brief time period they will create conditions for monitoring over a similar kind of vertical dominants with the characteristic circular movement of the rotor propellers of the generators.

For the time being in our country due to the absence of similar projects it is not possible to provide for a definite assessment of the visual consequences of the construction of similar sites. The problem here refers to a specific visuo-esthetic and psycho-physiological assessment of technical facilities which on their part have special dynamics depending on the wind regime within the area of the site.

The nature of the wind farm does not provide for grounds to draw the conclusion that both natural and anthropogenic modification of the project is not anticipated.

The sole serious modification in the nature of the landscape is obtained from the availability and the work of the anticipated for installation about 62 nos. of wind generators for the region but also for Bulgaria. They with their height of 60 to 100 m will actually result in a new type of technogenic landscape not only of the region but also for Bulgaria, which will significantly change the image of the region.

In conformity with the sign of leading human activity the landscape of the region is fully anthropogenic natural – cultural landscape. The biotic factors have predominated so far in it but with the installation of the facilities visible change in the physiognomic nature of the region will be reached. The forecast assessment of the anticipated modifications in the nature of the landscape indicate high degree of landscape heterogeneity but with almost unchangeable stability of the medium.

The degree of connexity of the landscape components is big whilst the degree of contrast will be relatively the highest. It is namely this which results in high change of the value of the landscape and of the natural frame which may be bilaterally assessed – in an economic and in landscape-esthetic aspects.

In ecologo-economic aspect on the basis of the approach applied in the economy of environment known as “Benefit – Cost Analysis”, the benefits of this exceptionally “pure nature using electric power production” are indisputable. This was proven a long time ago in leading European countries where the gratuitous strength of the wind serves people both for those within the region of the wind farm and for the economy of the country.

In landscape-esthetic aspect on the basis of the semiotic approach for assessment in conformity with sign systems and visual connections, the emotional comfort for the road connections passing along the main road connections between the settlements and in particular to Rousalka complex is rendered an account of under the method of “running landscapes”. It consists of perception of the landscape in the relationship “movement in a motorcar vehicle – vertical dominants” and the distance to them. The closest are the fastest passing in sight and the remotest – slower perceived. With medium speed of movement of the motorcar vehicles of about 60-70 km/h, those traveling with coming average distance of about 5 to 7 km, the foreseeability of the landscape will be unilateral (respectively from left or right depending on the direction) and at that within the framework of 5 to 7 minutes.

This is why the vertical visual – physiognomic nature of the wind farm from landscape – esthetic point of view for those passing through the region is within a smaller range of time and practically minimally significant.

The forecast for the anticipated changes in the landscape and its components in the realization of the wind farm is that they will be in very low values and at that solely for the following so called ‘weak’ geo-components:

- a) Flora. The impact here will be temporary solely whilst the construction and assembly works last on the territory, when it is expected to be about 0.15% of the total area of the wind power park.
- b) Fauna. Similar to the flora component here also during the construction no significant negative impact over any typical representatives of the fauna (mammals and reptiles), which are characterized by great dynamics, is

expected. The sole potential hazard and negative impact from the realization of the wind farm is the impact of the wind turbines over the ornithofauna in the region bending to "Via Pontica" Road.

- c) Soils. They as a derivative geo-component are relatively the most dependent on the impact of the strong geo-components (rocks, relief, climate) and most of all the human activity. But in this event the problem refers to the places where the foundations of the generators will be built up, which will actually result in the reduction of the area of the cultivable land by about 12 ha. A part of this land as a soil horizon will be disposed and stored in other parts of the site and its fertility will be used at recultivation and in other locations.

In conclusion it may be concluded from the investigations and analyses conducted that the construction of the wind farm in the planned territory of the Northern Black Seaside landscape region will not result in essential changes in the natural basis of the anthropogenic agrarian landscape. Changes in the physiognomic aspect will impose the vertical bodies of the wind generators, i.e. in the visual elements of the landscape which will be the "price" of this most ecology conformed manner for obtaining electric power from inexhaustible natural source.

3.10. PROTECTED NATURAL SITES AND TERRITORIES

Within the region anticipated for the implementation of the investment intention for a wind farm in the territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna which is fully in an agricultural fund, there are no protected natural sites and territories. The availability of deposits of protected vegetation species which require special protection is not established within the scope of the wind farm.

The forecast assessment for the anticipated negative changes from the implementation of the wind farm may be related to the assumed conflict between the work of the wind generators and the ornithofauna from migrating birds along Via Pontica Road. This adverse impact should be assessed multilaterally and with proven insignificant negative impact over the flight of the migrating birds on the part of the wind generators, the investment intention should be ratified and it should be passed to the subsequent phases of implementation of the wind farm.

3.11. CULTURAL HERITAGE

3.11.1. Characteristics and condition of historical, architectural and archeological monuments,, folklore and traditions, language and dialect, religion and beliefs, settlements; Single and group monuments

The territory of the wind farm comprises a part of the territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo. This territory is limited by the roads Kavarna – Hadji Dimitar – Porouchik Chounchevo, Porouchik Chounchevo – Sveti Nikola, Sveti Nikola – Bulgarevo, Bulgarevo – locality of Tyutyukler east of Kavarna. This territory is a

part of Dobroudja Black Seaside, rich in immovable monuments of culture – archeological settlements of the antique and Medieval epochs, sepulchral Thracian mounds and hill necropolises, antique and Medieval necropolises and others. All the archeological settlements and the smaller mounds fall in cultivable land and their cultural layer decreases with every passing year.

The following monuments of culture fall within the indicated zone:

No 14 – Settlement from the Hellenistic, Roman and Early Byzantine epochs. It is situated in the locality of Diamandiolou, to the east of the town of Kavarna. The dimensions of the settlement are 250/200 m, with an area of 50 dka. A marble partition altar plate was discovered – probably from the early Christian time period. Regime of use – B. Territory of the town of Kavarna.

No 15 – Settlement of the Early Byzantine and Early Medieval epochs. For now dimensions of the settlement of 650/350 m are fixed with an area of 227.5 dka but the settlement is probably much bigger. It is located to the right of the road Kavarna – Shabla, next to the locality of Tyutyukler. A stone scraper was also found during the past year which includes the Neolithic epoch within the chronological limits. Later Medieval funeral were discovered, excavated and published in the southeastern part of the settlement over a mound necropolis. A mound was discovered during saving excavations in the proximity of the settlement in the locality of Tyutyukler, a demolished and plundered tomb of the “Macedonian” type from the Hellenistic epoch. Regime of use – B. Territory of the town of Kavarna.

No 16 – Settlement of pre-Roman, Roman and Early Byzantine epochs. It is situated in the southeastern outskirts of the village of Porouchik Chounchevo, on the right-hand side of the road Kavarna – Shabla, before entering the village. Few archeological materials are also located from the left-hand side of the road, almost next to the village. Regime of use – B. Territory of the village of Porouchik Chounchevo.

No 18 – Settlement from the Roman and Early Byzantine epochs. It is situated to the southeast of the village of Hadji Dimitar, in the direction of the village of Sveti Nikola. It occupied an area of 50 dka and is with dimensions 200/250 m. Cultivable land. Regime of use – B. Territory of the village of Hadji Dimitar.

No 26 – Settlement of the pre-Roman, Roman and Early Byzantine epochs, the First Bulgarian Kingdom and the Second Bulgarian Kingdom. It is located in the middle between the villages of Bulgarevo and Sveti Nikola, at 1.5 km to the northwest of the bridge between the two villages. The shallow dry valley “flows” into “Bolata gully” at Bulgarevo forest. The settlement is with dimensions of 600/400 m and an area of 240 dka. The sole settlement inside into the inland with archeological materials from the Second Bulgarian Kingdom. Regime of use – B. Territory of the village of Bulgarevo.

3.11.2. Characteristic structures, location, number and value; approaches and access; monuments falling within the zones of hazard from contamination and damage

Five archeological settlements from various historical epochs, a demolished stone tomb from the Hellenistic epoch of the "Macedonian" type, about 50 sepulchral Thracian mounds have been discovered and documented so far. The mounds are located comparatively uniformly, a significant part of them are single, with comparatively big embankment and perspective, in some of them to discover tombs or funerals performed. There is accumulation of mounds in the locality of Tytyukler, around the village of Porouchik Chounchevo and in the middle between the villages of Porouchik Chounchevo and Sveti Nikola. The matter probably is about mound necropolises from earlier epochs. The mounds are deemed as monuments of culture of national significance. There is an easy access to these monuments from the two central highways Kavarna – Shabla and Bulgarevo – Kamen bryag. Interrural roads function between the two highways beside the forest protective belts creating a possibility for treasure-hunters' raids with metal seekers in the settlements and excavation of the mounds. There is no risk of contamination or damage on the part of the wind generators.

3.11.3. Analysis of the components of the environment which exert influence over the monuments of culture and the degree of impact (climate, waters, vegetation, soils and others). Additional factors of impact

A significant part of the small mounds and all the archeological settlements are in cultivable lands and owing to this reason a part of the cultural layer is annually washed out by the rains and the wind. The impact of the grass vegetation is weaker due to the regular treatment of the land. Beyond the components of the environment additional impacts are the treasure-hunters' excavations in the mounds and the settlements.

3.11.4. Status of the sites, the complexes and the monuments. Provided protection in compliance with the effective statutory regulations; Compatibility of the functions in the associated territories

The settlements and the mounds are included in the archeological map of Bulgaria as monuments of culture with various regime of use. Their preservation is in conformity with the Monuments of Culture and Museums Act (promulgated State Gazette, issue 29 of 1969) with numerous amendments and supplements. The regimes of use in conformity with this act are four in number:

Regime A: All kinds of activities (construction, urbanization, agricultural, meliorative and others), which disturb the integrity of the earth layer within the limits of the archeological sites shall be prohibited. The use of the land as meadows and pasture-grounds shall be admitted.

Regime B: All kinds of excavation works shall be prohibited as well as depth treatment of the soil (trench-ploughing), the sowing of permanent cultures with deep root system, marshing and other activities which can destroy or affect the archeological substance within the limits of the site. Agricultural treatment of the soil (ploughing) at depth of up to 0.25 m shall be admitted.

Regime C: All kinds of excavation works not related to agricultural activities shall be prohibited. All kinds of agricultural activities under the conditions of Art. 18 of the Monuments of Culture and Museums Act shall be admitted.

Regime D: All kinds of activities shall be permitted and those related to excavation works shall be coordinated with the state authorities keeping a watch over the preservation of the cultural-historical heritage (historical museums, the National Institute of the Monuments of Culture, the Archeological Institute with Museum with the Bulgarian Academy of Science) and under the conditions of Art. 18 of the Monuments of Culture and Museums Act.

All the sepulchral mounds are with regime of use A and monuments of culture of national significance.

The five archeological settlements are with statute of monuments of culture with regime of use B.

All the archeological sites have a definite regime of use. There are index-cards with the relevant information (see Annex IV) in the Ministry of Culture, the Institute for Preservation of the Monuments of Culture, city of Sofia, the Historical Museum of the town of Kavarna.

The functions of the wind farm, subject-matter of this EIA Report and the monuments of culture in the hereinabove indicated area are compatible in this specific event.

3.11.5. Cultural and natural frame and degree of preservation of the authenticity of the medium.

The preservation of the authenticity of the medium in the meaning of the preservation of the mounds and the mound necropolises in this kind is needed. To suspend their treatment and ploughing. There is a possibility to discover a tomb in some of the big mounds which if in possession of architectural and archeological significance could turn into a tourist attraction. The building up of the infrastructure in this event (enclosure, preservation, road for access to it) would not enter into conflict with the constructed wind generators.

3.11.6. Forecast and assessment of the anticipated impacts over the condition of the historical, architectural, archeological and other monuments located beyond the territory under investigation, from the implementation of the investment proposal

The implementation of the Project for a wind farm will not exert any adverse impact over the monuments of culture within the region.

It is recommendable not to build up wind generators in the proximity of the big mounds, in which there is a possibility to discover tombs with great architectural value.

3.11.7. Limits of impact and dissemination of the risk factors in relation to the nature of the medium, the esthetic and social value of the cultural and historical heritage

The five archeological settlements are located in cultivable land, significant archeological ruins are not expected to be discovered and owing to this reason their socialization and inclusion in the tourist flow is dropped out. Monuments of culture with scientific value remain as well as eventually their research.

3.11.8. Potential hazard of disturbance of the authentic natural and anthropogenic frame of the cultural and historical heritage

There is no potential hazard.

3.12. WASTE MATTER

3.12.1. Kind, nature and quantity of generated waste matter; manner of collection, transportation, storage, neutralization, treatment, recycling; measures for decrease of the quantity of disposed waste matter

In conformity with the investment proposal, the territory on which the wind farm will be built up is located on the territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo. The main occupation of the population from this region is farming – plant-growing and stock-breeding and partially tourism in summer. Most of the villages are situated at a very close distance from the tourist places of interest: Kaliakra Cape, the protected area Yaylata with Ogunheto and Rousalka resort complex. This assumes that a significant number of tourists on their way to these sites pass through the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo during the active summer season.

According to data of the municipality of Kavarna the population of the individual villages is presented in Table 26 and it should be taken into consideration that in summer the number of inhabitants increases by 15 to 20 %.

Table 26: Number of inhabitants per populated areas

No	Populated area	Permanent number of inhabitants	Functional type	Garbage collection	Unregulated landfills as at 2006	Distance from the landfill to the populated area km
1.	Bulgarevo	1496	V	Included in the system for centralized garbage collection	1	0.20
2.	Sveti Nikola	248	VII		1	0.60
3.	Hadji Dimitar	117	VIII	It is anticipated that in 2006 they will be included in the system for centralized garbage collection	1	0.10
4.	Rakovski	296	VII		1	0.10
5.	Porouchik Chouchvo	46	VIII		1	0.15

In event of visits on the spot and an inspection of the expert it was established that the existing until year 2004 (included) landfill of the village of Bulgarevo, which was located to the left of the road village of Bulgaria – Kaliakra Cape was displaced in the northeastern direction. The waste matter was scraped up and transported to the location newly defined by the municipality (photographs 1 and 2). The new location does not meet the requirements of Ordinance No 7 of the Ministry of health and is not operated in conformity with our legislation. There is free access to the waste matter of people and animals. No preliminary measures were undertaken for the provision of lower insulation screen aimed at not contaminating the surface and underground waters, the soils and the vegetation. This landfill must be reorganized or re-disposed to the future regional disposal area of the municipality of Kavarna.

In 2005 the waste matter from all smaller and unregulated landfills were transported to the biggest landfill of each of the villages. In these rural landfills the waste matter is sole dumped, and own transport is used for their transportation to the landfill. The waste matter is not compacted or pushed by equipment. They are usually thrown earth over once or twice a year.

There is no effectively functioning organized system for separate collection of the waste matter in the municipality of Kavarna as at this time. There are no enterprises for treatment of scraps on the territory of the municipality. Roma people and poor people perform to a certain degree manual soring out and taking out of paper, metal, glass bottles and plastics. This activity is not regulated and it is hazardous for their health.

All the villages generate waste matter of domestic nature, packages, agricultural and construction wastes, with the general title of “non-hazardous” waste matter.

- Domestic waste matter
 - Mixed domestic wastes - code
20.03.01
 - Domestic wastes not mentioned anywhere else - code
20.03.99
 - Voluminous wastes - code
20.03.07
- Packages
 - Plastic packages - code
15.01.02
 - Metal packages - code
15.01.04
 - Glass packages - code
15.01.07
- Waste matter of agriculture
 - Wastes from vegetation tissues - code
02.01.03
 - Wastes from animal tissues - code
02.01.02
 - Animal dung, urine and fertilizer (inclusive of used straw),
Waste waters, separately collected and treated beyond the
Location of their formation - code
02.01.06
 - Wastes from forestry - code
02.01.07
 - Wastes not mentioned anywhere else - code
02.01.99
- Construction waste matter
 - Mixtures of concrete, bricks, brick-tiles, tiles, faience
And ceramic articles - code
17.01.07
 - Glass - code
17.02.02
 - Mixed wastes from construction and demolition, other than
those, mentioned in 17.09.01, 17.09.02 and 17.09.03 - code
17.09.04



Photograph 1



Photograph 2

The villages also “generate” a certain quantity of “hazardous” waste matter thrown out jointly with the domestic ones such as:

- Batteries and aged accumulators - code
16.06.01
- Other batteries and accumulators - code
16.06.05
- Paints, inks, glues/adhesives and resins containing
Hazardous substances - code
20.01.27*

3.12.2. Analysis of the updated program for management of the waste matter of the municipality of Kavarna and of the programs of the big sources of waste matter within the framework of the municipality of Kavarna

It is anticipated in the Environmental Management Program to liquidate in stages all the non-legitimized landfills of the Municipality.

The issue of the neutralization of aged accumulators, batteries, fluorescent and mercury lamps has not been settled. All this waste matter is thrown out along with the other non-hazardous wastes on a mass basis.

According to the reported information cards for the procedure for execution of the documents with regard to the report and the information on the management of the activity relating to the waste matter, a great part of the production and hazardous wastes from the economic subjects are handed over for recycling to licensed companies and there are disposal areas built up for those which are not subject to subsequent treatment, for which there are sanitary permits issued by the Regional Inspectorate for Preservation and Control of Public Health – town of Dobrich.

The hazardous hospital waste matter will be burnt out in an incinerator.

The main conclusions for the part “Waste Matter” in the Environmental Protection Program are:

- the main problems of the municipality with regard to the waste matter are related to the absence of disposal areas corresponding to the new statutory regulations, the absence of separate collection and recycling, the absence of a disposal area for hazardous wastes;
- the main problems of the municipality with regard to the waste matter are related to the absence of disposal areas corresponding to the new statutory regulations, the absence of appropriate terrains for new disposal areas, the availability of unregulated landfills, the absence of separate collection and recycling, the absence of a disposal area for hazardous matter

- the needed organizational prerequisites for the solution of the problems in compliance with the statutory requirements but more efforts and funds are required for the completion of the problems which were started up for solution.
- At this stage there is still no decision about for long-term effective solution of the problem with the treatment of all kinds of waste matter.

3.12.3. Registration of aged contaminations with wastes and unregulated landfills located on the territory comprising the wind farm on the Territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna

During the visits on the spot and an inspection of the experts it was established that there are no unregulated landfills on the Territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo as well as aged contaminations with waste matter.

3.12.4. Location of the facilities for wastes, access, visual impact, catacity, term of operation

The distances from the functioning landfills to the individual populated areas are given in table 26. The wastes from all other illegal landfills existing up to year 2005 were transported to these landfills. The visual impact of the landfill of the village of Bulgarevo is very appalling as it comprises a very big area of 7 – 8 dka and the wastes are not compacted and are covered with earth. There is a possibility for scattering of slight fractons from the wastes at big distances by the wind.

The term of operation in conformity with the Wastes Management Program and the Environmental Preservation Program is 2008. After that year the wastes from these populated areas will be transported to the future regional disposal area, and the existing unregulated landfills will be regulated.

3.12.5. Route schedules for collection and transportation of the wastes

Since the middle of year 2005 the village of Bulgarevo and the village of Sveti Nikola have been included in the garbage collection of the town of Kavarna and the wastes are weely collected and transported by the available garbage transportation equipment of Tital Chistota Company.

It is anticipated that from the month of July 2006 the wastes from the villages of Hadji Dimitar, Rakovski and Porouchik Chounchevo should be collected and transported along with those of the villages of Bulgarevo, the village of Sveti Nikola and the town of Kavarna, i.e. they should be included in the centralized garbage collection of the Municipality of Kavarna.

3.12.6. Forecast and assessment of the anticipated changes in the environment on the territory allowed for in the investment proposal at management of the wastes – collection, transportation, disposal, treatment, neutralization and others

Wastes will be generated on the territory anticipated for the building up of the park during the construction. The probable wastes which will be generated will be as follows:

- Mixed domestic wastes form by the workers at the site - code 20.03.01
- Construction wastes
 - Concrete - code 17.01.01
 - Bricks - code 17.01.02
 - Wooden material - code 17.02.01
 - Glass - code 17.02.02
 - Plastics - code 17.02.03
 - Iron and steel - code 17.04.05
 - Packages of paints, varnishes, solvents, Anti-corrosion protection - code 08.01.13*
- Excavated soil and stones - code 20.02.02
- Eventually from shift – oils and oil products from motorcar vehicles - code 13.02.08*

The real possibility for their formation will be discussed in the presentation herein below and an assessment will be made with regard to their possible quantities.

The Investor will enter into a contract with a specialized company for **the execution of the construction and assembly works** related to the implementation of the investment proposal. This Company must have the needed equipment and personnel.. It must prepare a wastes management program in conformity with the requirements of Art. 29, Para. 1, item 3 of the Wastes Management Act and it must have a permit pursuant to Art. 37 of this Act for the

temporary storage of hazardous waste matter. The Company Contractor of the construction and assembly works must on the grounds of Art. 5 of the Wastes Management Act conclude a contract with a licensed company in possession of a permit for that pursuant to Art. 12 of the same Act for the subsequent treatment of the hazardous wastes.

The construction and assembly works for the erection of a tower will take maximum three or four days with a ready-made zero cycle. This does not impose long-term management for the wastes. Regardless of that the Company Contractor must anticipate in the wastes management program actions during the construction: collection, transportation and disposal of non-hazardous wastes to the disposal area of the town of Kavarna.

The excavation works for the foundations of the wind generators assume the realization of 24 304 m³ of excavated earth masses (62 wind generators x 392 m³). It is anticipated that these earth masses shall be spread out in the proximity of the temporary building sites. As the depth of the excavations is significant (2 m), this means that the soil formation rock will be reached which in the soils examined is found at average depth of under 1 m. This is why the excavation works must be performed selectively – the soil substrate of the humus-accumulative and the transitional horizons must be separated from that of the soil formation rock. The excavated from the surface 100 m earth mass in conformity with Ordinance 26, Art. 7 should be stored and used. The masses excavated from the soil formation rock, however, is admissible to be used if needed solely for backfilling of the already built up foundation up to depth not more than 1 m under the soil surface. **The superfluous quantities must be transported and disposed at a location specially selected for the purpose (disposal areas), the location for the disposal of the superfluous earth masses must be coordinated prior to the commencement of the construction with the municipality of Kavarna and the RIEW – Varna.**

The modern ways for the execution of concrete works do now allow for scattering of concrete mixture, respectively the generation of the concrete waste. At present work is done with ready-made concrete mixtures, which are supplied to the site by concrete delivery trucks and are poured into the shuttering with the help of concrete pumps. Due to this reason the generation of the construction waste of concrete is indicated solely as a possibility but it is difficult to anticipate and calculate specifically its quantity as this mainly depends on the precision in the work with concrete mixtures. It is assumed that this kind of waste will be in insignificant quantities if its generation is admitted and it will be transported to the disposal area in the town of Kavarna in due time.

The construction wastes of bricks, wood, glass, plastics, iron and steel are also indicated as possible wastes, generated at each building site. During the implementation of the present investment proposal the sole place where they would be formed is the site which the substation will be built up on. This is a building of a small scale and the indicated wastes will also be generated in insignificant quantities, measured from several kilograms to several dozens of kilograms. With availability of a wastes management program developed by the

Company Contractor of the Project the collection, the transportation and the neutralization of this type of waste matter will be regularly performed and will not create conditions for the unregulated damage of environment.

Hazardous wastes will be generated during the construction of the type of packages of paints, varnishes, solvents, anti-corrosion protection about 0.2 m^3 , as such may be formed solely during the construction of the electric power substation because the individual elements of the wind generators will be supplied ready-made with placed protective-decorative coating and solely assembly works will be performed on the designated and prepared sites.

The construction and assembly works include pouring of the foundations and assembly of the towers and the equipment. As it was indicated hereinabove the individual elements of the towers will be supplied ready-made: appropriately colored and with installed equipment in them. Owing to this reason the sole hazardous wastes which will be eventually generated will be those of oils and oil products from the construction equipment during the construction and assembly works. As the preparation of the sites (execution of excavations and pouring of the foundations) and the subsequent assembly of the wind generators are processes which are with limited duration (maximum 1 month for reaching the design strength of the concrete during the execution of the foundations and several days for the assembly of the towers, according to an expert assessment the wastes of oils and oil products will be in insignificant quantities. With observation of the requirement for change of the oils of the construction mechanization in locations specially designated for the purpose (for instance in the petrol stations) and prevention of spillages of oils and oil products on the site, this type of waste matter may be reduced to a minimum and solely their incidental flow or dropping on the building site from poorly maintained equipment will be observed. With a permit for temporary storage of the wastes of the type of oils and oil products and the observation of all requirements for that, it may be said that there is no hazard of permanent contamination of the environment, respectively the soils, the waters and the geologic basis with this type of waste matter.

Domestic matter will also be generated during the construction. With 180 working days for each of the stages of construction and 15 workers on the site the total quantity of domestic wastes for each of the stages will be 2.30 m^3 or in total for the entire project (for the two stages) – 4.60 m^3 .

During the operation “hazardous” wastes will be formed during the change of the greases and oils during the regular annual technical examinations of the wind generators (once a year). But this is specialized activity and is performed by specialists of the company manufacturer of the wind generators as it undertakes the supply of the new greases and oils and the subsequent storage and treatment of the already worked out such.

No permanent personnel will be anticipated for the site during the operation of the wind farm. The substation will be maintained by personnel of 2 persons and mineral water for potable needs will be supplied on the site and for

domestic needs – water by water cisterns. No construction of a sanitary unit and a sewerage system will be anticipated owing to which the issue with the wastes and the waste waters formed by the work of the personnel (chemical toilets and/or cesspit) must be appropriately settled in the detailed design. The quantity of the formed domestic waters with 310 working days per year and an 8-hour working day will be $0.5 \text{ m}^3/\text{year}$.

3.12.7. Influence of the way of collection and transportation of the wastes from the wind farm on the other components of the environment, including the aesthetic characteristics of the environment, the health risk, etc.

The ways and procedures of collection, storage and transportation of the wastes, generated during the construction of the wind farm will not exert any adverse impact on the other components of the environment.

The surplus of excavated earth will be stored at places determined by the Municipality and approved by RIOEW – Varna.

By the opinion of the experts, this earth should be used for periodical spilling over the depot of Kavarna and that of Bulgarevo, as well as for the recultivation and hygienization of the latter, according to the updated Program of waste management for the municipality of Kavarna and the program of management of the environment for the municipality of Kavarna.

3.13. Harmful physical factors

3.13.1. Noise – sources of noise pollution, impact on the different objects in the region, impact at the places of work and the residential areas, limits of penetration.

Determining the physical characteristics of the factor

The sound by its physical nature consists of mechanical vibrations in elastic medium. The values characterizing the sound are the sound pressure, the sound power, the velocity of distribution and the wave length in the respective medium.

The sound pressure is the difference between the momentary value of the pressure P_1 in the medium of distribution of the sound wave, and the pressure P_0 in the same medium, in case no sound wave passes through it. The unit of measuring the sound pressure is Pa (Pascal) and $1 \text{ Pa} = 1 \text{ N/m}^2 = 10 \text{ } \mu\text{bar}$.

The lowest sound pressure to which the human ear reacts is $20 \text{ } \mu\text{Pa}$, while the limit of feeling pain is 20 Pa .

The logarithmic scale for determining the sound pressure is determined AS FOLLOWS:

$$L_p = 10 \lg (p/p_0) = 20 \lg P/P_0, \text{ dB}$$

Here P is the sound pressure at the moment of measurement and P_0 is the reference pressure equal to $20 \mu\text{Pa}$.

The sound power is the sound energy which passes per unit of time through a unit of area. The level of the sound power is determined as follows:

$$L_p = 10 \lg p/p_0, \text{ dB}$$

Where p is the sound power at the moment of measurement and p_0 is the reference value = 10^{-12} W.

The noise is a sound which teases human ear and creates unpleasant effect by its impact. The noise is one of the most significant adverse impacts leading to acoustic discomfort in the environment. The adverse impact depends on its type and the conditions generating it. The origin of the noise is determined by the types of activities which generate it. Characterizing the noise in the environment, the main components are industrial noise, noise from the transport, internal for the residential districts, internal house, noise from construction, etc. Noise is a complex of vibrations with different frequency, amplitude, period, etc. Generally the classification is made by the origin of the noise – industrial, transport, etc., by the type of the vibrations – constant, impulse, mixed, by the frequency – low frequency, average or high frequency, etc.

Depending on the character of the noise it could be constant and varying (intermittent, periodical, etc.).

The effect of the noise is different depending of the character, the frequency band, the intensity, the period of exposure, etc.

The assessment of the constant noise is made in dB(A), which is assessment of the noise power integrated into the curve A, accepted worldwide as the most suitable for such assessment. The varying noise and especially the intermittent, the impulse noise, etc., is evaluated by the equivalent level of the noise by evaluating the real time of the exposure of man to this factor.

Sources of noise pollution

The main sources of noise in the environment are:

- the transport – vehicles, the public transport, the railway town and country transport, the air transport, etc.
- the internal for the residential districts noise – from parkings, garages, from the sports areas, the schools, the kindergartens, the shops, the restaurants, the cinemas, the rail way and the bus stations, etc.

- internal for the houses noise – from everyday houseware, radio, TV, players, from conversations, quarrels, etc.
- town noise – from technical equipment, ventilation, refrigerators, workshops, etc.
- industrial noise – from the production enterprises

The contemporary technologies for the production of electric energy introduce the noise from the wind power generators.

At the places of work all professions are exposed to the load of the noise and with some of them it is really significant. These are the wood processing enterprises, the turbines and the generators, the textile industry, the metal processing, the machine and polymer production, etc.

The impact of noise on man

Noise affects mainly the sound analyzer, as well as on the central and vegetative nerve system, the vestibular apparatus, the cardio – vascular system, the immune system, the stomach activity, the internal secretion glands, etc.

It is well known that the changes in the limit of hearing are accepted as pre-pathological state. It is also known that the changes in the sensitivity to the noise are called noise tiredness and are due to prolonged exposure to noise. The hygienic standards were introduced on the bases of the damages in the hearing ability.

The prolonged impact of noise on man results in extra-aural effects on the organism which affect mainly the central and the vegetative nerve system, the cardio-vascular system and the analyzers.

Existing problems in the environment

There are no representative data for the municipality of Kavarna concerning the acoustic conditions. The noise generated there is predominantly from transport. Traditionally, there follow the everyday noise, the industrial noise and the lowest is the level of the construction noise. This information is valid for the town of Kavarna as well.

There are no data about the acoustic environment in the municipality of Kavarna. There are no significant noise sources as on the neighbouring territories, which could affect the region. There are no air-ports, sea-ports, railway lines and industrial enterprises.

The noise in the region is mainly from transport. Road E87 crosses the region from Rumania to Turkey. It is seriously loaded in three seasons – spring, summer and autumn. The calculated noise levels for the heaviest traffic periods at a

distance up to 20 m from the road are 65 dB(A) and 55 dB(A) respectively during the day and at night.

An increase in the intensity of the noise levels near the roads have been observed with the years - up to 65 -68 dB(A), which generates an environment unfavorable to live in.

3.13.2. Vibrations – sources of vibrations and limits of distribution. Impact on the permanently living /working on the territory and possible effect on tourists and the population

Determining the physical characteristics of the factor

The vibrations are determined as oscillations of a mechanical body around a point of equilibrium. The values characterizing these oscillations are the acceleration (a), the velocity (v) and the amplitude (d). The value vibro-velocity is most often used in the evaluation of these vibrations and the latest standards in compliance with those of the EU use the so called vibro-acceleration, which is the time derivative of the velocity.

The assessment of the vibrations from the hygienic standpoint uses the terms level of the vibration velocity and level of the vibration acceleration, which are logarithmic values similar to those used for the assessment of the noise levels.

The vibrations, depending of their temporal characteristics, are periodic, non-periodic and stochastic. Depending on the part of man they exert an impact, they could be viewed as general and local. Most often the general vibrations have frequencies of 1 – 63 Hz, and the local – from 8 to 1000 Hz.

The assessment of the vibrations is connected with the requirements of measuring in a three coordinate system (measuring a vector). The resonance effects must also be taken into account in the evaluation of the impact, which are between 5 and 12 Hz for a standing person and between 4 and 6 Hz and between 20 and 30 Hz for a sitting person.

Sources of vibrations in the working and natural environment

The possible sources of vibrations in the environment could be the transport machinery, the construction equipment and this used in the open mines.

The natural sources of vibrations are the earthquakes.

The impact of vibrations on man is a complex physiological and bio-mechanical process of interaction of vibrations with different character, power and frequency and the human organism.

It is considered that the vibrations are accepted by several analyzers like skin, proprio- and intero-ceptive receptors and the vestibular apparatus.

The impact depends on the level of the vibro – acceleration /velocity, the period of the impact (the exposure), the frequency of the vibrations, the type of the vibrations (local, general), the point of the impact (in case of local vibrations), the position of man and the frequency of repeating the impact.

The so called vibration disease is the main one, which is considered a result of the vibration impact, and it could be observed among people working under conditions with high levels of local vibrations. The main mechanism of the disease is connected with the effect of the vibrations on the skeleton. There could be a spasm of the blood vessels (the white fingers syndrome), problems in the peripheral sensitivity and in the vestibular apparatus. Most of the secondary effects are connected with problems in the stomach and the intestine, the cardiovascular system, the vegetative nerve system.

Existing problems in the environment

According to the geological investigations in the region and the seismic region-determination in Bulgaria since 1987, the area of the future WPP falls into a region with maximum intensity of the seismic processes of the IX degree according to the scale of Medvedev-Sponheuer-Karnik with an earthquake coefficient $K_c = 0.27$.

There are no sources of vibration impact in the region other than the transport artery, which does not generate general vibrations which could be hygienically significant.

3.13.3. Ionizing radiation – sources, types and scope of distribution, level of pollution, data on the region from the national monitoring system

Determining the physical characteristics of the factor. Sources of ionizing radiation in the working and the natural environment

The radioactive nuclides found in nature since ancient times - natural sources, or those artificially prepared, are in most cases the sources of ionizing radiation.

The type and the properties of the atoms are determined by two values – the atom number and the mass number. The atoms with exact atom and mass numbers are called nuclides. The nuclides with the same atom number and different mass number are called isotopes.

Many nuclides (over 2000 by now) are unstable combinations of protons and neutrons. They spontaneously change their electric charge (the atom number), their mass (the mass number) and their energetic state, discharging particles with electric charge and/or gamma rays, and in some cases – a characteristic

roentgen radiation. These spontaneous changes of the nuclides are called radioactivity, radioactive decay. Only some isotopes of the chemical elements are radioactive. Natural radioactive sources are the isotopes of some heavy elements towards the end of the periodic system, as well the isotopes of some light elements – K (potassium), Rb (rubidium), Sm (samarium) Gd (gadolinium) from which only K plays a significant role in the internal irradiation of man.

The Ministry of environment and water (MOEW) through the Executive agency on the environment (EAE) and the laboratories of radiological control in the RIOEWs, controls the radiation state of the environment by systematic monitoring along approved networks and points throughout the country, by methods and parameters of the observation.

Besides, control of the radiation situation in the environment, water, soils, food, is performed by the National center of radiobiology and radiation protection, with its control laboratories, as well as the units of radiation protection of the Regional Inspectorate for Preservation and Control of Public Health from the Ministry of Health.

The control on the radiation situation performed by MOEW and its units monitors the following parameters:

- radiation background – by dose rate, in nGy/h;
- specific activity of the natural and technical nuclides in soils, residues, wastes, in Bq/kg;
- overall radioactivity of water, in Bq/l;
- contents of Uranium and radium in water, respectively in mg/l and mBq/l;
- concentration of radon in the ambient air, in Bq/m³.

The radiation γ background is not assessed in units of dose rate or dose (exposition dose X[R], equivalent H[Sv], absorbed D[Gy]). The substances uranium, thorium, lead and their isotopes are not γ sources predominantly (primary emission), and the investigated activities by MOEW are only their overall radioactivity in Bq/kg, and not an indicator of the most penetrating radiation (the γ emission). For instance, uranium predominantly emits α particles.

The natural γ background is a characteristic physical factor of the environment and could be measured everywhere.

The natural radio-nuclides – uranium, radium, thorium, and the products of their decay, the radioactive nuclides of potassium, rubidium, etc., are widely distributed in the earth and in the components of the environment – the lithosphere (rocks, soils), the hydrosphere (surface, river, lake, sea water), the air, the flora and the fauna.

The dose burden of the population from natural sources of radioactivity is mainly due to:

- the concentration of radon in the air – 54%;
- the cosmic radiation – 16%;
- the contents of potassium K40 in the elements of the environment – 13%;
- other natural radiation sources – 17%

Besides the natural sources as a result of man's activities there are some artificial sources of radioactivity in the environment. These are mainly:

- the waste water and the rock masses from the mining industry for heavy and rare metals;
- the gas aerosol discharges from the thermal and the nuclear power stations;
- the cinder and the ashes from the thermal power plants using coal;
- the construction materials.

The monitoring of the λ background in our country is performed through the National automatic system of continuous monitoring of the radiation λ background, including 26 local monitoring stations, covering the territory of the country. The atmospheric radioactivity is determined by automatic collection of aerosol samples (volume of up to 900 m³ air) on filters by stationary automatic stations. The assessment of the atmospheric radioactivity is performed by λ spectrometric analysis for determining the specific volume activity of the natural and artificial nuclides in them.

Existing problems in the environment

The radiation state of the soils, the bottom residues and the wastes from the activities of enterprises – potential polluters, is monitored by non-destructive γ spectrometric analysis of samples from control points determined earlier on the territory of the country.

The radioactive state of the surface water outside objects – potential polluters, is assessed in compliance with the Ordinance No 7 / 08.08.1986 on the indicators and standards for determining the quality of the running surface water – overall β activity (750 mBq/l), the contents of uranium total (0.6 mg/l), and the contents of radium 226 (500 mBq/l). The samples from the surface and ground water in the regions of production of uranium, are analyzed in compliance with the requirements of the Ordinance on the purpose of radiation safety and protection in eliminating the consequences from the uranium producing industry in the republic of Bulgaria – SG No 101/1999 for overall β activity (2000 mBq/l), contents of natural uranium (0.3 mg/l) and contents of radium – 226 (500 mBq/l). The water samples are analyzed by the parameters mentioned in BS 2823/1983

Drinking water, registering the overall β activity (0.75 Bq/l), the concentration of natural uranium (0.6 mg/l) and concentration of radium (150 mBq/l).

The municipality of Kavarna and the region of the future wind farm are on the Black sea coast. The plateau for the future park consists of rocky and agricultural land. The radiation background is a result of the activity rocky basis, limestone for the greatest part.

On the territory of the municipality there are no mines and no production of ores and minerals, which could contribute to the increase of the natural γ background. There is no enterprise on that territory which could use raw materials with higher radioactivity.

In the region of Kavarna no radioactive isotopes are used for medical purposes. There are no industrial sources of ionizing radiation.

The calf breeding complex could be considered one of the old objects using sources of ionizing radiation but it is not exactly on the territory in question. By 1990 the isotope I 131 has been used for the early diagnostics of pregnancy of the cows. Practically this could not lead to any problems since the period of $\frac{1}{2}$ decay is 8.06 days and this source does not exist from a very long time.

The potential threat is the NPP “Cherna Voda” on the territory of Rumania. The reactor is different from those used in our NPP (VVER type) the levels of emission of tritium are high. There are no data by now from performed measurements after the start of operation of NPP Kozloduy.

Since in the region there are no artificial sources of radiation and similar equipment, the only discussed radioactivity could be the natural radioactivity.

3.13.4. Non-ionizing radiation – sources, types, technologies with emission of electromagnetic radiation, scope of the distribution, impact on the workers and the population, levels of pollution

Determining the physical characteristics of the factor

The non-ionizing radiation includes a great number of factors of the environment, united under that term, due to their physical character – the electromagnetic nature of this radiation.

This includes the following environmental factors:

- static electric field, intensity E , V/m
- constant magnetic field, magnetic induction, B , T
- super low frequency electric and magnetic fields, frequency $f > 0$ Hz up to $f = 300$ Hz. These are measured in the upper mentioned units;
- radio-frequency electromagnetic fields. These are evaluated by the intensity of the electric field E , V/m, and the intensity of the magnetic field H , A/m.

- super high frequency (microwave). The density of the power of the electromagnetic field S , W/m^2 is the measuring unit;
- optical waves – ultraviolet UV, infrared IR. These are evaluated by the density of the power S , W/m^2 and/or the density of the energy W , J/m^2 .
- Each of the electromagnetic factors united under the term non-ionizing radiation has a different biological impact, a different method of measurement and evaluation and different biological criteria of hygienic standardization and therefore, different limits and methods of reducing the adverse impact. Only their physical nature, that is, the fact that they are electromagnetic field factors, studied by the physical branches electrostatics, magnetostatics and electrodynamics is the reason for their unification in a common set of factors – non-ionizing radiation.

Sources of non-ionizing radiation in the working and the natural environment

The sources of non-ionizing radiation are many different types.

For the purposes of the industry, the communications and the medicine these could be generators for the thermal processing of metals and dielectrics, open and closed distributors in the energy production, radio and TV transmitters, sector antennas with base stations for the mobile communications, radars, locators for the aviation, SOS systems for the navy, medicinal irradiation devices, impulse magnets, etc. , lighting systems with specific lamps for the respective technologies and processes, laser systems, etc.

In everyday life such sources include all the electric houseware, the electric installations, the communication systems.

People get irradiated by different non-ionizing radiations in the electric transport, in the discos, the hospitals, during cosmetic procedures, etc.

The non-ionizing radiation could be included in the list of the so called universal factors, that is, factors which could be found everywhere, like the climatic factors.

Impact of the non-ionizing radiation on man and on the environment

The impact of the non-ionizing radiation on both man and the environment is various.

The static fields for instance, affect the immune system and the central nerve system of man.

The super low frequency electric and magnetic fields induce in the human body electric currents which could result in adverse effects like exciting of some excitable structures, electric shock, unpleasant feelings, etc. The magnetic field from such sources is included in the list of the cancerogenes type 2B – possible, by the International agency of cancer research (IARC). This means that there is evidence from epidemiological studies that these fields can result in the

development of certain types of cancer and especially to leukemia in children as well as some types of cancer of the central nerve system.

Such fields could lead to electric shock in case of touching massive metal surfaces near high voltage electric transmission lines or other conductors, due to the so called short circuit.

The radiofrequencies and the microwaves affect man mostly by absorbing the electromagnetic energy by different tissues and its conversion into heat. There exist also some specific non-thermal effects, connected with resonance, information and other impacts, which most generally harm the functioning of the system hypothalamus – hypophysis – the above-kidney glands.

The optical radiation affects mostly the eyes and the skin and leads to cataracts, loss or damaging the central and the peripheral sight, burns of the retina or the cornea, etc., depending on the wavelength, as well as erythema, aging of the skin, skin cancer. The UV H scope is included in the list of the cancerogenes group A by the IARC, that is, the optical radiation is a proven cancerogene for man.

Besides the described effects on human health, there are also other effects of interaction of the non-ionizing radiations with the environment, which could result in other problems of the safe functioning of the systems and the equipment.

One of these effects is the possible interference of the electromagnetic waves which could result in communication problems.

Another effect is the eventual direct or non-direct effect of the electromagnetic waves on the medical equipment, the active implantants or other precise technique connected with the security of the flights, the computer systems, etc. this effect is studied by the so called electromagnetic compatibility, for which the EU has developed a number of documents and standards, part of them adopted by our legislation. Effects like that on the quality of the TV and radio links shouldn't be neglected as well.

Speaking about the unpleasant effect from the optical waves we should not forget the possible impact of the so called blicks, negative light effects resulting from the manner of its entering the eye, from reflections, blinding and temporary loss of possibility of accommodation or even seeing.

Existing problems in the environment

The non-ionizing radiation is measured by the laboratories of the Ministry of Health and the MOEW, with the purpose of accepting new objects irradiation with different frequency bands as well as of control of the radiation in the working environment and the residential areas. There is no national monitoring system of

the different types of non-ionizing radiation in the residential areas, although there are enough measuring devices in the country for different frequency bands.

In the region of the future wind farm it could be said that only the natural values of the different non-ionizing radiations could be established. These are:

- the natural background of the electrostatic field
- the magnetic field of the Earth, characteristic for the respective latitude;
- the background values for the Earth in the radiofrequency and the microwave bands from sources in the Cosmos
- the existing levels of the optical radiation from the Sun.

In the regions near the wind farm the following sources of electromagnetic fields and of waves from the microwave and the radiofrequency bands could be found:

- electric transmission lines with 20 kV; there are no data of lines and distribution devices with higher voltage – 110 kV in the region of the future park;
- military communication systems;
- SOS system of the navy with a powerful source “Kaliakra”, nor operating at present;
- radio-communication and locator stations;
- mobile radio-location equipment of the navy and the aviation.

Besides there are sources of electromagnetic fields in the hospitals (physiotherapeutic equipment and other systems), in the houses, video-displays of the computer systems – in the houses and in the offices, copying technique, base stations, mobile connection systems, etc. The most powerful sources of radiofrequency radiation in the region are the SOS emitters in the village of Bulgarevo. For the most part these are not functioning. The irradiation diagram of these antennas is in the direction towards the sea and not to the coast.

The background values of the radiofrequency and microwave electromagnetic fields have increased many times for the past 100 years all around the Earth because of the existing nowadays communication systems. This is valid not only for the region of the future WPP, but for the whole Earth atmosphere. This is an increase of the background values of the radiofrequency and the microwave radiation due to the communication systems, but not of the limit values for the normal urban life in the 21st century. The increase stays in the limits of the new natural values and this is valid for the region of the implementation of the investment proposal, where there are no sources of such irradiation.

3.13.5. Forecast and evaluation of the impact of the noise on the implementation of the investment proposal. Cumulative effect

The noise is generated by several different parts of the turbine: the generator, the gear box, the contacts between the hub and the supporting tower, which generate mechanical noise. There also exists aerodynamic noise from the rotation of the blades. The combination of the noises from the water turbine could be described as mechanical noise, similar to that of a moving car, combined with the aerodynamic impulse whistling of the propellers.

Such a noise is generated only when the turbine functions. For the horizontally designed turbines this is valid for wind velocities of 4 – 30 m/s. at velocities of 6-7 m/s the turbine operates and the noise from the wind is comparatively low. When the wind velocity is over 10 m/s the noise of the wind is stronger than that of the operation of the turbine.

People often compare the different noises in their own way. The average noise level in a house is about 50 dB(A), while that from a moving car in the street it is about 60 dB(A) at the distance of 300 ft. The quiet vacuum cleaner generates noise about 70 dB(A) and this noise could be registered at a distance up to 100 ft. near the trees when the wind is weak the measured noise is about 55 – 60 dB(A).

The human ear can distinguish at least 3 dB(A) differences between the noise levels, the lower difference is masked by the noise in the environment. Most of nowadays turbines in the residential areas generate noise levels of values very close to these in the environment.

Although under certain conditions the intensity of the noise from the wind generator could be the same as the noise from the environment, the frequency could be different. So the noise from the turbine could be distinguished from that of the environment, though it is of the same intensity. This is not an absolute rule. Practically if a man listens very carefully, he would identify all other components of the environmental noise – the barking of dogs, the noise from the traffic, even the noise from the trees.

Most generally the levels of the noise decrease with the increase of the distance to the equipment. A turbine with high power as the ones discussed here typically generates noise with levels 90 – 105 dB(A). At a distance of 1 diameter of the rotor at the earth level the noise decreases to 55-60 dB(A) and at 350 m from the generator – to 35 – 45 dB(A). (The admissible limit value of the noise level in premises for sleep according to the Hygienic standards 064/1972, is 35 dB(A) for closed windows and for the new areas it is 40 dB(A) at night; near traffic arteries (like the E87 road) it is 45 dB(A).

The Investor has not submitted data on the height of the hubs, because in the course of development of the technical design model investigations will be performed for determining the optimal height of each of the wind generators. So the maximum possible efficiency of the energy park will be ensured. That is why

it is not possible to make any Forecast of the distance, at which the noise level will decrease to the standard values for the residential areas.

Most generally speaking, the turbines, located at distances greater than 450 m from any residential places in flat country will not cause any problems to the inhabitants resulting from the noise factor, due to the fact, that the hygienic standard values of 40 dB(A) will not be reached.

Despite that we have tried to make certain calculations in order to determine the worst case in the operation of the turbines.

For the most part the noise from the equipment in the residential areas comes from the aerodynamic noise, generated by the blades rotating in the wind. These are structures with changing velocity of rotation depending on the velocity of the wind. So the aerodynamic noise increases with the increase of the velocity of the wind.

The aerodynamic noise is also a function of the velocity of rotation of the propeller. It is obvious that the linear velocity of the tips of the blades is many times greater than that of the other parts. This velocity depends on the geometric characteristics of the propeller itself.

The tip speed ratio (TSR) is a determined value which connects the velocity of the tips of the blades with the velocity of the wind. TSR 10 means that when the velocity of the wind is 25 m/h (11 m/s), the tips of the blades will move with 250 m/h (111 m/s). The increase of the tip velocity leads to greater noise. The nowadays low speed generators operate with TSR from 5 to 7, which generates noise which cannot be heard at the background of the environmental noise.

According to the main acoustic equation and on the grounds of the works of Gutin and Blohintsev, using the methods of the theory of similarity, the respective sound frequency f_s from the tip of the propeller will be determined as follows:

$$0.3 = ts.2Ro/v_o$$

In this equation 0.3 is the semi empirical value of the Struhal number in the theory of similarity, Ro is the maximal radius of the propeller at wind velocity v_o .

The noise generated by a specific source shall be compared to the noise of the environment and the other noises. In the case of the wind generator, if it is located near a residential area, this background noise must be compared to the noise from the vehicles and the agricultural technique, the dogs, the children, etc. The environment itself generates noises which interfere with the noise from the equipment. All these noises increase with the increase of the velocity of the wind.

When a part of a machine is being evaluated for its noise emission, two tests are usually performed. One of them is when the machine is switched off. The second test is performed when the machine is operating. In the case of the turbines the tests can be performed at high and low wind velocities and when the turbine is

switched off and is operating. Since the wind is also a reason for noise generation, the environmental noise increases with its speed and masks the noise from the turbine.

In this case the most adequate information about the noise levels before the final installation of the equipment could be obtained by measurements in the following manner:

- noise measurements in the environment with three microphones for the open space and three microphones for higher pressure. In the open space the noise level shall be measured not by the A curve, but by the D curve.
- the measurements shall be repeated immediately before the final installation of the equipment after the tower is erected;
- all the measurements shall be performed at the base of the tower.

In the tests of the operating equipment the measurements shall be performed following the same procedure.

The specialists from NREL (National renewable energy laboratory) in the USA have noted that the operating conditions for the wind turbine affect strongly the noise generation. They have established two scenarios when the noise really increases under normal operating conditions. One of the cases is when the mechanical connections at the base of the propeller are broken and the other – when the rechargeable battery is not full.

In the first case the turbine blades are a free moving system and rotate without control, thus creating more intensive noise. In case of normal connections the noise decreases. In such a situation the equipment must be switched off.

The second case is when the battery system cannot accept more energy. This often happens when the wind is very strong or when there is a storm. In this case the surplus energy shall be shunted by a resistor. In that situation the turbines float, generating louder noise.

High power turbines shall be evaluated separately at a distance of about 350 m from the residential buildings which will probably be enough to keep the noise down to the admissible values. This depends mostly on the power of the turbine, but also on the terrain.

The literary data point out that the decrease of the noise at the base of the mast is of the order of 0.143 dB/m. But according to the well known solution of Paul Langeven about the generation of an additional stream at the base of the mast, additional minimal noise level is obtained of + 6 dB, which turns the 350 m where the noise reaches 35 – 45 dB into a safety zone at the distance of 392 m. The suppositions in the performed calculations are within the minimal deviation for determining the noise levels (3 dB(A)).

The frequency interval of that additional noise level is of the order of half the determined low frequency as a result of the rotation of the turbine, divided by the radius of the mast. The frequencies of this additional noise are within the interval of the infrasound that is why the decrease of the additional component is slower with the increase of the distance. Simple calculations show that if the tower has a diameter of 3 m, additional safety distance of about 130 m shall be secured. This results in the increase of the safety zone up to 530 m.

In case a more detailed preliminary evaluation will be necessary using a numerical method, all the installation and operation parameters of the equipment will have to be taken into account. This is a serious design problem which requires the respective technological time for its solving.

Besides, on the basis of the data from the literature and additional calculations about the infra-sound component, the worst case for the planned type of turbines requires a safety hygienic zone of 500 m.

It is obvious that these calculations concern a single generator. In the presence of more turbines as in the future park, a cumulative effect shall be expected from the noise emission of the separate turbines, depending on their location.

Speaking about the cumulative effect, we shall not forget the cumulative non-specific (extra – aural) impact of noise on man, in combination with the vibrations, the heating and the electromagnetic fields in the radiofrequency and the microwave intervals. This discussion concerns the effect of these combinations in the working environment, and this is not possible to be done, except for the agricultural activities in the region in the warm seasons.

3.13.6. Forecast and evaluation of the impact of the vibrations from the implementation of the investment proposal

The equipment for the production of electric energy are sources of vibrations. The generated vibrations are general, with frequencies of about the frequency of operation of the turbine (0.14 – 0.33 Hz). These could be emitted in case of poor quality installation of the equipment, as well as in the case of not elastic enough foundation to absorb the generated vibrations.

Following from the main air – acoustic equation of Bolhintsev – Hough, the tangential and the normal accelerations, generated as tensions on every blade of the propeller and in the flow around the cabin, lead to tensions on the mast, whose point of application moves in a cycle. This results in transmitting low frequency vibrations to the base of the mast, with a periodic component, whose main wavelength is a multiple of height of the mast, from the base to the point of connection of the cabin. The amplitude can be determined but the angle of the attack of the blade by the air flow shall be known, as well as the mass of the

propeller and the mass of the cabin. Since there are not enough data about these, such calculations cannot be performed for a quantitative evaluation of the vibration situation,

As far as the dynamic volume of the air flow is also responsible, besides the propeller and the mast of one 3D attractor (2 connected rings in two mutually perpendicular planes) from the law of conservation of energy it follows that the difference between the velocity of the wind (to the 3rd power) and the obtained energy ensure about 40 kW energy which is parasitic and is lost as noise and vibrations.

By now there are no data in the world about registered high values of the general vibrations around such type of equipment and even this factor is not considered harmful for the environment. Probably this is due to the quality of the construction performed by the companies on the basis of the recommendations of the manufacturers of the equipment. Obviously in case of following the requirements of the manufacturer the vibrations do not present a problem for the environment in the wind farms.

Such low frequency vibrations cannot be felt and cannot affect the population because in this particular case the residential area is far enough from the equipment. Besides the earth mass consists mainly of rocks which are a big inert mass where the general vibrations shall be absorbed. The low level general vibrations (below the permissible limits for the population) cannot affect the environment.

Despite this, after the installation of the equipment it is necessary to perform measurements for the assessment of the technological vibrations which could be generated with the start of operation.

3.13.7. Forecast and assessment of the impact of the non - ionizing radiation from the implementation of the investment proposal

The non- ionizing radiation in the region of the wind generators is mainly within the interval of the super low frequencies and the low frequency electromagnetic fields. Since the equipment consists of generators of electric current all the problems, connected with the adverse impact of the electric and magnetic fields at the main industrial frequency of 50 Hz concern these as well as other know generation systems.

There are no standards in Bulgaria concerning the electric and the magnetic fields in the residential areas. The only document in force which reviews these factors is the Ordinance No 7/1999 on the minimal requirements to the safe and healthy working conditions and to using the working equipment. There also exists a BS on the electric fields with industrial frequencies, but it also concerns the

working environment. Table 27 presents the maximal admissible limits from the mentioned documents:

Table 27 – Maximal permitted limit values of the electric and magnetic fields

Standard	Frequency band	Electric field E, V/m	Magnetic field B, G
Ordinance No 7	1 – 100 Hz 0.1 – 4 kHz	25 kV/m $2 \cdot 10^6 / f$ V/m	$600/f^*$ $600/f$
BS 12.1.002 - 78	50 Hz	25 kV/m	-

* - f is the frequency of the electromagnetic radiation in Hz.

For the frequency of 50 Hz the maximal permitted value is 12 G. For people with cardio-stimulators the permitted value of the magnetic induction is $B = 1$ G.

The turbines themselves are sources of electric and magnetic fields and the values of the electric field are usually much lower – intensities of not more than 100 – 200 V/m – values which can be met in the residential buildings and the houses. The values of the magnetic field depend on the consumption of electric energy and these cannot be determined exactly by calculation. Despite that, data from measurements near the turbine generators in WPP show that the magnetic induction can reach $B=1$ G. This value is warning and risky for people with active implantants, but does not cause risk for people with normal health. The same value was accepted as maximal permitted in the recommendations of the WHO for the hygienic standards for the population.

Other sources of electric and magnetic fields with industrial frequencies are the covered distribution devices, transformers, electric power transmission lines with high voltage. The wind generators generate current which is distributed with average voltage (20 kV). The measurements for such systems show that the electric field does not exceed $E=100$ V/m, and the magnetic induction – $B=100$ mG.

Besides the electric and magnetic fields with industrial frequencies, the wind turbines and the generators generate such fields with higher frequencies – harmonic with the basic (industrial) up to 1 – 2 kHz. These electromagnetic fields are in the spectre of the low frequencies and for them there is a standards only for the working environment (Ordinance No 7, see Table 27). The measurements around the turbines in WPP in the country show that the intensity of the electric field is $E=10 – 50$ V/m, and the magnetic – $B=10 – 100$ mG.

Compared with our standards for the working environment it is obvious that these values are hygienically significant, but they are lower than those presented in Table 27. Only in the immediate vicinity of the turbines (1 m) where the presence

of people is impossible, the magnetic induction with 50 Hz could lead to problems for people with active implantants.

Compared with the most protective hygienic standards in the world, these values of the electric and the magnetic fields are within the permitted limits for residential places. Here we have in mind the limit values in Russia ($E=1000$ V/m) and Poland ($B=800$ mG).

For that reason we do not have any regulated hygienic protective zones around electric power transmission lines and covered distribution devices with voltage below 110 kV.

Besides, the Forecast for the effect of the super low frequency and low frequency electromagnetic fields is such, as not to expect any adverse impact on the working people – those performing repairs and maintenance activities, and the passers by along the roads, the inhabitants of the nearest residential places. No adverse impact is expected on the flora and the fauna in the region of the WPP. In this respect there is a large experience from more powerful energy systems in other countries and in Bulgaria.

3.13.8. Forecast and assessment of the other physical factors on the environment and taking into account the requirements of the regulations in force on the protection of human health and the environment. Evaluation of the expected impacts on other components of the environment and on the objects and the equipment, existing already or planned according to the investment proposal.

The unfavorable light effects as factors – part of the non-ionizing radiation and other physical “pollutants” of the environment

The problems of the light effects from the wind generators are one of the most problematic aspects of the evaluation of the impact of the non-ionizing radiation on the human eye. The individual acceptance varies widely – the turbines are accepted as dynamic visual sculptures by some and unacceptable teasing of the eye by others.

The acceptance varies depending on the weather. Investigations in Great Britain on the acceptance of the risk show that the local people are more sensitive to the turbines after they have operated for some time. That is why the WPP are being constructed in locations where they could not be seen directly from citizens.

The location of the installation, the dimensions of the turbine, the color of the towers are of considerable importance for the unpleasant visual effects. The presence of roads, buildings, other electric power mobile systems could be important in the prognostication of such effects of the sight. For instance, in new Zealand such WPP are constructed on rocks near the sea shore, because in the region there are mainly agricultural lands.

The experience of many countries introducing the wind power systems leads to the following recommendations on the installation of the turbines, in order to reduce the unpleasant visual effects:

- all the turbines in the park shall have similar dimensions and structures;
- the blades shall rotate in the same direction;
- in case of flat country the turbines shall be preferably installed in a line and not be scattered around the territory;
- light colours – light grey and white are the most suitable for all the parts of the turbines in Northern Europe, so that they could be seen against the sky. When the background is a lighter sky, the dark colours are more suitable;
- the distance and the location of the turbines in the park is important. When the landscape is open or impressive, this location is not important. Actually the human eye often sees the vertical objects higher than they are, despite the distance to them.

In summary we can say that the conditions for the installation of the equipment cannot be generalized, so that no unpleasant visual effects are generated. Each installation shall take account of the landscape, the dimensions, the local specific background and the natural lighting, the number of the people who could watch the park, etc. It is necessary to plan the regions by photographic simulations, with the respective motion of the equipment in the park.

In Great Britain there are certain data of the cumulative effect of the visual effects from a specific region to different wind farms. Unfortunately, it is not clear yet how this cumulative effect shall be assessed.

An important element in the construction of new equipment in the wind farms is having in mind that with getting closer to the turbines, the dimensions increase and the visual effects change. This must be taken into account when planning the roads in the region.

In a similar manner the location of the additional power transmission lines in the region must be evaluated.

There exist specific visual effects, resulting from the rotation of the blades – vibrations of shadows and flicks.

Besides the general visual effects the turbines generate effects which may cause temporary problems with the sight.

The vibration of shadows, the stroboscopic effect could be more significant inside the houses, if the blades cross the sun rays, leading to the vibration of shadows in the rooms. This happens when the buildings are near the turbines and the angle of the sunrays is very small.

The blicks – the common reflection of the sun rays by the rotating propellers may lead to unpleasant feelings. This can happen in case of specific orientation of the hub, and a specific angle of the sun rays. The reflective ability of the blades is also important and it depends on the colour and the age of the blades. The matt surface decreases the effect. The blicks are important to the drivers on the roads in case of looking at the blades under a specific angle. The effect is registered at great distances – up to 10 – 15 km.

In the case of the equipment to be installed in the WPP in Kavarna municipality, for our geographic latitude, the most suitable colour is the dark green. The generators are equal in dimensions and structure. It was planned they to be installed in lines, with a few exceptions, at distances of 200 – 600 m from each other. The distance to the first residential buildings shall be about 1000 m (the village of Bulgarevo).

A very important condition, facilitating the implementation of the project, is the lack of any other constructions and equipment in the region of the installation of the wind generators, except for the electric power transmission lines of 20 kV. This reduces the probability of producing such light effects.

Effects, connected with the electromagnetic compatibility with the communication systems

Receiving a high quality signal by the radio, TV or microwave communication systems could be disturbed in several ways by the operation of the turbines (the discussions concern a modulating signal with very low values – to nanovolt/m).

The tower may disturb, reflect or decline the electromagnetic waves along the route of the transmission of the signals by communication systems.

The rotating propellers may generate similar effects depending on the time. Because they are not made of metal, they cannot play the role of antennas in the communication lines which would have caused disturbances in the local TV signals.

The generator itself creates electromagnetic disturbance though this effect is muted by screening and proper maintenance of the turbines. Practically the generator does not differ much from any other electric generator, for which there are good enough technological decisions, so only in very rare cases the wind generator can present a problem in this aspect.

Generally these effects could be limited, because the towers and the blades are thin elements in the region of distribution of the communication signals, so they can only disturb, but cannot reflect or decline the signal. Using a material

absorbing the electromagnetic signal for the blades, and this is the usual manner of their production, this effect could be minimized.

Despite that, the location, the dimensions and the structure of the turbines could be of significant importance, depending on the type and the location of the communication equipment.

Studying in details the effect of the disturbance of the communications, it is important to know that this effect matters for communication, using electromagnetic waves in the microwave spectre, $f > 300$ MHz. The key zone of such potential interference is the so called first Frenell zone. It is an ellipsoid formed between the transmitter and the antenna and its dimensions depend on the wave length (or the frequency), the distance and the local atmospheric conditions. We may talk about 1st Frenell zone around a turbine only if it is the only obstacle with dimensions less than 0.3 times the radius of the zone. Such effect can be calculated on the basis of data for the frequency of the emission, the local conditions and the structure and the location of the turbine.

We do not have enough information about the communication equipment in the region. All the electromagnetic effects like weakening of the signal, etc., could be determined only after knowing all the electric characteristics of each turbine, the generator, the tower, the blades, especially the metal contents in the structural elements.

Effects of the air traffic

Because the towers are of considerable height (> 70 m) and the blades are also long and mounted at a great height, flying in the region over the park shall be avoided. It is necessary to mark the towers with respective lights, after a consultation with the respective aviation institutions, controlling the air traffic. When such equipment is to be installed, it is better their region to be far from airports.

We have no data the region to be used as a route of the civil and military aviation. There are no airports nearby.

3.14. Harmful and hazardous substances

According to the Protection from the Harmful Effect of Substances, Preparations and Products Act (promulgated in SG No 10/2000, amended No 91/2002, No 86/2003, amended and supplemented No 114/2003, No 101/2005) and Ordinance on the classification, packaging and labeling the existing and the new chemical substances, preparations and products, adopted by Governmental act No 316/2002 (promulgated SG No 5/2003, amended and supplemented No 66/2004, No 50/2005, No 57/2005), the chemical substances and preparations

are classified as hazardous if proven that they have at least one of the enlisted properties (Table 28)

Table 28 Properties of the chemical substances and preparations which determine them in the category of the hazardous ones

Category (signs of hazard)	Category (signs of hazard)
1. Explosives (E)	8. Harmful (Xn)
2. Oxidizing (O)	9. Corrosive ©
3. Exceptionally flammable (F*)	10. Teasing (Xi)
4. Easily flammable (F)	11. Sensibilizing* (Xi)
5. Flammable (F)	12. Carcinogenic * (T, Xn)
6. Strongly toxic (T*)	13. Toxic for the reproduction* (T, Xn)
7. Toxic (T)	14. Mutagenic* (T, Xn)
	15. Hazardous for the environment (N)

The long term effects on human organism (*) result from the substances and the preparations which lead to damages after a prolonged period of impact. For instance, allergic diseases to the breathing or the skin under the action of sensibilizing agents, changes in the possibilities of getting pregnant, spontaneous abortions, earlier births, new born children with physical and functional defects under the action of the substances, classified as toxic for the reproduction, genetic defects from the impact of the mutagenic and gene –toxic agents or risk of cancer due to carcinogenic activity. The chemical substances determined as carcinogenic , mutagenic or toxic for the reproduction (CMR) are classified into category q,2 and 3, which determine the degree of the risk for the people and the strictness of the measures for prevention the potential impacts from exposure of the workers and the population.(Ordinance on the hazardous chemical substances, preparations and products, liable to prohibition and restrictions in trade or use, adopted by Governmental Act No 130/2002 (SG No 69/2002, amended and supplemented SG No 62/2004, No 97/2005).

On the area of about 60 km² for the installation of the wind generators in the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, no hazardous substances and preparations are stored. In the past and nowadays there have not been any enterprises or objects sources of previous pollutions. There are no production units of the petroleum industry, metallurgical enterprises, stores for pesticides, production of chemical substances, pharmaceutical preparations, polymer products, mines and dressing factories. Near the area for the installation of the generators there are no military units, petrol stations, car fleets, stores for petroleum products, stores for chemical products. The chosen area consists of agricultural lands.

The municipality of Kavarna has a concession of using the deposits of oil in its territory, but at present no activities are being performed, connected with the

production and processing of oil which may lead to pollution of the environment in the region of the park.

Through the territory of the municipality passes the international road E87. No heavy traffic passes through the region of the future WPP, which could lead to pollution of the environment with hazardous substances.

During the construction of the foundations with dimensions 14,5 x 14, 5 m, the supply of the parts of the wind generators and their installation, during the construction of the substation and the construction of the power transmission lines the following hazardous substances are expected to be temporarily generated (Table 29)

Table 29 Emissions of hazardous chemical substances and preparations during the construction of the electric substation, the foundations of the generators and the transmission lines

Chemical substance/preparation. CAS No	Sign of hazard	Adverse health effects	Conditions of exposure
Carbon oxide 630-08-0	F* strongly flammable T toxic	Strongly flammable, toxic in case of inhaling – causes hypoxia and hypoxemia. Leads to the formation of carboxy hemoglobin. Affects the nerve, the cardio-vascular system, the production of blood. Toxic for the reproduction.	Emissions of waste gases from the heavy motor vehicles, the excavation machines, the cranes
Carbon dioxide 124-38-9		Asphyctant – replaces oxygen in the air. Affects the nerve system	Emissions of waste gases from the heavy motor vehicles, the excavation machines, the cranes
Nitrogen oxides 10102-44-0	T* toxic Xn harmful	Toxic – affect the lungs. In high concentrations lead to edema of the lungs, alveolitis. Irritates the eyes, the	Emissions of waste gases from the heavy motor vehicles, the excavation machines, the

Chemical substance/preparation. CAS No	Sign of hazard	Adverse health effects	Conditions of exposure
		respiratory tract, the skin, chronic bronchitis, frequent bronchitis, frequent pneumonia. General toxic effect	cranes
Sulphur dioxide 7446-09-5	T toxic, C - corrosive	Toxic upon inhalation. Affects the respiratory, the nerve system, the heart. In high concentrations causes chemical burns. Irritates the respiratory tract, the eyes, the skin. Has strong unpleasant odor. Hazardous for the environment	Emissions of waste gases from the heavy motor vehicles, the excavation machines, the cranes
Waste motor oils PSB"s 1336-36-3	Xn harmful N hazardous for the environment	Harmful. Hazard of cumulative effects, affect the nerve, the cardio-vascular system, the liver, the kidneys. Mutagenic. Hazardous for the environment, especially for the water organisms.	Pollution of the soil from poorly maintained motor vehicles and construction machines
Diesel oil 8006-61-9	Xn – harmful N hazardous for the environment	Harmful. Hazard of cumulative effects. Allergen. Affects the nerve system, the skin, the blood production, the lung, the kidneys. Mutagen. Hazardous for the environment, especially for the water organisms.	Spills and leaks in the loading of fuels. Bad quality fuel.
Cement	Xi – irritant Alergen.	Irritates the skin, the eyes, the respiratory tract. Alergen.	Chronic effects when the requirements for

Chemical substance/preparation. CAS No	Sign of hazard	Adverse health effects	Conditions of exposure
		Contains pollutants (Cr 6+, Cd, Co, Ni) and is under the control of Governmental act No 156/2004). Irritating and allergic effects on the skin and the mucous membranes.	labour safety are not being observed.
Polymer materials		Causes acute and chronic diseases due to irritation or allergic reactions of the respiratory system (bronchial asthma) and the skin.	The instructions for labour safety are not observed
Paints, varnishes, solvents, hydroisolation	Xi – irritants Allergens	Causes acute and chronic diseases due to irritation or allergic reactions. Affect the nerve and the respiratory system, the liver, the endocrine state and the skin.	

At the first stage of the implementation of the investment proposal (2006 – 2007) an electric substation will be constructed 20/110, electric power transmission lines for 20 kV and 110 kV and 30 wind generators with installed capacity of 60 MW. At the second stage (2007 – 2008) 32 more wind generators will be mounted with installed power of 60 MW.

The Investor GEO Power Ltd. Has accepted the responsibility to follow the contemporary requirements for environmentally friendly construction of the foundations of the wind generators and their installation in ready elements. The technical literature for such type of equipment contains information about the special lubricants and greases used in the wind generators. The reducer oils are encapsulated in the bearing parts. The prevention of spills and leaks of hydraulic oil in the brakes and transformer oil in the transformer box is ensured by the installation of oil-capturing baths. The wind generators shall be supplied by the manufacturers with included in the supply containers of grease for the gears and of lubricants for the azimuth – gears. Periodically the containers shall be replaced with special greases for long term action of the rotating gears. The replacement

of the used specialized oils and greases shall take place during the periodical maintenance and repair activities by qualified specialists with company-supplied ready encapsulated containers. The waste lubricants are classified as hazardous substances and shall be stored in compliance with the requirements of the environmental legislation (Ordinance on the requirements to the treatment and transportation of used oils and waste petroleum products, adopted by Governmental act No 230/2005 (SG No 90/2005).

The mentioned reducer, transformer, hydraulic oils and lubricants are classified as harmful (Xn) and hazardous for the environment (N). In contact with the skin, through the respiratory system in case of fires and high temperatures, or by taking them in through the mouth, they affect the nerve system, the liver, the kidneys, the blood production and can lead to skin diseases, allergic and photoallergic contact dermatitis. The waste hydrocarbon oils contain stable organic pollutants (polycyclic aromatic hydrocarbons – PAH, polychlorinated biphenyls and polychlorinated furans – PCBs, PCFs). They enter into the organism through the food (fats of vegetative and animal origin, meat and milk products, eggs) and cumulate in the fatty tissue. They exert long term adverse effects on the immune system, the endocrine state and the reproduction. They are classified as mutagens and carcinogens, categories 2 and 3, according to Directive 2004/93/EC. In the last years through projects of the Program of preservation of environment of the UN (UNEP) and the WHO, in Bulgaria special measures are being taken to decrease the pollution of the environment with stable organic pollutants.

By data of Company GEO Power Ltd. the specialized lubricants and greases for the wind generators are very pure in order to be in compliance with the special requirements. They are produced by approved companies on the basis of synthetic hydrocarbons and special additives. The used new wind generators do not include reducers and that is why they do not contain the usual amounts of 200 l reducer oil. All the systems preventing the friction are closed and protected with special devices (installed oil capturing boxes and/or baths, bullets for loading, electronic signalization devices for registering leaks). They shall be checked during the periodical technical maintenance of the generators and in the cases of registered deviations from the normal operation, displayed in the station for the remote control, the respective measures will be taken.

During the technical maintenance, the reducer, hydraulic and the transformer oils of the wind generators will be changed by specialized teams of the company, engaged with the maintenance. This will guarantee the lack of pollution of the agricultural lands. Checks will be performed for eventual leaks, since the omissions in the systems of reduction of the friction will have an unfavorable effect on the operation of the equipment. There will be no hazard from pollution with hazardous petroleum oils and grease of the soil, the ground and surface water and the agricultural production in the region of the installed wind generators.

The investment proposal does not anticipate the construction of a permanent road network in the area of the location of the 60 generators. This will ensure the lack of any soil pollution with petroleum fuels and lubricants from motor vehicles.

The operation of the electric substation is connected with the use of transformer oils. In February 1997 UNEP declared the necessity and started internationally coordinated activities for the reduction of the stable organic pollutants (POPs) in the environment, including these from the electric distribution transformer oils. According to Ordinance on the classification, packaging and labeling of the existing and new chemical substances, preparations and products, adopted by Governmental act No 316/2002 (SG No 5/2003, amended and supplemented No 66/2004, No 50/2005, No 57/2005) it is required to evaluate the risk, to elaborate certificates of analysis for the contents of the risky pollutants and information safety sheets for each petroleum oil, used in the electric stations. In the project of MOEW on the implementation of Action plan with measures for reducing the risk for the environment and the health of the population (2002 0 2004) of the exposure to POPs,, special attention is paid to the import, the use and the management of the wastes from the oils used in the electric transmission devices.

3.15. Health and hygienic aspects of the environment

The territory of the municipality of Kavarna has an area of 480.6 km² and a population of 18 285, by data of the municipality. There is one town – Kavarna and 20 villages. About 70% of the population lives in the town. The population in the villages is comparatively small in number and has a permanent demographic statute.

By data of the national statistical institute and the National center of health information in the Ministry of Health (Health preservation 2003, Health preservation 2004, the National Statistical Institute and the National Center of Health Information, 2004 and 2005, Sofia), the parameters of the demographic state of the population of Kavarna in 2002 and 2003 are presented in Table 30.

Table 30. Demographic parameters of the movement of the population in the municipality of Kavarna towards 31.12.2002 and 31.12.2003.

Population, overall number	Live-born children Birthrate		Number of deceased General death rate		Deceased children under the age of 1	
	number	%	number	%	number	%
2002 Kavarna municipality 16433 inhabitants	126	7.67	215	13.08	1	7.9
2003	136	8.29	228	13.91	3	22.0

Kavarna municipality 16391 inhabitants						
200 Republic of Bulgaria 7801273 inhabitants	67359	8.60	111927	14.30	831	12.3

The comparison of the basic demographic parameters for the municipality of Kavarna for the period 2002 – 2003 shows that there is an increase in the birthrate, an insignificant increase in the death rate and an unfavorable index of children death rate. The death rate among the children under the age of 1 is 22% while the average for the country is 12.3%.

In comparison with the data for the country for 2003, the death rate in Kavarna is lower and the birth rate is lower too than the average values for the country, but the differences are small and statistically unreliable. The natural growth of the population is negative – 5.4% for 2002 and -5.6% for 2003, while the average for Bulgaria in 2003 is– 5.7%. There is no difference practically here. For the period 2002 – 2003 no significant changes in the demographic state of the population have been observed. The trend of reduced birth rate is preserved, as well as the higher death rate among people over 60. As a conclusion it could be said that the demographic characteristics of the population in Kavarna does not differ significantly from these for the country, though the death rate among children below 1 is very high for 2003.

The ratio of the town and country population is similar to that for Bulgaria. The trend of decrease of the population in the villages is preserved. The number of men is smaller than that of women. The demographical ageing of the population is a steady trend and the largest is the part of the people over 65. There is a trend of reduction of the number of the young people, especially in the villages. By data of the municipality of Kavarna, the population is permanent. The visitors in the summer months do not exceed 2000 people.

The death rate is an integral parameter which gives indirect correct information about the diseases among the population. The number of the dead and the death rate per 100 000 of the population in the Region of Dobrich for 2003 by causes for the death, according to the International classificatory of the diseases, are presented in the published book Health preservation 2004 (NSI, NCHI, 2005, Sofia). In table 31 some information is presented on the death rate by illnesses for the Region of Dobrich in 2003. The causes for the death are presented by groups of diseases, which are connected mainly with the adverse effects of the residential environment.

Table 31. Death rate by the causes of the death per 100 000 people for the population of the Region of Dobrich by the ICD. Diseases connected with the factors of the environment of living.

Causes for the death according to the International classification of the diseases – IX revision	Dead per 100 000
Total for the Region of Dobrich	1424.9
New tumors	236.7
Malignant new tumors of the respiratory tract	53.0
Other malignant tumors of the digestive system	88.3
Diseases of the endocrine glands, the digestion, the metabolism, the immune system	26.2
Diseases of the blood and the blood producing organs	3.3
Diseases of the nerve system and the sensors	13.8
Diseases of the blood vessels	899.5
Diseases of the respiratory system	58.2
Diseases of the digestive system	41.5
Complications during the pregnancy, the birth and the post-natal period	-
Disease of the skin and the underneath tissue	0.5
In-born anomalies	4.8
Transport accidents	12.4
Suicides and self hurting	26.7

The standardized data for the structure of the death rate by diseases in the region of Dobrich does not differ substantially from these for the other regions in the country, which are not identified as Hot spots due to the adverse impact of the environmental factors.

In the municipality of Kavarna the death rate among the people over 60 – 65 has increased and the reason for over 90% of the deaths are due to 4 classes of diseases, like the statistical data for the country: on the first place are the disease of the blood system (mainly ischemic disease of the heart and brain insults, hypertonic disease), on the second place are the malignant tumors (cancer of the digestive, respiratory system and the mammary glands in women), on the third place are the disease of the respiratory system and on the fourth place – the diseases of the digestive system.

The average age of the population of the municipality of Kavarna is about 70 years – like that for the country. For the women this age is higher with 4 or 5 years. The population in the villages lives longer than that in the town.

The registered diseases from malignant tumors, infection diseases and the ill under medical control in psychiatric institutions per 100 000 people for the population of the Region of Dobrich for 2003 are presented in Health

preservation 2004 (NSI, NCHI, Sofia, 2005). Part of them connected with the adverse environmental impacts, are presented in Table 32.

Table 32. Registered diseases per 100 000 people for the population of the region of Dobrich in 2003

Socially significant diseases	Ill per 100 000
Total malignant tumors	2038.6
Malignant tumors of the digestive system	375.6
Malignant tumors of the respiratory system	168.0
Skin melanoma	19.6
Other skin malignant tumors	257.2
Malignant tumors of the mammary gland	697.9
Malignant tumors of the thyroid gland	32.0
Malignant tumors of the lymph and blood producing organs	75.4
Dysentery	14.8
Virus hepatitis	74.9*
Lyme disease	5.2
Disease from active tuberculosis	40.6
Alcohol and drug psychosis	42.7
Neurosis	257.1
Syndrome of alcohol addiction	242.7
Narcotic addiction, nicotine included	3.8
Drug abuse without addition	3.8

* the standardized parameter has a higher value in comparison with the value for other regions in the country.

The data about the health status of the population in the Region of Dobrich does not differ significantly from these for many other regions in the country, which were not determined as Hot spots according to the risk for the health of the population due to the pollution of the environment.

In the Region of Dobrich there are 9 hospitals and dispensers 5 of which are multy – profile hospitals with 770 beds. The region has 7 social institutions. They have a capacity of 1341 places. There are 12 creches in the town of Dobrich, with 589 places. The hospital service for the population of Kavarna is well organized in the town of Kavarna.

The primary disabled persons over 16 years of age in 2003 for the Region of Dobrich are 2394 and the share of these with loss of workability is over 70%. The population is secured with medical personnel, qualified physicians and urgent medical aid.

The data on the employment and unemployment rates (Table 33) were taken from the edition of the National statistical institute (Employment and unemployment, NSI, 1/2005, Sofia, 2005).

Table 33. Manpower, employed and unemployed people for the northeastern region of planning against the data for the Republic of Bulgaria for 2004 – 2005, coefficients (K) in %.

Main parameters of the employment and the unemployment, in%	Bulgaria, %			Northeastern region of planning, %		
	III quarter 2004	IV quarter 2004	I quarter 2005	III quarter 2004	IV quarter 2004	I quarter 2005
Labour force: coefficient of economic activity	50.8	49.4	48.0	51.9	50.6	49.5
Employed people Coefficient of employment	45.3	43.6	42.5	44.0	42.7	41.5
Unemployed people. Coefficient of unemployment (total)	11.0	11.8	11.3	15.1	15.7	16.2
Unemployed people. Coefficient of unemployment (men)	11.5	12.5	11.7	15.0	15.3	15.1
Unemployed people. Coefficient of unemployment (women)	10.4	11.1	10.9	15.2	16.2	17.5

The manpower in the Northeastern region of planning of economic activities, where the municipality of Kavarna is located, has a little higher coefficient of economic activity than the common for the country, but the employed people occupy a smaller share. The employment coefficient for the Region of Dobrich is 37.7% (42.7% for the men and 33.0% for the women). The unemployed people are with a higher share than the average for the country. The unemployment of women at the age of working capacity is a little higher. The structure of the unemployment for 2004 for the Northeastern region shows that the period of

unemployment up to 5 months has the greatest share in the group of the unemployed – 36.9%, followed by the share of the unemployed for 3 or more years. – 32%. Smaller is the share of the unemployed for a period of 6 – 11 months up to 24 – 35 months. The investigation shows that the qualified young people with a proper education find jobs by the end of the first year after their graduation.

The investment proposal of the company Geo Power Ltd. Supposes the opening of additional working positions during the construction of the wind farm, that of the electric substation, the maintenance of the wind generators.

The municipality of Kavarna is not determined as a Hot spot in the evaluation of the risk for the environment by MOEW in the Strategy for the preservation of environment with an action plan for 2001 – 2006, (CM, 2001). The same is valid for the National plan for activities on the health – environment (CM, 2004) of the MPH and MOEW, in which the Dobrich municipality is not considered problematic concerning the health of the population in connection with the risk of environmental pollution.

A territorial – structural plan for the municipality of Kavarna – a final project, has been developed, including the approved positions of the residential areas, the villages and the places of rest, It is finished and its broadening in the future is not being considered. The WPP will be located at a distance bigger than 200 m from the seaside lands of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo and the town of Kavarna. The seaside is an object of specific protection according to the final project of the territorial structural plan of the municipality of Kavarna.

Through the area of about 60 km² determined for the two stage installation of the wind generators and the substation which are sources of non-ionizing radiation and are controlled by the Ordinance No 7/1992 on the hygienic requirements for the health protection of the residential environment (SG No 46/92, amended and supplemented by No 46/1994, No 89 and 100 from 1996, No 101/1997, No 20 and 41 /1999, No 40 of 2002). At a distance of 500 m from the borders of the terrain, planned for the implementation of the investment proposal, there are no children and students' institutions, Hospitals, sanatoriums, hospitals, services, churches, museums, parks, touristy objects, and regulated zones for rest museums, churches, tourist sites and regulated rest zones. There are no children's hospitals, hospitals, sanatoriums, There are no resort complexes nearby, places for rest and recreation, sports complexes, reservations, zones for hunting and fish-catching tourism. The agricultural vegetation is used for growing. Sunflower, maize, wheat, etc., and the installed wind generators will not affect adversely this activity of the population in the municipality of Kavarna, in case the recommendations shall be observed. the workers on the field not to get close to the equipment.

In the region around the site for the installation of the wind generators there are no sanitary – hygienic zones for sources of drinking water and mineral water for every day purposes. There are water wells used for irrigation.

Near the terrain for the installation of the 60 wind generators includes no orchards or vegetable gardens, stockbreeding houses and bird farms, stores for fodder, for agricultural products and food, enterprises of the food processing industry, the pharmaceutical and the cosmetic industry. There are no other objects with a specific hygienic protection statute.

The sanitary – hygienic zones, determined by the legislation on the protection of the population from the adverse impact of the unfavorable environmental factors refer to:

- the limits of regulation of the residential zone in the villages, the resorts and the tourist complexes, enterprises and stores of the food processing industry. These are determined by the hygienic protection zone on compliance with Ordinance No 7 /1992 on the hygienic protection of the residential environment (SG 46/1992, amended and supplemented No 46/1994, No 89 and 101/1996, No 101/1997, No 20 and 41/1888, No 40/2002). In the Ordinance No hygienic protection zone shall be foreseen for activities connected to the operation of wind farms. The MPH, on the grounds of the EIE reports on the WPP in Kavarna and the written opinion of RIPCPH - Dobrich, has accepted a temporary hygienic – protection zone of 500 . The villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo are at distances bigger than 1200 m from the borders of the park;
- the competent authorities controlling the measures of reducing and preventing the adverse impacts on the health of the population, recommend the development of a Program for the communication of the risk for the health of the population. Detailed information about the possible unfavourable psychic, behavioural and health effects, as well as the measures for their management, is presented in the edition of the Ministry of environment of France – “Manual on investigating the impact of the environment of the wind farms” (Guide de l’etude d’impact sur l’environnement des parcs eoliens. Ministere de l’Ecologie et de Developpement Durable, Agence de l’Environnement et de Maitrise de l’Energie, Paris 2004, 1-123 pp).
- the electric power transmission lines for 20 kV will be under the ground. The investment proposal foresees the passage of an air line for electric power with 110 kV. The hygienic protection zone according to Ordinance No 7/1992 on the hygienic protection of the residential environment (SG 46/1992, amended and supplemented No 46/1994, No 89 and 101/1996, No 101/1997, No 20 and 41/1888, No 40/2002) about electric power transition lines with voltage of 110 kV is 10 m. On both sides below the line no buildings are to be constructed for residential or other purposes.

- The hygienic protection zone for open distribution devices for 400 kV is 200 m, and for the distribution devices for 750 kV – 300 m.
- on the territory planned for the construction of the WPP and in the surrounding regions there are no sources of central drinking water supply or water supply for sanitary purposes, nor mineral springs. That is why in this case the requirements of Ordinance No 3/200 on the investigation, the design, the approval and the operation of the sanitary hygienic zones around water sources and the equipment for the supply of drinking and sanitary water and around the mineral water springs, used for prophylactic, drinking and hygienic purposes (SG No 88/2000) shall not be applied.

According to a Project of MOEW on the prevention of the pollution of the cultures used for food with hazardous substances, resulting from the traffic of motor vehicles (polycyclic aromatic hydrocarbons, polychlorinated biphenyls, heavy metals, fine dust particles) it was adopted in the 5 m zone along both sides of the roads with heavier traffic (main roads, roads of classes I and II), not to grow vegetation used for food by people and animals. Within the borders of the future WPP temporary roads are planned to be made for passing of motor vehicles during the construction of the substation, the foundations and the installation of the wind generators and the construction of the ground cable network. The investment proposal does not foresee the construction of a permanent road network.

Literary data on the impact of the wind generators on the population near the wind farms

In the last years more frequent discussions take place on the reaction of certain groups of the population in England, the USA, Germany, Denmark and Sweden, who do not accept the wind farms near their homes. In the Internet letters with complains from individuals and NGOs are being published more often. A considerable part of them are not scientifically motivated. The environmental and health legislation in the EU countries has no unified policy on the management of the risk, because the reliable investigations on people in this field are few. Summaries of the literary data on the evaluation of the health risk in the construction and the operation of the WPP were published by the Ministry of the Environment of France (Guide de l'étude d'impact sur l'environnement des parcs éoliens, MEDO, 2004) and by the Ministry of the Environment of Sweden (E. Pedersen, 2003, E. Pedersen, K.P. Waye, 2004). These are based on epidemiological investigations of chosen groups of inhabitants mainly in regions with flat agricultural lands. These are also based on interviews and specially developed questionnaires, precise characteristics and measurements of the noise, contemporary statistical processing with non-parametric analysis for determining the reliability of the results. According to the American Wind power Association, the global electric energy from wind generators is increasing each year with 26%. The USA (7 GW) and Europe (29GW) have 90% of the

cumulative capacity by the end of 2003. Further down the main conclusions on the health effects of the wind generators on the people are enlisted, on the grounds of the literary data for Europe in investigation of large groups of people living at distances from 320 m to 800 m from the installed equipment (individually or in groups of 2-3).

- when the height of the wind generators is over 12 m, a procedure of EIE is necessary and a public discussion. The higher the equipment (over 40 – 50 m), the more the complaints of the population about the changes landscape, the frequency of the unfavorable visual effects, the intensity of the aerodynamic noise, met with unpleasant feelings in the afternoon and the evening hours in the open near the houses of the inhabitants;
- the mechanical noise generated by the generator itself has frequencies of below 1000 Hz and includes a poorer set of tones. It could be efficiently reduced by technical improvements in the construction of the newer kinds of generators;
- the aerodynamic noise is a result of the movement of the blades which leads to movement of the air. It has a broad spectre, and increases with the bigger equipment. The levels of the acoustic pressure – SPL, increase with the quicker rotation of the blades. The contemporary generators have a considerably higher levels of acoustic pressure than the levels of the mechanical noise which was considerably reduced. The aerodynamic noise is accepted as something different from the background noise, generated in the living environment. The investigated persons describe it as whistling, flapping, the sound of a whip, whistling, spatter, pulsing and echo / resonance. The people get used to this modulated noise with high frequencies and too unusual for the residential areas with more difficulty,
- the families from the villages living near the WPPs complain more often from the unpleasant aerodynamic noise during the day, when they are outside their houses, or in the night when the windows are open;
- in comparison with the single wind generators, the aerodynamic noise increases if 2-3 generators form a group of close locations;
- E.Pedersen and K. Waye (2004) perform a crossed type epidemiological study of 513 persons from farms in agricultural regions in Sweden with dimensions of 30 km², where 16 generators were located in 5 groups. The calculated standardized levels of the acoustic pressure of the measured noise in dB(A) were distributed as follows: below 30.0 dB(A), 30.0 – 32.5 dB(A), 32.5 – 35.0 dB(A), 35.0 – 37.5 dB(A), 37.5 – 40.0 dB(A) and over 40.0 dB(A). The number of the investigated persons for each SPL interval varies from 15 to 137. The largest is the group exposed to the impact of the 32.5 – 35.0 dB(A) noise of the wind generators, at a distance of 450 – 1099 m from the houses.
- The share of the persons who determine the presence of noise from the generators outside their houses increases from 39% for the interval 30.0 – 32.5 dB(A), to 85% for the group exposed to 35.0 – 37.5 dB(A). the investigated do not complain of the noise below 32.4 dB(A)., but the frequency of the complaints statistically reliable increases at levels over

37.5 – 40.0 dB(A). From 215 persons who determine the presence of noise from the wind generators, 25% have complaints in connection with the intolerance to it. This concerns mainly the noise from the blades of the equipment;

The complaints, especially from the aerodynamic noise increase among the inhabitants, who also have a visual contact with the generators;

- comparatively smaller is the share of the investigated persons with complaints from the changed landscape, the moving shades of the blades or the clicks;
- the complaints from the wind generators repeat almost every day when the inhabitants are outside the houses, resting or having a family occasion. The noise disturbances increase with the wind coming from the nearby wind generators;
- only 7 % of the investigated persons have complaints from the noise of the wind generators during the night, mainly when the windows are open, but 16% (128 persons) exposed to SPL above 35,0 dB(A), speak about disturbances of their sleep at open windows;
- the investigation of E.Pedersen and K.P.Waye (2004) shows that the wind generators cause complaints predominantly from the aerodynamic noise at SPL above 35.0 dB(A). The authors prove the dependence dose – response, which is related with the visual effect;
- in the research literature there are no proofs for other damages on the health of the population (additional cardio – vascular disturbances, hypertonic disease, diabetes, neurosis, etc.). The complaints of the stress from the changes landscape, the noise and the visual effects were proven. The data cited differ considerably from the known information on the health impact of the noise from the traffic in the living environment. It was established that the WPP do not exert an adverse impact on the working ability of the neighbouring population;
- the changes in the landscape are not always positively accepted if there had not been any information meetings with the population. The WPP located over lowlands or behind slopes, cause less complaints than those on even terrain;
- the visual effect depends on whether the wind generators can be seen from the houses where people live. When the terrain is flat, and at the presence of noise, these are accepted with greater difficulty. The coloration which was standardized by the International organization of the civil aviation (Organisation de l'Aviation Civile Internationale (OACI) with the DNA NO 20700/16.11.200, could reduce the complaints. In all cases the wind generators are painted in light colors (white, light beige, light grey) with little variations in the tones. The visual effect depends on the meteorological conditions, the shining of the sun and the place of watching the wind generators (including the windows of the houses, the sight angle from the cars, the angle of watching passing by the park, the color of the sky, the surrounding vegetation and the landscape);

- the visual effect and the noise from the wind generators is accepted with greater difficulty by the visitors of the resorts, the rest and recreation zones, because they expect lack of any side irritants, connected with industrial or energy objects (Guide de l'étude d'impact sur l'environnement des parcs éoliens, MEDD, 2004; E. Pedersen, 2003, E. Pedersen, K.P. Waye, 2004). Persons with lower limit of noise registration with problems of the nerve system, with emotional weaknesses, with more conservative thinking, are more sensitive to the unpleasant effects of the wind generators.

When choosing the number and the location of the wind generators in the present investment proposal, the visual effects from the standpoint of the population of the villages of Bulgarevo, Hadji Dimitar, Sveti Nikola, Rakovski and Porouchik Chounchevo. The used III class roads for access to the agricultural lands in the territory of the villages will not be changed. The least distance from the existing roads in the park to the wind generators is 600 m.

The coloration of the wind generators will be with metal coating and paints which are matt. These will reduce the probability of blinks and blinding the drivers of the motor vehicles.

Near the WPP there are no zones of rest and recreation. The investment proposal includes prevention of conflict situations considering the perspectives of using the neighbouring regions for tourism and resort complexes.

It is recommended the assessment of the visual effects. (Guide de l'étude d'impact sur l'environnement des parcs éoliens, MEDD, 2004) to be performed :

- approaching the WPP from a great distance;
- approaching the park;
- near the wind generators.

It shall be noted that the complaints of the people increase upon approaching the wind generators from a distance less than 300 – 400 m.

Choosing the most favorable location, it is recommended to use scenarios with simulated photographic computer visual effects of the 3D type and cartographic presentations (Guide de l'étude d'impact sur l'environnement des parcs éoliens, MEDD, 2004).

In all cases it is expected with the change in the landscape the location of the generators to be of great importance. The conclusions from the international experience show that if the changes in the landscape are properly modeled and discussed with the inhabitants of the residential areas in the region, and when they are in compliance with the contemporary ideas of achieving the minimum adverse impact of the visual effects, the populations gets used to the new landscape with the time.

- the big dimensions of the wind generators, the permanent noise and the aerodynamic flows, the non-ionizing radiation, despite their low power,

- lead to disturbances , unpleasant feelings and the feeling of fear among people who have not got used to them. This matters in those cases, in which the population is engaged in agricultural activities or uses a road in the region of the park;
- when it snows and when there is ice, the formation of big ice pieces on the blades of the generators after the weather gets warmer could cause trauma and such cases were described. The climatic conditions in the region are not characterized by frequent hazards from ice formation in winter;
 - the height of the towers of the installed generators will be 85 m, 95 m or 115 m, depending on the wind characteristics. In the literature it was pointed out that the impact and the characteristics of the aerodynamic noise are more unfavourable when the equipment's dimensions are bigger. For distances of 100 m two kinds of noise were registered (from mechanical origin, which cannot be heard from a distance greater than 200m, and from aerodynamic origin , which leads to complaints. The latter depends on the configuration of the generator and the strength of the wind. When the wind velocity is below 3m/s (about 10 km/h) the wind generators do not rotate. At 4 – 5 m/s (15 – 20 km/h) the wind generators start rotating and at 12 – 15 m/s (40 – 50 km/h) they reach their maximum of efficiency depending on the type and the configuration of the equipment. When the wind velocity is 15 – 30 m/s (about 50 – 90 km/h) the power of the produced energy and the level of the aerodynamic noise are constant. At higher velocities the noise increases but from security considerations the wind generators are switched off;

It shall be noted that there is no proportional dependence between the electric power of a wind generator and the power of the generated noise (Guide de l'étude d'impact sur l'environnement des parcs éoliens, MEDO, 2004, E.Pedersen, 2003, E.Pedersen, K.P,Waye, 2004). It was accepted that in flat country a generator with acoustic power of 105 dB(A) generates the following noise levels:

- about 55 dB(A) at a distance of 100m from the wind generator, which is equal to the noise of a normal conversation, but it is not accepted by the population;
- aerodynamic noise with levels over 35.0 dB(A) is related to the subjective complaints among the population, living at distances of 300 – 400 – 1000 m from the wind generators;
- closely located generators in groups of 2 and 3 increase their noise impact;
- about 40 dB(A) at distances of 400 – 500 m from the wind generator, equal to the noise in a living room , where the inhabitants read or talk quietly. The aerodynamic noise with such intensity, due to its specific characteristics, does not result in complaints from a considerable share of the investigated groups of the population;

- below 30 dB(A) at distances of 800 – 1000 m from the wind generator , which is equal to the noise in a sleeping room, where the inhabitants rest. The aerodynamic noise with such intensity does not cause any complaints from the investigated groups.

For the contemporary big wind generators (85 – 115 m height of the towers) the prognostic levels of the acoustic power and the stability of the sound at wind velocities of about 10 m/s at the height of 10 m from the ground surface is about 102 dB(A).

The review of the legislation of the EU countries (E. Pedersen, 2003) shows that it is based on different principles: standardized noise levels generated by the wind generators, degrees of deviations from the background noise level, zone of living or recreation. There are no determined hygienic standards on the level of the noise generated by the wind generators in Bulgaria. Its evaluation is based on the health criteria adopted with the legislation on preserving the public health. According to Guide de l'étude d'impact sur l'environnement des parcs éoliens, (MEDD, 2004) the additional level of the equivalent noise generated by the wind generators, shall not exceed with more than 5 dB(A) during the day and with more than 3 dB(A) at night the measured noise background level (before their installation), if the background noise is higher than 30 dB(A). More details on this point are given in the materials of the Ministry of the environment of France (Guide de l'étude d'impact sur l'environnement des parcs éoliens, MEDD, 2004), and in the summary elaborated by the Ministry of Environment of Sweden (E.Pedersen, 2003).

No adverse impact from the non-ionizing radiation shall be expected from the electric power transition lines, since they in principle will be under the surface and for the air lines and the electric substation the hygienic protection zones are presented by Ordinance No 7/1992.

The possible sources of hazards during the construction of the wind generators are connected with the loaded motor vehicles, supplying the parts of the generators to the places of their installation, the loading and the reloading of the construction materials for the foundations of the generators. When the height of the generators is about 85 – 95 – 115 m, the dimensions of the foundations will be 14.5 x 14.5. The depth of the foundations will be 2.50, from reinforced concrete. The height of the foundations over the ground surface will not exceed 0,5 m, so the terrain will be elevated with maximum 0.5 m.. The big dimensions of the foundations demand excavations with heavy machines, the use of a crane for the installation of the generators as well as other specific technique. The excavation machines for the laying of the ground cable network for the transmission of electric power will exert a temporary impact (the excavations will be about 60 x 80 cm). The construction of the substation is also connected with temporary pollution of the environment with waste gases from the vehicles, dust particles, construction wastes and additionally generated noise and vibrations.

The adverse impact of the construction works for the installation of the generators, the electric power transition lines and the substation is temporary and can be distributed into the following groups:

- chemical factors – waste gases from the vehicles and the construction and excavation machines, fuel oils and machine oils, concrete, cement, polymers, hydro-isolation and paints. The lubricating petroleum oils and greases necessary for the wind generators are included in the equipment. For securing the transformer oil, oil capturing containers have been secured;
- physical factors – noise and vibrations from the motor vehicles and the heavy machinery, work in the open under unfavorable microclimate in the warm and cold seasons, work at strong winds;
- physiological factors – psycho – sensor tension due to the large dimensions of the wind generators and the high specific requirements in the period of their installation; physical tension from loading, work with heavy loads, heavy machinery, excavation works and leading and reloading, laying of cables;
- risk from falling, hurting, burying beneath, accidents;
- risk of accidents due to omissions in the electric safety.

The enlisted adverse impacts concern the workers in the companies, hired by the Investor, performing such specialized construction and mounting works. The requirements of the Law of the safe and healthy conditions of work shall be observed for them (SG No 124/1997).

During the operation of the WPP, the distance to the generators of 1200 m to the nearest villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo and the town of Kavarna and the choice of the points of their location guarantee the minimal adverse impact of noise and vibrations, air movement, non-ionizing radiation, disturbances in the communication systems, unpleasant visual and psychological effects. The electric cable network will be under the surface. Only the line from the substation to the Kavarna substation will be in the air. The operation of the WPP will be remotely controlled by qualified specialists. The supply, the construction of the foundations, the installation and the control of the wind generators will be performed by specially trained technical personnel with enough experience in this kind of specialized work.

The other villages in the region of Kavarna are far enough from the WPP, and within the borders of the terrain of its location there are no other objects with specific health protection statute.

The performed consultations show that the local administration (mayors, public figures, administrators from the municipality of Kavarna) and the population of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik

Chounchevo and the town of Kavarna support the investment proposal. The construction of the WPP was coordinated with the Regional Inspectorate for Preservation and Control of Public Health - Dobrich.

The impact of the harmful substances during the construction of the foundations, the substation, the laying of the cable network will be performed once and for a short period during the first and the second stage of the implementation of the investment proposal. It is necessary to observe the requirements of Ordinance No 17 on the contents in the fuels of sulphur, lead and other substances, harmful for the environment (SG No 97/1999), which guarantees the abatement of the adverse impact of the pollutants in the diesel oil on the environment and the living environment.

During the construction activities the requirements of the following Ordinances shall be observed: Ordinance on the significant requirements and the assessment of the compliance of construction products, adopted by Governmental act No 286 (SG No 93/2000, amended and supplemented SG No 75/2001, 115/2002, 109/2003).; Ordinance No 2 from 2004 on the minimal requirements to the healthy and safe conditions of labor in the construction and installation works (SG No 37/2004); Ordinance No 12/2004 on ensuring safe and healthy conditions of labor in working with motor vehicles (SG No 6/2005); Ordinance No 8/2004 on the conditions and the manner of performing the activities of operators of electric power system and the distribution lines, as well as of the operative personnel on duty in the objects of the electric energy system and the electric devices of the consumers (SG No 79/2004); Ordinance No 9/2004 on the technical operation of the electric plants and networks (SG No 72/2004).

We have to note that the investment proposal will have a significant favorable social, economic, environmental and health impact. The data on the wind characteristics in the region of the municipality of Kavarna and the preliminary investigations of the specialists show that the overall installed capacity of the park of 60 wind generators will be 120 MW. The same amount of electric energy obtained from burning organic energy carriers on the basis of oil, would pollute the environment with CO₂ emissions of the order of thousand of tons.

The environmental and health standards and regulations in force at present including the population and the workers on the object are in compliance with the Directives of the EU. The hygienic limits were updated in the period 1997 – 2005.

The hygienic limits for the levels of noise, vibrations in the working environment are presented in the following documents: BS 15204 – 80. Determining the industrial noise; BS 14478 – 82. Industrial noise. Hygienic standardization; BS 12.1.012 – 80. Limits for the industrial vibrations; Ordinance No 6/2005 on the minimal requirements to ensuring the health and safety of the workers at risks from the exposure to noise (SG No 70/2005), BS 12.1.012 – 84. Determining the

industrial vibrations. The permitted level of equivalent industrial noise is 85 dB(A). It is important for the drivers of the heavy motor vehicles and construction machines., the persons driving the cranes during the installation of the generators and the laying of the ground cables. At the site of the WPP during the operation of the generators no presence of personal is foreseen.

The standards concerning the prevention of adverse impact of the noise generated by industrial objects as well as the protection from noise on the territory of the residential areas was updated by the Law on the protection from the acoustic pressure in different zones of the residential areas and Hygienic limits, No 0 – 64 on the limit values of noise in the residential areas, (SG No 161/1975) are presented in Table 34.

Table 34: Limit values of the acoustic pressure levels in residential areas

Territories and zones in residential areas	Level of the noise dB(A)	
	By day	By night
Residential zones and territories:		
- existing town parts	55	45
- existing town parts to town arteries	60	50
Central town parts	60	50
Industrial territories and zones	70	70
Terrains for hospitals, rest houses, recreation houses, etc.	45	35

The calculations of the noise impact, the air movement, the vibrations generated by the wind generators, shows the absence of any risk from adverse impact on the health of the population of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo and the town of Kavarna. The wind generators will be located at a distance of 1200 m from the regulation lines of the residential areas and 600 m from the closest passing roads.

No adverse impact is to be expected from high pressures, high temperatures and ionizing radiation.

The limit values of the chemical agents in the air during operation are presented in Table 35 (in compliance with Ordinance No 13 from 2003 on the protection of the workers from risks from exposure to chemical agents, SG, N0 8 /2004).

Table 35: Limit values for the chemical agents in the air at the places of work

Chemical agent	Limit values in mg/m ³	
	Exposure	
	8 hour exposure	15 minute exposure

Nitrogen dioxide	4,0	
Nitrogen oxide	20,0	
Carbon monoxide	40,0	200,0
Carbon dioxide	9000	
Sulphur dioxide	5,0	10,0
Hydrogen sulfide	14,0	21,0
Dust, insoluble, containing less than 2% of silicon dioxide in the respiratory fraction:	10,0	
- inhalatory fraction	4,0	
- respiratory fraction		
Petroleum distillate – gas oil	1600	
Cement dust	8,0	

In the construction of the wind power generators, the substation and the electric power supply network under and above the ground, a short term temporary adverse effect is to be expected as a result of the emission of waste gases from the motor vehicles and the heavy machinery, of dust from the soil or cement dust. The area of the eventual pollution will not exceed 200 – 300 m.

The admissible pollution of the ambient air in the residential districts is presented in Tables 36 and 37.

Table 36: Admissible limit concentrations of harmful substances in the ambient air according to Ordinance No 14 / 1997

Harmful substance	Admissible limit concentration, mg/m ³		
	Average annual	Average 24 hour	Maximum single
Carbon oxide	-	10,0	60,0
Nitrogen dioxide	0,05	0,10	0,20
Nitrogen oxide		0,06	0,060
Sulphur dioxide	0,05	0,15	0,50
Methyl mercaptane		-	9 x 10 ⁻⁶
Hydrogen sulphide	0,006	0,008	0,008
Suspended dust, total	0,15	0,25	0,50

Table 37: Standards on preservation of human health from pollutants of ambient air according to Ordinance No 9 / 1999

Air pollutant	Standard	Period of averaging	Value, µg/m ³	Starting date for compliance
Nitrogen oxide and dioxide	Average per hour	1 hour	200 NO ₂	01.01.2010
Nitrogen oxide	Average	1 year	40 NO ₂	01.01.2010

and dioxide	annual			
Sulphur dioxide	Average per hour	1 hour	350	01.01.2005
Sulphur dioxide	Average per 24 hours	24 hours	125	01.01.2005
Fine dust particles 10	Average per 24 hours	24 hours	50	31.12.2008
Fine dust particles 10	Average annual	1 year	30	31.12.2008
Fine dust particles 2.5	Average per 24 hours	24 hours	40	31.12.2008
Fine dust particles 2.5	Average annual	1 year	20	31.12.2008
Lead	Average annual	1 year	0.5	01.01.2005

Ordinance No 9 on the limits for sulphur dioxide, nitrogen dioxide, fine dust particles and lead in the ambient air abrogates items 1, 2, 102 and 122 of Annex No 1 to Article 2, paragraph 1 of Ordinance No 14/1997. The values of the limits for sulphur dioxide, nitrogen dioxide, fine dust particles and lead refer to the preservation of human health and of the eco-systems depending on the impact of the air pollutants.

During the operation of the wind generators, no impact of dangerous substances due to the pollution of the agricultural areas and the crops on the territory is to be expected. The waste lubricants and other materials from the wind generators will be changed during the periodical repairs and the maintenance of the equipment by a specialized company, which will collect these materials for disposal in a suitable way, in compliance with the requirements to the management of dangerous wastes in Government Act No 53 from March 19, 1999 on the treatment and transportation of industrial and dangerous wastes (SG No 29 / 1999). No adverse impact on the health of the population is to be expected resulting from the pollution with resistant organic substances and heavy metals of the fodder and the grain and the other food staffs produced by the farmers for their own needs on the territory of the wind farm.

The population of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo and of the town of Kavarna may have some questions concerning the operation of the wind farm, because the large equipment will change unusually the landscape and may cause unpleasant visual and physical feelings. In certain cases in sunny days looking at the rotating blades may cause a momentary dazzle. This is important in case of passing near the wind generators during the farming activities on the territory of 60 000 m². The feeling of fear from the dimensions of the equipment, the uneasy feeling as a result of the noise and the aerodynamic movement of the air near the wind

generators may arise in the visitors those the number of the holiday makers in this region of the municipality of Kavarna is not large.

No adverse impact on the health of the population of the residential areas located within the 5 km zone around the park is to be expected.

The distance of 1200 m of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo and the town of Kavarna from the wind farm, the hygienic protected zone being 500 m, guarantees the lack of any additional load on the environment with hazardous impacts.

The favorable social, economic, ecological and health effect of replacing the existing energy sources based on burning petroleum products and natural gas, was approved in many EU countries.

The data from the literature, the experience in using such type of equipment in other countries and in our country, have shown that the operation of the wind generators does not result in any additional adverse impact on the environment and the residential areas. The following effects could be expected, which could result in complaints from the population (Guide de l'etude d'impact sur l'environnement des parcs eoliens, MEDD, 2004).

- Generation of noise above the permitted level, vibrations, aerodynamic movement of the air and non-ionizing radiation in the zone 100 – 400 m from the wind generator, depending on the dimensions of the latter. This concerns the people engaged in agricultural activities since the Investor has purchased the agricultural areas of the villages around the park.
- Risk of dazzling of the people engaged in farming in the region, using the vegetation for pasture, as well as the drivers of the motor vehicles passing along the road in case of unfavorable combination of sunshine and direction of movement of the blades. The wind generators will be painted by a cover with minimum reflection properties.
- Possibility for failure in the telecommunications – TV, radio, mobile phones, computer networks and other microwave signals.
- Danger of pollution of the environment by waste lubricants (redactor, transformer, hydraulic) of the wind generators in case of significant omissions and/or accidents during the changing of the former, their storage and rendering harmless. Risk of pollution with transformer oils from the maintenance of the electric substation.
- Unfavorable psychological effect from the large dimensions of the equipment and the continuous movement as a result of the wind. Development of fears resulting from lack of knowledge or lack of trust. The psycho-sensor effects are a reaction to the improperly presented information on the impact on the health and the environment and to the improper risk communication. The physical perceptions near the constantly moving blades of the high installations could raise a number of

- questions among the children and the older people if they are at a distance 100 – 300 m from the wind generators.
- Unpleasant visual impact of the unexpected and unacceptable change of the landscape in a region which has generally been even and calm and without any industrial objects. The changed landscape requires a careful approach to the population and the visitors of the region, including the children.
 - The enlisted factors with an adverse effect on the environment concern only certain groups of the population which will pass by or which will perform some farming activities in the region of the wind farm. There will not be any infrastructure on the territory of the park, no additional roads, administrative buildings, fence, guards, etc.
 - The enlisted factors are not expected to affect the permanently engaged operators since on the site there will not be any permanently present staff. The control of the equipment will be remote. Specialized teams of the company, hired to control and maintain the wind generators, will visit probably once a year the equipment for its maintenance and routine service, and eventually, in case of accidents. The operation of the substation will create risks for the staff, due to the non-ionizing radiation, the improper safety measures and the pollution with transformer oils in case of improper handling.

Territorial scope

It is limited to the site of the wind farm of 60 000 m². The height of 85 – 98 – 113 m and the length of the three blades of 35 – 40 m are the reason for enlarging the scope of the adverse psychological and visual impact on the population engaged in farming in the nearby areas. The drivers of the motor vehicles along the third class roads among the farms, under specific circumstances (position of the sun, direction of movement) could be dazzled. No accidents are expected resulting from ice pieces in winter since in that season there are not any agricultural activities.

Measure of the impact

The adverse impact of the expected physical factors (immediate visual effects, noise, vibrations, non-ionizing radiation) on the population is insignificant since the wind generators are located at a distance longer than 1200 m from the residential areas. The electric supply lines will be underground. The requirements to the protected hygienic zones of the electric substation and the construction of the power supply line of 110 V to substation Kavarna will be observed. The Investor guarantees the safe change of the waste lubricants and oils from the boxes of the wind generators and this is to be controlled by the regional authorities. The psychological and visual impact at the beginning could be significant since the people are not acquainted with this type of energy production. It would be necessary to organize meetings and lectures with the

local population, including the children, in order to help with the realistic evaluation of the health risk and with overcoming the eventual stress from the presence of the large wind generators in the changed landscape.

Duration of the impact

Constant, daily, 365 days a year, for more than 30 years.

Cumulative and combined impacts on the environment – these were evaluated using the complex method of Walker, L.J., J. Johnston (Guidelines for the assessment of indirect and cumulative impacts as well as impact interactions, NE 80328/D1/3 May 1999, European Communities, Luxemburg, 1-172). The combined cumulative additional impact includes noise, vibrations and non-ionizing radiation, the psychological and visual effect of the moving generators on the nerve and the cardio-vascular system. The danger from dazzling in case of unfavorable circumstances as well as the unusual appearance of the wind generators could cause some accidents. The location of the wind farm at 1200 m from the residential areas and 600 m from the roads ensures minimal health risks.

Assessment of the possible cumulative impacts on the environment and the health of the population

In some countries from the EU (England, Germany) the complaints from the construction of wind farms increase among the population. The references including interviews and meetings with different groups of people and representatives of NGO result in the following conclusions:

- The low frequency noise could result in headache, nausea, dizziness, vertigo, anxiety, affected sleep, etc. This was observed in case of exposure at the places of work. There are no proofs from the epidemiological studies among the population that the wind generators located at distances of 650 – 110 m from the residential areas at measured noise levels of below 30 dB(A) cause any real complaints. There are proofs of the origin and the increase of complaints in cases of 150 – 500 m distance to the residential districts and levels of the aerodynamic noise above 35.0 dB(A). The limit level which does not affect the night sleep is 35.0 dB according to the WHO.
- There are proofs that a distance to the wind generators longer than 400 m does not affect the night sleep of the people in the residential areas.
- The amplitudes and the fluctuations of air movement resulting from the rotation of the blades, increase, if the wind generators are higher than 85 m and if they are located in groups close to each other, With the increase of the noise level a resonance could be reached in case of open windows, unfavorable direction of the wind and resonance characteristic of the rooms in the house.

- At night when the direction of the wind changes, the prognostic level of the noise could increase with 15 – 18 dB(A).
- Each increase of the noise level with 10 dB from the background noise level in the residential areas could result in complaints.
- The noise from a point source decreases with 6 dB when the distance to it increases twice in case of flat country.
- Some people have lower level of perception and tolerance to noise. Most often these are people with neurosis, insomnia due to stress for other reasons, hormonal dysfunction or exposed to high noise levels from other sources.
- The noise from the wind generators could not wake up a man asleep, but could prevent him from falling asleep when he has a negative attitude to the constructed wind farm in the vicinity of his village.
- The frequency of the complaints from the noise was statistically proved to be higher among these groups of investigated people, who communicate about visual effects due to the wind farms.
- Some people generally have a negative attitude towards any changes of their living environment.
- Psychologically the wind generators located around the villages or near the resorts are accepted with more difficulty by the population than the wind farms located near the towns.
- There are no proofs established by the epidemiological investigations in the EU countries and the USA that the noise from the wind generators could contribute to any additional dysfunctions of the cardio-vascular system, the nervous system, the humeral balance and the immune defense of the population. There are data of subjective complaints resulting from omissions in the location of the wind power generators around the residential areas.

Ordinance No 7/1992 on the hygienic requirements for health protection of the residential areas (SG No 46/1992, amended and supplemented in SG No 46/1994, No 89 and 101/1996, No 101/1997, No 20 and 41/199, No 40/2002) does not anticipate any hygienic protection zone for activities related with the operation of wind generators. That is why the hygienic protection zones for objects and activities, which are not considered by Annex No 1 and No 2 of Ordinance No 7, are determined by the Ministry of Health on the basis of a written position of the Regional Inspectorate for Preservation and Control of Public Health – Dobrich and the elaborated EIA report explaining the health and hygienic aspects of the location of the site.

The suggestions of the EIA experts for the choice of a hygienic protection zone of 500 m are based on the expected cumulative impact of the physical factors of the environment, related to the operation of the wind generators – noise and vibrations, non-ionizing radiation, as well as the psychological impact of the visual effects of the changes landscape were accepted by the Ministry of Health.

It has approved a temporary hygienic protection zone of 500 m for the wind farms.

No construction of residential buildings, resorts and other zones for recreation is anticipated in the region due to the geographical characteristics and the minimal possibilities of comfortable access to the seaside (there are no sandy beaches near the region of the wind farm).

No failures in the telecommunications are to be expected (radio, TV, mobile phones and other microwave signals) by the population of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo and the town of Kavarna.

In the period of operation of the wind farm there will not be any staff, engaged in the permanent control of the equipment, because the whole process is automatic and will be controlled remotely. That is why there are no infrastructures in the investment proposal other than the electric substation and the power transition lines. No additional pollution of the ambient air, the ground water, the drinking and sanitary water, the water used for irrigation, the water of the Black sea and the soils is to be expected. No adverse impact is to be expected on the crops grown on the territory of the region of the wind farm.

There are some possibilities for complaints from groups of the population because of the changes in the landscape, the visual effects, obstacles for the agricultural activities on the territory of the park, the dazzling and the unusual aerodynamic noise at distances shorter than 500 m from the wind generators.

3.16. Description, analysis and assessment on the eventual significant impacts on the population and the environment

By now the EIA Report has described and analyzed the components and the factors of the environment, the material and cultural heritage and the human health, which could be affected by the implementation of the investment proposal. It has been noticed that each of the factors has an insignificant impact on the environment in the region of construction of the wind farm – the environment would be affected to a very small extent by the implementation of the project on the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna.

Additionally the eventual impacts on the environment and human health were summarized and described as a result from the implementation of the investment proposal, the use of the natural resources, the emission of harmful substances during the normal operation and in case of accidents, the waste generation and the creation of discomfort. The discussions were made taking into account the specific features of the investment proposal – the production of electric energy from a renewable source – the wind, and the definitely insignificant impact on the environment and the human health.

As it was noticed in the characterization of the investment proposal (item 1 of the EIA Report) in this case of analysis of the impact on the environment it is the most important to pay attention to the protected territories and species (flora and fauna), the residential places and the zones of visual impact. In this respect the analysis of the impact of the construction and operation of the wind generators will be concentrated on these sensitive elements of the environment.

The analysis that follows further was performed by taking into account the activities of the company Geo Power Ltd. in relation with the implementation of the investment proposal. Observing the Bulgarian legislation, it has developed certain sides of the project using teams of licensed specialists, which have:

- determined the borders of the protected zones and the buffer zones;
- performed the monitoring on the flora and fauna in 2004, 2005 and 2006;
- determined and coordinated with the Ministry of Health the hygienic protection distances between the wind generators and the residential areas, taking into account the recommended 500 m hygienic – protection zone.

3.16.1. Impacts resulting from the implementation of the investment proposal

Protected territories and species

In the region of the implementation of the investment proposal there are no protected territories. According to data from the town history museum of Kavarna, in the area of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo in the region of construction of the wind farm there are objects, included in the archeological map of Bulgaria. If the wind generators are to be located at the border of an archeological object, the eventual archeological investigations will be performed at the expense of the investor or the wind generators shall be removed to another position (Annex III).

It is expected that the only significant impact of the wind turbines will be on the migratory birds. The location of construction of the wind farm is in one of the most important ornithological regions on the Bulgarian northern seaside. It was proved that here there is a bio-geographical population of about 20 types of water birds and a number of globally endangered species, and this region is an important air corridor for the migratory birds of pray and the storks “Via Pontica”.

It is this problem that has to be assessed from every possible aspect and only after it is proved that the adverse impact of the wind generators on the ornithofauna is insignificant, the proposal could be given a green light for this ecologically most friendly way of energy production.

Residential areas

The analysis of the implementation of the investment proposal shall take into account the effects originating or connected with the direct impact on the residential areas, that is, the population in the vicinity of the sites with the wind generators. There are data that the population accepts the risk as existing (no matter if it were real or not) some time after the implementation of the installation and the start of operation. A cumulative effect is mentioned of the light effects which could result from the position of the sun and under specific weather and the direction of movement of the blades.

Classical examples of the acceptance of the impact from the noise were observed in the USA at the time of the small power wind power turbines located in the residential areas. At wind velocities of 16 – 36 mph (7 – 16 m/s) at a distance of 50 ft (15 m) from the wind generator, the noise meter measured levels of 55 – 59 dB(A). The assessment of such a place was that the noise from the wind generator was masked by the noise from the rustling of the leaves of the trees. When the noise meter was directed towards the trees, the registered noise level was 60 – 62 dB(A) at the distance of 300 ft (90 m). This is higher than the noise measured near the equipment.

The noise from the wind farm in the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo will be within the limits of the hygienic standards for residential places and near residential areas, because the turbines will be located far enough from the latter. This statement is based on the performed investigations and calculations, which show that a zone from minimum 350 m to maximum 500 m depending on the power of the operation of the equipment, leads to a reduction of the noise level below the admissible limit values.

The closest villages to the wind farm are Bulgarevo, Sveti Nikola and Hadji Dimitar. From the standpoint of the impact on the population as visual perception, noise and light effects, it must be noticed that the Regional Inspectorate for Preservation and Control of Public Health - Dobrich and the Ministry of Health shall approve the hygienic protection zone of 500 m around the wind farm. The investment proposal anticipates the separate generators to be located in compliance with these recommendations and the standards in force in other countries. In such a way this impact, specific for the investment proposal, shall be classified as insignificant.

The wind farm which is a subject of the present Contract, would not allow the origination of the mentioned light effects, if the color coating of the objects is the proposed dark green shade at the existing location of the equipment.

Therefore, the object could be constructed in such a way as not to change the state of the environment, including the residential areas, concerning the physical factors.

As a conclusion it should be mentioned that the construction of the wind farm creates to the maximal extent a possibility to preserve the comfort of the permanent population and the holiday makers by observing the requirements of the standards in force and the Bulgarian legislation.

Zones of visual impact

The problem expected with the significant changes in the zones of visual impacts is connected with the appearance of the landscape where the wind generators will dominate it.

The implementation of the wind farm will result in an abrupt change in the visual parameters of the territory. The problem of whether the visual impact would be adverse or not, is controversial. The factors, mentioned in the recommendations in the EIA Report for the wind farm are the following: suitable color coating of the generators, decreasing the effect of reflecting the sunshine and elimination of the eventual dazzling.

Therefore a video – aesthetic evaluation shall be performed of the techno-gene elements with the visual impact and the visual perception by different subjects.

Though this assessment shall have a somewhat subjective character, it could be prognosticated in two directions: The first is connected with the scale of the transformation of the landscape, taking into account the public need for such objects. This to the greatest extent concerns the people living near the wind farm, For them the so called adverse impacts of the operation of the park are only visual, while the environmental and economic effects are significant. The second direction concerns the emotional comfort of the persons passing by the park, and their visual assessment of the aesthetic quality of the landscape.

Starting from the semiotic approach for the evaluation of the sign systems and the visual connections under equal topographic conditions and visual contents of the object, the individual perception ability is decisive for the assessment. In the case of this wind farm, the motor vehicles will pass by it mainly towards the villages of Bulgarevo – Kamen bryag and the town of Kavarna – Hadji Dimitar. With average velocity of the vehicles of 80 km/h the distance being 7 km, the visual perception of the vicinity shall include about 5 minutes. It can be accepted that for a part of the visitors this new for Bulgaria techno-gene landscape will have a certain attraction.

Therefore the immediate visual impact of the wind generators on the people passing by and through the park, is only very short term so we cannot speak about the formation of negative emotionally – aesthetical discomfort.

Besides this new for Bulgaria landscape could have a positive (attractive) aesthetic effect.

3.16.2. Impacts resulting from the use of natural resources

The main characteristic of the investment proposal is the use of the potential of the territory for the production of energy from an alternative source – the wind. It is characteristic for the renewable sources that their use does not result in the exhaustion of the natural resources like coal, oil, natural gas, etc., it does not result in the generation of large quantities of waste materials like with the Nuclear power plants and the thermoelectric power plants. 9In this respect the implementation of the investment proposal will be in compliance with the energy strategy of Bulgaria.

In performing the assessment of the impact resulting from the use of the natural resources special attention shall be paid to the economic efficiency of the production of electric power from the wind.

The next tables and curves present the results of the modeling of the economic efficiency of the production of electric energy by different turbines in the investigated region. This model gives a general idea for the comparison between different generators in the investigated region in order to recommend the optimal choice. The model was developed on the basis of the summery of the results in the publication “Wind power. The facts” where the results from the work of different by type and power wind generators in the EU countries were published by the European commission in 1999 and 2004. The model takes into consideration a number of conditions like the wind resource, the turbine parameters, the price of the investment. Table 37 summarizes the investment costs and as it could be seen, the generator is responsible for 74 – 82%. The price of a new turbine (Fig.37) decreases with time and here a new price of 1000 EUR/kW was accepted. The other percents are for the foundations (Fig.38), the electric power transmission lines, the electric installation in the region of the park, the infrastructure, the planning and managing the park, the purchasing of land, etc. (these vary between 0 to 15%).

Table 38

Distribution of the investment costs according to the publication “Wind power. The Facts”, European Commission, Brussels, 1999, 2004

I. Investment Costs	Percents, %
Price of the turbine	74 – 82
Foundations	5,0 – 11,0
Electric connections (laying the cables)	5,0 – 11,0
Connection to the electric network	7.5 – 15.0
Infrastructure	1.5 – 3.5
Planning	2.0 – 4.0

Management	3.0 – 6.0
Purchasing of land	0.0 – 5.7
Tests of the equipment	3.0 – 8.0
II. Other costs	2.0 – 4.0

The operation costs are presented in Figure 39

Like a function of the total yearly costs in BGN per kW installed capacity. The depreciation costs are connected with the total amount of the investment during the whole period of operation (20 years).

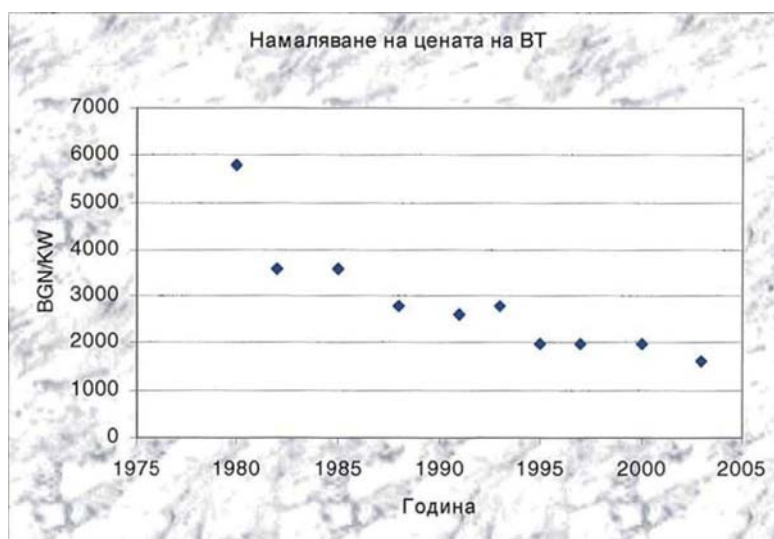


Figure 37 Decrease of the price of the generators with the years

In the figure:

X-axis – year; Y-axis – BGN/kW

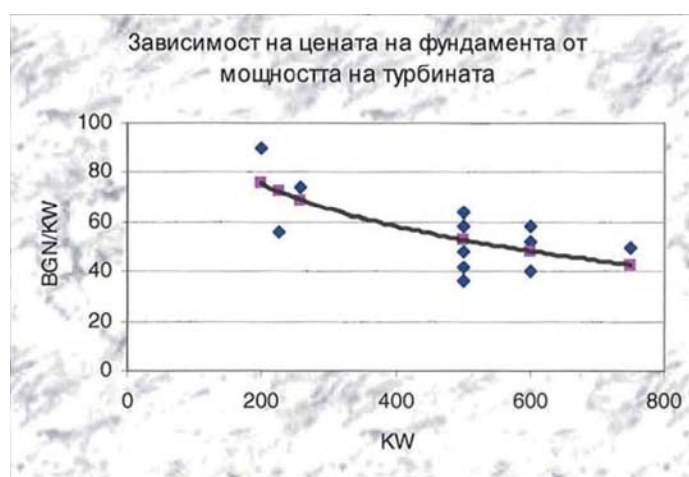


Figure 38 Dependence of the price of the foundation on the power of the turbine

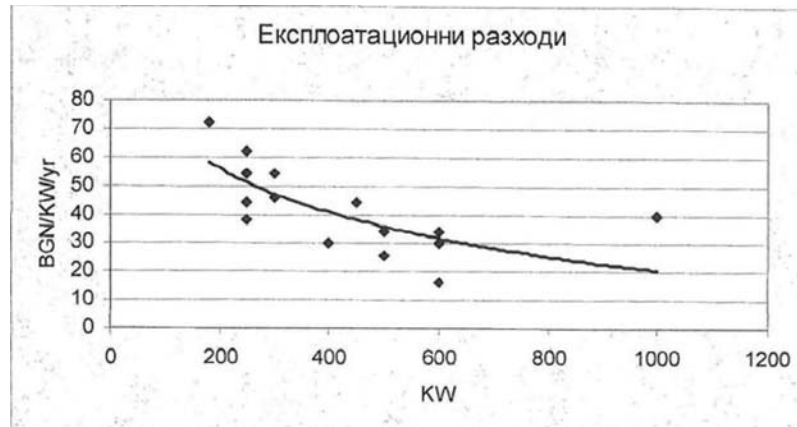


Figure 39: Overall operation costs for the maintenance of the wind generators

It was accepted that the investment to be funded by 25% own funds and 75% loans from banks and other institutions. The period of paying the interests to the different banks was accepted as 10 years with a rate of 10%. It was also accepted that the year costs of loan services increase on the average by 3%. The revenues in the model were determined as a result of the year production of electric energy at the specific location and the number of the generators to be installed, multiplied by the price of the electric energy, determined by the State Energy and Water Regulatory Commission and in relation to the investment costs. In this case the purchase price of the electric energy was accepted as 120 BGN/MWh. The costs were determined as a percentage of the investment sum and the economic result was the difference between the revenues and the costs.

Of course, the actual price of the turbine and of the whole investment, as well as the price of the electric energy and the other costs, included as expert, will become known after signing the respective contracts by the investor and the producer of the turbines, the NEC and the other Contractors. These costs could be optimized and eventually decreased in compliance with the specific conditions and the ideas of the investor.

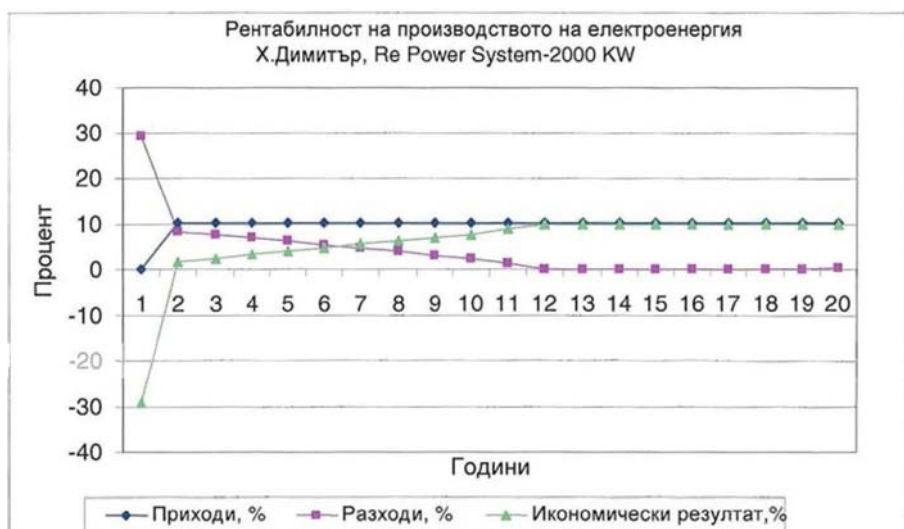
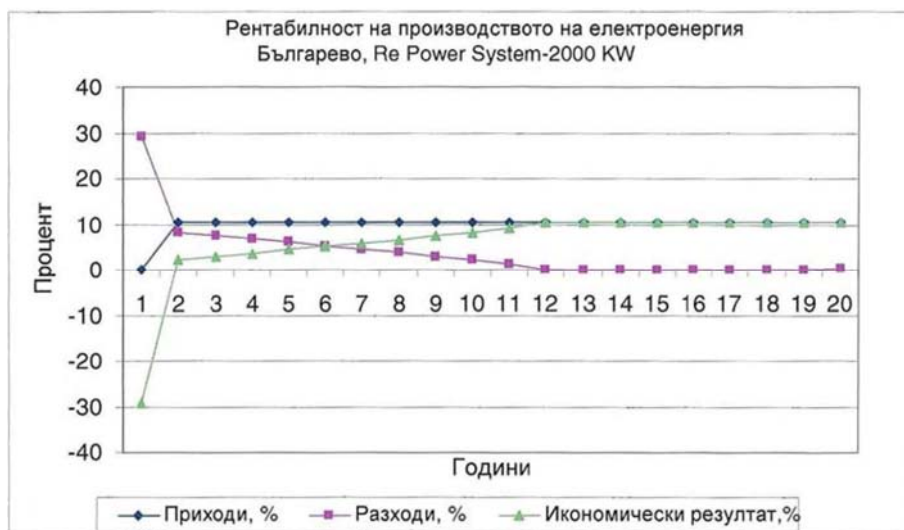
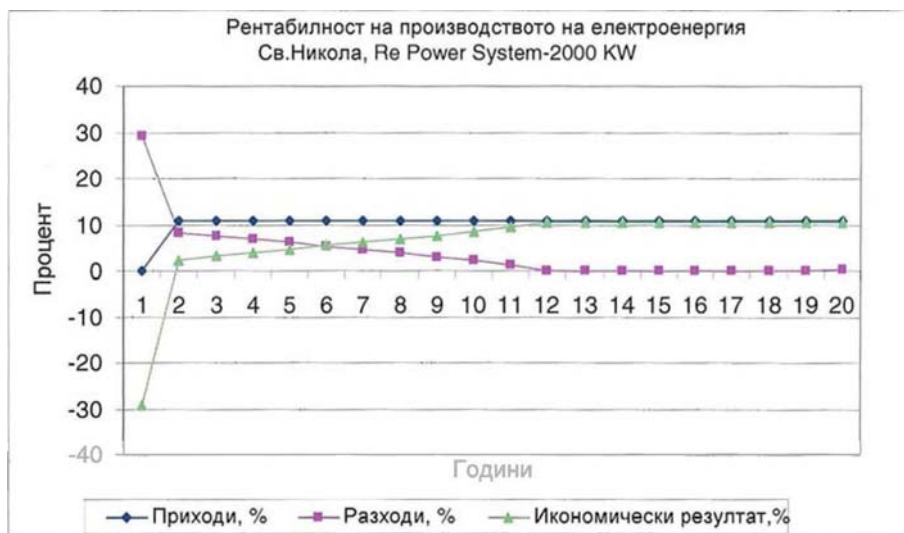
In case of using of old generators, their price depends on their technical state and it varies from half the price of a new turbine to 1/3 of it or about 500 EUR/kW per 1 kW installed capacity.

New generators

Let us review the obtained economic results in case new generators are used in the region of implementation of the investment proposal. The investigation was performed for the region of the villages Sveti Nikola, Bulgarevo and Hadji Dimitar.

In the first year of the implementation of the investment the economic result (the difference between the revenues and the costs) is small positive and even negative due to the fact that the costs then are the greatest and the income from the operation of the equipment is very limited and even inexistent (Table 38, Figure 40). The curve of the economic result passes through the zero after the first two years. On the 6th – 7th year the economic result is near to the revenues with the exception of the operation costs. Details could be seen in Figure 40.

Figure 40. Profitability of the production of electric energy by Re Power Systems – 2000 kW in the different areas of the investigated region.



In the Figure

Profitability of the production of electric energy by Re Power Systems – 2000 kW
in the region of Sveti Nikola

X – axis – revenues %, costs - %, economic result, %.

Y-axis - %

Profitability of the production of electric energy by Re Power Systems – 2000 kW
in the region of Bulgarevo

X – axis – revenues %, costs - %, economic result, %.

Y-axis - %

Profitability of the production of electric energy by Re Power Systems – 2000 kW
in the region of Hadji Dimitar

X – axis – revenues %, costs - %, economic result, %.

Y-axis - %

Table 39. Revenues, costs and final economic result from the operation of the Re Power systems – 2000 kW in different areas of the investigated region)in % of the investment)

Location	Revenues	Costs	Economic result	Period
Sveti Nikola	204,2	79,6	124,6	2/6
Bulgarevo	200,1	79,6	120,4	2/6
Hadji Dimitar	190,1	79,6	110,5	2/7

On the basis of the data presented above about the profitability of the production of electric energy by the natural resource the wind, the following could be mentioned:

- in case of choosing the right equipment for the production of energy, the implementation of the investment proposal will have a direct economic effect on the local consumers of energy – it will be about 2,5 – 1,5 times cheaper than the traditionally produced energy.
- The construction of the wind farm offers at the same time a decision of the most efficient use of the land and wind resources. There is no need to use any other natural resources.
- Each of the wind generators occupies a small area, necessary only for the foundation and it could be accepted that the adverse impact on the crops and on the flora and fauna species would be minimal. Besides these impacts are very short term, because the construction and installation works will be followed by the re-cultivation of the affected areas.
- It is necessary to take into account the social price of the construction of the object. It includes the measures to prevent the pollution of the environment and is the lowest in the production of electric energy by wind

generators. The implementation of the investment proposal is expected to increase the economic activity and to increase the employment. This will improve the image of the municipality of Kavarna and the standard of living in the zone influenced by the operation of the wind farm.

3.16.3. Impact as a result of harmful emissions and waste generation

During the implementation of the investment proposal the discharged emissions will be negligibly small. Their impact on the quality of the ambient air is temporary since they are limited only to the construction period and their territory is only within the region where the park is to be constructed. It is not expected that they will exert any impact on the climate.

On the territory of construction of the wind farm in the region of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, wastes will be generated only during the period of the construction. These will be mixed sanitary wastes from the workers on the object, construction wastes, excavated rocks and soil and eventually lubricants and oils from the motor vehicles in case of an incidental spilling. Their amount and probability of generation were discussed in details in the EIA Report.

Due to the short term of the construction and installation works (the erection of one tower could take 3 – 4 days in case of finished zero cycle), it would not be necessary to develop a program for waste management, prescribing the activities during the construction including the collection, transportation and dumping the non-dangerous wastes into the nearest sanitary depot, as well as a permit under Article 37 of the Waste Management Act on the storage of dangerous wastes and a contract with a person licensed in rendering harmless the oils and the petroleum products, which, though in minimal amounts, will be generated during the implementation of the investment proposal and will not exert any adverse impact on the environment.

During the operation of the wind farm two persons will be engaged to work in the substation. Sanitary wastes in insignificant amounts will be generated and their collection and transportation shall be organized in coordination with the municipality to the depot of the town of Kavarna.

4. INFORMATION ON THE USED METHODS OF THE ASSESSMENT AND FORECAST OF THE IMPACT ON THE ENVIRONMENT

- Statistical and dynamic modeling of the meteorological conditions.
- Method of calculating by balance the emissions of harmful substances (pollutants) discharged into the ambient air – code CHEB– 94 070300 and 94 030102.

- Statistical and model investigations of the water discharged streams.
- Maps with iso-lines for the water discharge streams by standard methods.
- Hydrological region determination of Bulgaria
- Guidelines of the UNESCO on the assessment of the seismic risk and specific methods, developed for particular cases.
- Leopold's matrix for the ecological assessment of the impact on the vegetation.
- Methods of working with the cadastre of the agricultural lands in the Republic of Bulgaria (1988).
- Assessment of the health risk in compliance with the requirements of the WHO and the Agency of protection of the environment of the USA.
- Scheme of risk management of the WHO.
- Toxicometry.
- Biological monitoring.
- Indicators of steady development.
- Lists and matrixes for the flora and the fauna.
- Delphi method of group expert assessment.
- Space analysis and decision making.
- Complex expert assessment of the landscape.
- Method of visual evaluation of the landscape – publ. MOEW, S., 1997
- Method of complex expert evaluation of the landscape – publ. V.Troeva and G.Tsolova, Landscape planning, S., 1997
- Method of calculation by balance of the emissions of harmful substances (pollutants) discharged into the ambient air
- Gutin L.Ya., About the noise field of a rotating air screw, JTP, 1936, vol.VI, p. 899
- Method of determining the overall power of the noise emitted to the environment by an industrial enterprise and determining the noise level at the place of impact, MOEW, 1999
- Method of measuring and assessment of the noise in residential areas and Method of elaborating maps of the noise of the residential areas (publ. BAA, No 8/1979)
- Method of investigation and assessment of the electromagnetic radiation in substations of high voltage and transformer stations. A collection of methods of hygienic investigations, the National Center of Hygiene, Medical Ecology and Nutrition, Vol. IV, p. 31-39, 2002
- Radiofrequency radiation hazards, exposure limits and their implications for broadcasters, European Broadcasting Union, Tech.3278 – E., February, 1995, Geneva.
- TLVs for physical, chemical and biological indices, ACGIH, 2003
- Guidelines for limiting exposure to time-varying electric and magnetic fields (up to 300 GHz), ICNIRP, Health Physics, April 1998, Vol.74, No 4, p.494-522.
- Council recommendation on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz), 1999/519/EC.

Biological monitoring

The performed monitoring on the migration of the birds in the region of the villages Bulgarevo, Sveti Nikola and Hadji Dimitar, the municipality of Kavarna, included the periods August 15 – November 15, 2004, March 1 – May 31, 2005, August 15 – November 15, 2005. The reports of the birds migrating during the day were performed at a stationary point located at the highest level of the said territory, a hill located next to belt No 2359. It is about 3,5 km to the north of the village of Bulgarevo. The visual observations were performed every day from 8.00 to 19.00, and before April 1 and after November 10 – till 17.00. The time for observation was shortened when the weather was unfavourable.

In order to establish the terms and the dynamics of the migration of the non-roaming and the song-birds the track or the transect method was used. The transects were constant and covered both the forest shelter belts and the agricultural areas with different monocultures. The tracks were followed every day in the morning between 9.00 and 11.00 and sometimes in the evening between 16.00 and 18.00. The overall length of the transect was 5700 m. Besides these constant observations in the periods of the full moon observations were performed on the night migration of the birds against the moon disk.

At certain places in the investigated territory ornithological networks were placed for catching birds. Additional information was obtained in this way on the types and the proportions of the migrating birds in the different periods.

The basic method of determining the types of bats was the registration of their ultrasounds and the direct observation in caves near the Rousalka. Detector type Petterson D 240 was used as well as sound recorders SONY. The computer analysis was performed by a special software BatSound 3.10.

5. MEASURES ANTICIPATED TO PREVENT, DECREASE AND WHERE POSSIBLE, ELIMINATE THE ADVERSE (NEGATIVE) IMPACTS ON THE ENVIRONMENT AND THE HEALTH OF THE POPULATION AS A RESULT OF THE CONSTRUCTION OF THE WIND FARM ON THE TERRITORY OF THE VILLAGES BULGAREVO, SVETI NIKOLA, HADJI DIMITAR AND POROUCHIK CHOUNCHEVO, THE MUNICIPALITY OF KAVARNA.

In the separate sections of the EIA report on the investment proposal for the construction of a wind farm on the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar and Porouchik Chounchevo, the municipality of Kavarna it was noted, that the impact of the implementation of the investment proposal on the separate components of the environment, except for some aspects, concerning the route of migration of the birds Via Pontica, was insignificant. Despite this, the team of the experts, who have elaborated the EIA report, suggested some specific measures concerning some of the components of the environment, which could be affected by the implementation of the investment proposal:

Ambient air

In order to minimize the dust emissions from the construction works and the secondary pollution of the air the following measures should be anticipated:

- re-cultivation of the disturbed areas after the end of the construction and installation works and the preparation of the sites for the wind generators;
- in order to prevent the secondary pollution of the ambient air the temporary roads must be moistened regularly during the transportation of the excavated masses to the storage depots;
- in order to prevent the secondary pollution of the ambient air the construction site must be moistened regularly in dry weather.

Climate

There are forest belts in the region which protect the agricultural areas from the strong winds and the wind erosion of the soils. It is in this connection that the location of the generators must be according to the presence of these belts and the generators should not be near the belts, especially near the well developed belts, with dense vegetation and considerable height. Practically the region of the wind farm is open to the wind from the north, east and south.

Water

- during the construction of the wind generators drinking water will be supplied to the workers on the object;
- during the construction and installation works chemical toilets will be supplied for the workers;
- during the operation of the wind generators the personal of the substation will be supplied with drinking water and there will be a sanitary pit for the sanitary water from the shower and the sink;
- due to the karst character of the greatest part of the terrain where the equipment will be installed, no leaks and spills of petroleum products are to be allowed on the site from the construction machinery.

Geological base and earthquakes

- during the design of the foundations of the wind power generators and during their operation an assessment will be performed of the seismic effect (risk) which would arise during their simultaneous operation;
- during the design stage an engineer and geological survey will be performed for each step of the foundations of the wind generators;
- the construction of the foundations of the wind generators will be performed in compliance with the calculated loads and the recommendations of the engineer – geological reports.

Land and soil

In connection with the protection of the soils and in this case the soil is one of the most fertile in the country – the leached black earth, it is recommended the installation and the construction works to be so organized as not to affect the soils by the construction machinery and the transportation vehicles. In the course of the excavation works the area of the excavation shall be limited to the minimum possible area around the sites of the wind generators and the recommendations concerning the re-cultivation of the excavations and the areas around them, mentioned in item 3.6 in the EIA report, shall be observed. In the case of the leached black earth it is especially important the construction and the installation works to be performed when the moisture of the soils is less than 50 – 60 % from the Wnna – the limit field moisture, so that the secondary compaction of the soil shall be reduced to a minimum. After the end of the construction works deep ameliorative scarifying shall be performed or, as a compromise, deep ploughing with turning of the layer and the application of organic fertilizers. During the first 1 – 3 years cultures shall be grown with a deeply penetrating root system.

The repair activities of the construction and transportation technique shall be performed outside the territory of the object on specially equipped places (repair shops).

The following measures could be pointed out additionally:

- performing the construction and installation works in a way which prevents the erosion processes;
- securing a temporary site for the storage of the excavated earth during the construction of the foundations of the wind generators;
- shaping the stored excavated earth with a suitable anti-erosion profile or using it in the depot of the town of Kavarna or for the re-cultivation of not-approved dunghills in the region;
- using the excess of excavated soils from the humus horizon;
- when elaborating the technical design the elaboration of a Project of the re-cultivation of the territory, affected in the course of the construction of the wind generators, the sub-station and the ground cable network shall be ordered and its implementation shall be ensured;
- changing the statute of the agricultural lands for the construction of the wind farm in compliance with the Regulation on the application of the Law on the protection of the agricultural lands, approved by a governmental act No 240 /1996 (SG No 84/1996, amended and supplemented in No 100/1997, No 14, 48 and 63 / 2000 and No 41 and 66 from 2001, No 31 / 2003, No 41/2004) only for an area of 12 ha (the foundations of the 62 wind generators, the substation and the cable network).

Vegetation

- the excavated earth for the foundations of the wind generators shall be used by back filling on the concrete steps and for covering the internal communication channels;
- in the future excavation works at the places of installation of the equipment and the communications the surface soil layer shall be stored at determined places and used for further meliorative activities.

Fauna

- during the works on the terrain areas other than those determined in the project documentation shall not be affected;
- during the excavation activities the upper humus layer shall be collected and stored separately near the future foundation and after laying the concrete the former shall be laid over it. In this way the natural vegetation shall be restored for a short period of time as well as the animals connected to it;
- undertaking a broad campaign among all the participants in the construction and installation works in order to prevent damaging the flora and the fauna in the region. The company - contractor shall be engaged with the responsibility not to allow the workers and the other staff to kill and catch animals, ruin their habitats, collecting the eggs of the turtles and the birds, etc.
- it is necessary to take all the necessary measures beforehand, so that there were no risks from fires, spills of fuel and lubricants, damaged machine parts, concrete wastes and any other activity, which will result in harming animals in their natural habitats.
- it is necessary to limit the velocity of the motor vehicles to and from the object to 30 km/h in order to avoid running into some slower moving animals;
- construction and installation works should not be performed in the evening and the night because they would require artificial lighting on the site, which would disturb the animals, many of which are active in the dark;
- to decrease the adverse impact from the blades of the generators these should be colored or signalized in such a way as to repel the birds during the day and they must be noticed from a long distance even if the visibility is not good, and these should also repel the birds active during the night;
- placing fencing and protective equipment around the site to protect the animals;
- in case of high concentration of migrating birds in a narrow corridor passing through the region of the park, the equipment must be switched off in the conflict seasons;
- the works on the terrain shall be controlled by the local Regional Inspectorate for Preservation and Control of Public Health and the interested NGO. For the purpose there shall be elaborated a plan for such type of activities (monitoring);

- after the start of operation of the wind farm in is necessary at least a year long compact monitoring in order to establish the actual impact of the equipment on the nesting, migrating and the winter spending birds in the region;
- the construction and installation works shall not be performed during the generative period of the birds, in the months May and June, after the little birds have left the nests and the harvest is over;
- the temporary roads for the access to the local sites shall be determined most rationally and after a consultation with a specialist in the fauna, in order to avoid the destruction of habitats. After the construction is over, the temporary roads and the piles of earth should be re-cultivated to their initial state;
- the investor shall install a radar equipment for warning and switching off the equipment in order to protect the flocks of migrating birds.

Landscape

- to reduce the unpleasant visual impact of the wind generators these shall be coloured in a suitable way and the blades shall be coated with an anti-reflecting layer;
- the excavated earth and rocks shall be stored and after the construction and installation works these should be returned over the concrete foundations of the generators and should be covered with humus.

Wastes

- when assigning the implementation of the object the Investor shall require from the company, engaged in the construction and installation works, to elaborate a program of waste management, in compliance with Art.29, para 1, item 3 of the Waste management act and to possess the necessary permit to perform activities of storing and handling dangerous wastes, as well as to sign a contract with a licensed person for the treatment of dangerous wastes. Reference: Answer from the MOEW, No 94-00-739/June 09,2006 to the asking of the team of experts who have elaborated the EIA report, concerning item 6 of the letter No 1766/April 20, 2006 if RIOEW – Varna.
- during the construction all the excavated earth from the foundations of the generators, etc. shall be stockpiled and used further to cover old illegal dunghills, to cover with a layer of earth the nearby depots and the eventual pollutions, etc. Part of the soil could be used fro the final re-cultivation of the terrain if the waste management plan does not anticipate the transportation of the earth to the future regional depot;
- containers should be placed for collecting the different types of wastes during the construction of the wind generators which should be transported to the places of their re-use or rendering harmless.

Harmful physical factors

Concerning the physical factors, the operation of the wind generators shall not exert a significant impact on the environment, so we are going to mention here only some measures which shall be taken during the installation and the operation of the generators.

Measures against the noise in case of most unfavorable conditions, depending on the type of the generators, the relief and the local wind characteristics

As it was mentioned earlier, the modern turbine generators take into account all recommendations for reducing the noise to the possible minimum. From the time of the first turbines with small power, the modern structures have reduced the noise levels down to 10 – 15 dB(A). Besides, the noise level decreases with the square of the distance along the axis of the propeller from the source and this allows the observation the standard requirements even at small distances. At a distance of minimum 350 m to about 500 m from a system with power $P = 2$ MW, the noise level reaches 40 dB(A), which is below the noise level in the villages and towns from sources like traffic of vehicles, children's voices, etc. and which is required by the respective Bulgarian standards.

Certain rules shall be observed which result in the reduction of the noise in the region:

1. Observe the hygienic – protection zone of 500 m around the wind generators in which the construction of residential buildings, hotels, schools, hospitals, etc. shall be forbidden, as stated by Art.5 of the Amendment of Ordinance No 7;
2. Measure the noise level for its assessment before and immediately after the installation of the equipment and during their testing for operation;
3. Measure the electromagnetic radiation in the low frequency and the radio-frequency bands, as well as the vibrations after the installation of the equipment;
4. Color in a suitable manner the equipment depending on the environment, the background, so that the generators shall be naturally included into the landscape and do not endanger the passing birds. For our geographic latitude the least conflict variant with the minimum of problems from light and stroboscopic effects would be to colour the equipment in dark green. We recommend the posts, the hub and the blades to be colored in matt dark green.

Measures to protect the workers and the potential visitors and the passers by from accidents in case of force major (earthquakes, storms, extreme velocities of the wind, etc.) in compliance with the international standards

- we recommend warning marks to be placed around the region limiting the visitors and the passers by;

As for the workers who periodically visit the wind generators, it would be necessary to take measures to decrease the noise level by switching off the equipment (which would be normal during prophylactics) or by wearing individual protective equipment (anti-phones) when switching off the rest of the generators isn't possible. The company has planned enough measures to ensure the labor safety, preventing the workers from eventual accidents, resulting from the maintenance of the equipment;

- it would be necessary to take measures (by warning) concerning the agricultural workers who could be in the hygienic-protection zone.

Health and hygienic aspects of the environment

Measures to prevent and reduce the significant adverse impacts on the people

Measures to prevent and reduce the significant adverse impacts on the people engaged in the construction of the wind farm

- the excavation works for the foundation of the generators and the cables shall be performed by using the respective equipment under the strict control for ensuring the labor safety;
- the construction of the foundations, the supply, the reloading and the installation of the wind generators shall be performed under the control of qualified persons with suitable machinery and a crane;
- the routes for the heavy machines and the vehicles to the place of installation of each generator shall be prepared beforehand, secured and coordinated with **KAT**.
- the workers shall wear helmets, suitable shoes, hard in the front, anti-phones, gloves and working clothes according to the season;
- no activities shall be performed when it is raining, snowing or when the wind is strong;
- the preliminary instructions shall include all the possible risks for the limbs, from over-loading, from labor accidents, etc.;
- no leaks and spills of petroleum products, used oils and lubricants shall be allowed;
- drinking water and water for sanitary purposes shall be supplied to the workers in compliance with the hygienic requirements, as well as a temporary chemical toilet, a place for rest and a canteen;
- the requirements of the Law on the healthy and safe labour conditions shall be observed (promulgated SG No 124/1997, amended No 86/199, No 64 and 92/2000, No 25 and 111/2001, amended and supplemented No 18 and 114/2003, No 70/2004, No 76/2005) and the standards connected with it;

- a permanent telephone connection shall be ensured with the town of Kavarna in order to be able to take immediate measures in case of accidents. Medical aids from Kavarna shall be used in such cases.

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Measures to prevent the adverse health impact on the population

- visitors shall not be allowed during the activities of preparation for the foundations and the installation of the wind generators. This is especially important for curious children and young people from the nearby villages;
- preliminary information shall be prepared in a suitable form for the population of the neighboring villages, especially for those using the lands around the park for farming and for those using the local roads within the region of the park. The purpose and the advantages of the wind generators shall be explained as well as the eventual adverse impacts on the health and the ways of their prevention. The best way to do this is to use leaflets and brochures. This campaign is important for the population of the villages near the equipment, especially for the young people and the children;
- special information shall be supplied on the health impact on the owners of the lands near the site;
- suitable color for the equipment shall be applied in order to reduce the psychological and visual impact on the population;
- warning signs for the drivers shall be placed informing about the risk of dazzling from the rotation of the blades when the sun is low;
- in case of failures in the telecommunications measures shall be taken for their elimination. The population in the region shall be warned about the possible jamming;
- the maintenance and the repair of the wind generators shall be performed in compliance with the international standards by qualified personnel, so that no accidents would be allowed, because the sites would have no fences nor guards;
- Emergency plan shall be elaborated in order to prevent the eventual accidents in case of calamities (storms, heavy snowfall, ice, floods, etc.) in the region of the wind farm.

Plan of removing the equipment after the decommissioning of the park

The construction of the wind farm on the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna aims at using the natural resource of the region – the wind, for the production of energy. This is an initiative which anticipates the long-term use of the equipment. Since the use of renewable energy sources is a standing problem for the modern energy production, it was supposed that this type of activities would enlarge and encompass new areas suitable for their natural characteristics, where new wind generators would be installed. The operation of

the 62 wind generators planned for installation in the investment proposal, would require permanent monitoring and performing the respective activities connected with the operation of the equipment.

The decommissioning of the wind farm for a certain period, according to the experts who have elaborated the EIA report on the investment proposal, would be necessary only under extreme and exceptional circumstances.

No decommissioning of the equipment is anticipated in realistic terms.

The wind generators are facilities which are durable and easy to repair and maintain. They preserve their project parameters in case of repairs and reconstructions.

The Investor does not consider it economically beneficial to decommission the park because the natural source (the wind) is a renewable source and is practically everlasting. So it would not be practical to stop its use.

The purpose of the investment is to use new wind generators which, after they become obsolete, would be dismantled from their foundation in the reverse order of their installation. On the existing foundations the investor will install new generation wind generators in the same way as before (the generators will be supplied to the site in separate elements, suitably colored, with mounted equipment). On the site these elements would be installed according to the instructions of the manufacturer.

Despite all the information supplied by now, in case of an abrupt change in the economic conditions in our country, in the investment policy of the Investor or in case of circumstances which would stop the operation of the wind farm, a Plan for the removing of the equipment after the decommissioning of the park has to be elaborated. It must include the following:

1. The Investor must demand from the manufacturer of the wind generators upon their purchase a detailed Instruction of their dismantling. This instruction must include the cases of extreme and exceptional circumstances. It will be one of the documents necessary for the start of operation of the equipment.
2. The equipment, according to the opinion of the experts, shall be dismantled in separate modules in the reverse order of their installation. So the dismantled equipment can be transferred to another site for re-use.
3. In case this does not happen, the Investor could sell the equipment to companies possessing the necessary permits for such activities.
4. The foundations of the generators are of such dimensions and lie below the terrain, so it would be economically impractical to destruct them and transport them to a depot as inert waste materials or to sell them to other companies as filling materials.

5. It was anticipated the area above the foundations to be recultivated in compliance with the elaborated Plan for the recultivation of the disturbed lands, whose development was recommended by the Plan of measures. In this way, though the terrain above the foundations belongs to the Investor and he has the exceptional right to use it after the change of the purpose of the agricultural land, this terrain could be used again for farming purposes. The recultivation of the area over the foundations shall be performed in compliance with Ordinance No 26/1996 on the recultivation of disturbed terrains, the improvement of low productive areas, taking off and using the humus layer (promulgated SG No 89/1996) and its amendments and supplements.

In the following Table 40 the plan is presented for the execution of the measures for prevention, reduction and where possible, elimination of the adverse impacts on the environment and the health of the population as a result from the construction of the wind farm.

Table 40. Plan of execution of the measures for the prevention, reduction and elimination of the significant adverse impacts

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
Recultivation of the disturbed regions after the construction and installation works for the preparation of the sited for the generators	Design Construction	Minimization of the dust emissions
Regular moistening of the temporary roads during the transportation of the excavated earth to the depots for temporary storage	Construction	Minimization of the dust emissions and preventing the secondary pollution of the ambient air
Regular moistening of the construction site in dry weather	Construction	Minimization of the dust emissions and preventing the secondary pollution of the ambient air
Climate		
Location of the generators according to the presence of the forest belts (the generators must not be near the belts)	Design	Preserving the forest belts
Water		
Supply of drinking water to the object during the construction	Construction	Ensuring drinking water for the workers

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
Chemical toilets for the workers on the object during the construction and installation works	Construction	Ensuring toilets for the workers
Chemical toilet for the personnel of the substation during the operation of the wind generators	Operation	Ensuring toilet for the personnel.
Supply of drinking water for the personnel of the substation during the operation of the wind generators of a suitable quality as well as water for sanitary purposes	Operation	Ensuring drinking water for the workers
Due to the karst character of the terrain where the generators will be installed, no spills of petroleum products to be allowed from the construction machinery	Design Construction	Protecting the ground water from pollution
Geological base and earthquakes		
In designing the foundations of the generators and their manner of operation evaluation shall be performed of the seismic risk in case of their simultaneous operation	Design Operation	Secure bond of the foundation and the base and guaranties for operation without accidents
Performing an engineer – geological survey of each step of the foundations of the generators	Design	Secure bond of the foundation and the base and guaranties for operation without accidents
The foundation of the generators shall be in compliance with the calculated loads and the recommendations in the engineer – geological reports.	Design	Secure bond of the foundation and the base and guaranties for operation without accidents
Land and soils		
The construction and installation works shall be organized in such a manner as to affect the soils to the possible minimum by the construction and transportation machines	Design Construction	Preserving the upper soil layer
Performing the excavation works the area of the excavations shall be limited to the minimum possible around the sites of the generators	Design Construction	Preserving the soil layer and preventing the erosion processes

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
Observing the recommendations concerning the recultivation of the excavations and the affected area around them	Construction	Preventing the erosion processes
The construction and installation works shall be performed in case of moisture of the soil within the scope of the so called physical maturity (moisture content less than 50 – 60% from the Wnna – limit field moisture)	Construction	The secondary compacting of the soil is reduced to a minimum
After the construction and installation works deep meliorative rustling must be performed or deep ploughing in combination with organic fertilizers	Construction	Restoring the porous structure of the soil
During the first 1 – 3 years cultures shall be grown with deeply penetrating root systems	Operation	Restoration of the upper soil layer
The repairs of the construction and transportation machines shall be performed outside the object, in special repair shops	Design Operation	Preventing the pollution of the land with oils and petroleum products from the construction machines
Determining a temporary site for storing the excavated earth from the foundations for the generators	Design construction	Preventing the pollution of the nearby areas with earth from the construction sites
In case of longer periods of storage of the excavated earth, grassing of the stockpiles.	Construction	Preserving the upper soil layer and preventing the erosion processes
During the elaboration of the technical project, the development of a project for the recultivation of the disturbed lands must be ordered, taking into account the activities of the construction of the wind generators and their dismantling, the construction of the substation and the cable network, and its execution must be	Design Construction	Preservation and restoration of the surface soil layer

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
provided for.		
A change in the statute of the agricultural land must be made for the construction of the wind farm in compliance with the Regulation for the application of the Law on preserving the agricultural lands only for an area of 12 ha.	Design	Preservation and restoration of the surface soil layer
Vegetation		
The excavated rocks for the foundations of the wind generators shall be used for backfilling over the concrete steps and for pavement over the internal communications	Design Construction	Recultivation of the lands disturbed by the construction and restoration of the vegetation
During future excavations in the places of installing the equipment and the communications to them, the agricultural soil layer shall be stored at specified places and shall be used in further meliorative activities	Design Construction	Prevention of the pollution of the nearby areas with excavated earth and possibility for the further recultivation and restoration of the vegetation
Animal world		
During the works no other areas shall be disturbed but these determined in the project documentation	Construction	Prevention of the pollution of the nearby areas with excavated earth and possibility for the further recultivation and restoration
During the excavation works the upper humus layer shall be collected and stored separately and after the laying of the concrete shall be laid over it	Design Construction	For a comparatively short period the natural vegetation shall be restored as well as the animal species connected with it
Carrying out an information campaign among the participants in the construction and installation works so that the damage of the flora and the fauna in the region will be prevented.	Construction	Preservation of the fauna

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
The company – contractor of the construction must be engaged with the responsibility not to allow the personnel to catch and kill animals , not to destruct their hiding places and not to collect the eggs of the birds, the turtles, etc.		
It is necessary to limit the speed of the vehicles passing to and from the object down to 30 km/h in order to avoid accidents with slowly moving animals.	Construction	Preservation of the fauna
It is necessary to take all the measures not to allow any fires, spills of fuels and lubricants, the discharge of waste materials, damaged machine parts, concrete, etc., which would cause damage to the animals and their natural environment	Construction	Preservation of the fauna and the environment
Construction and installation works shall not be performed in the evenings and at night because these would require artificial lighting at the sites and this would disturb the animals, many of which are active in the dark.	Construction	Limiting the disturbance of the animals and the birds
The blades of the wind generators shall be colored in such a way as to repel the birds in daytime and be visible in case of poor visibility, as well as to repel the night birds.	Design Construction Operation	Reducing the adverse impact of the blades on the birds
Placing fencing and protective equipment around the sites	Operation	Preservation of the animals
In case of high concentration of migrating birds in a narrow front through the region of the park, the equipment must be switched off in the conflict seasons	Operation	Decreasing the adverse impact of the blades on the birds
After the start of operation of the wind farm it is necessary to perform at least a year long impact monitoring in order to establish the actual impact of the equipment on the nesting, migrating	Operation	Establishing the adverse impact on the animal world

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
and winter passing birds in the region.		
The construction and installation works must not be performed during the period of reproduction of the birds, the months May and June, after the young birds have left the nests and after the harvest is over.	Construction	Decreasing the adverse impact on the nesting birds.
The construction of the temporary roads for the access to the sites shall be performed in the most rational manner and after a consultation with a specialist in the local fauna, in order to avoid the destruction of the habitats. After the construction is over, the temporary roads shall be recultivated to their initial state	Construction	Reducing the adverse impact on the animal species
The investor shall install radar for warning and switching off the generators in order to protect the flocks of migrating birds.	Operation	Preventing the eventual collisions during the migration periods
Landscape		
The wind generators shall be colored and the blades shall be coated with an anti-reflex paint	Design Construction Operation	Reducing the unpleasant visual impact of the generators
After the construction and installation works the excavated earth shall be returned over the concrete foundations of the generators and will be covered with humus.	Design Construction	Including the park into the surrounding environment
Wastes		
When assigning the implementation of the object, the Investor shall demand from the construction company to elaborate a program of waste management in compliance with Article 29, Para 1, item 3 of the Wastes Management Act and to possess the necessary permit for storing dangerous wastes, as well as to be engaged into a contract with a licensed person for the treatment of	Construction	Preventing the pollution of the surrounding areas with waste materials

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
the dangerous wastes		
During the construction all the excavated earth which is not going to be returned to the sites, must be transported to a depot	Design Construction	Preventing the pollution of the surrounding areas with excavated earth
Containers shall be placed for the collection of the wastes generated during the construction of the generators which will be transported to the places of their handling and/or reuse.	Construction	Preventing the pollution of the surrounding areas with waste materials
Harmful physical factors		
The hygienic protective zone of 500 m around the park shall be observed and in it no construction of residential buildings, hotels, hostels, hospitals, etc. will be allowed in compliance with Art.5 of Ordinance No7	Design	Reducing the adverse impact on the population
Measurements shall be performed of the noise levels before and after the installation of the equipment and during the testing of the generators	Operation	Reducing the adverse impact on the population
Measurements shall be performed on the electromagnetic radiation in the low and radio frequency bands as well as of the vibrations after the installation of the equipment	Operation	Reducing the adverse impact on the population
The equipment shall be suitably coloured depending on the environment and the background	Design Construction Operation	Reducing the adverse visual impact on the population, including the equipment into the landscape, ensuring the safe passage of the birds
Measures shall be taken to decrease the noise levels by switching off the equipment (which is normal in case of prophylactics) and by using anti-phones when this is impossible	Operation	Reducing the adverse impact
Warning marks for limiting the access to the region of the park of visitors and	Operation	Reducing the adverse impact

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
passers by		
Developing a system of communication with the public on the problems of the physical factors and the protection from their impact	Design Construction Operation	Reducing the social tension and changing the expectations of the population towards the production of energy from the wind
Health and hygienic aspects of the environment		
Measures to prevent and reduce the significant adverse impacts on the people		
The excavation works for the foundations of the wind generators shall be performed under strict control in order to ensure the labor safety	Construction	Reducing the adverse impacts on the health of the people
The supply, the reloading and the installation of the generators on the foundations shall be performed under the control of qualified personnel with suitable heavy machinery and a crane	Construction	Reducing the adverse impacts on the health of the people
The routes of the heavy motor vehicles shall be determined beforehand to each foundation and shall be rendered harmless	Construction	Reducing the adverse impacts on the health of the people
The workers must use helmets, suitable shoes with a firm front part, gloves and protective clothing according to the season	Construction	Health protection of the workers
No activities shall be performed when it is raining or snowing and when the wind is strong	Construction	Reducing the adverse impacts on the health of the workers
Preliminary instruction including all the possible risks from hurting the limbs, from overloading, from accidents, etc.	Construction	Health protection of the workers
No spills of petroleum products and lubricants shall be allowed	Construction	Health protection of the workers. Preventing the pollution of the soils,

Measures	Period/stage of execution	Result
1	2	3
Ambient air		
		the surface and ground water and the vegetation
Drinking water shall be supplied as well as water for sanitary purposes, in compliance with the hygienic requirements, a temporary toilet, a place for washing, a place for rest and a canteen	Construction	Health protection of the workers. Avoiding the eventual accidents and taking immediate measures in case of fires, accidents, etc.
Measures to prevent the adverse impacts on the health of the population		
Visitors and other persons shall not be allowed into the site during the preparation of the foundations and the installation of the generators. This is especially valid for the curious children and young people from the neighboring villages	Construction	Preventing eventual accidents
Special information shall be supplied about the impact on the health of the people to the owners of the agricultural lands located nearby	Operation	Preventing adverse impacts on the health of the population
Suitable coloring of the generators	Design Operation	Reducing the unpleasant psychological impact on the population
Warnings to the drivers of the vehicles about the risk of dazzling from the rotation of the blades when the sun is low	Operation	Preventing eventual accidents
The maintenance and the repair of the generators shall be performed in compliance with the international standards and by qualified personnel	Operation	Preventing eventual accidents, because the sites have no fences nor guards
Elaboration of an Emergency plan in order to prevent all dangers during calamities (storms, heavy rains, heavy snowfall, floods, etc.)	Design Construction Operation	Health protection of the workers. Risk management and limiting the impact on the environment in case of accidents.

6. INFORMATION ABOUT THE PERFORMED CONSULTATIONS DURING THE ELABORATION OF THE EIA REPORT ON THE INVESTMENT PROPOSAL FOR THE CONSTRUCTION OF A WIND FARM

In compliance with the national legislation on the preservation of the environment and the practice in our country and the EU countries, it would be advisable to popularize the design and the construction of new production objects at the earliest possible stage of the investment process, even during the pre-investment investigations.

The regulation on performing the evaluation of the impact on the environment of investment proposals in the construction, activities and technologies, adopted by Governmental act No 59/2003 (promulgated SG No 25/2003, amended and supplemented No 3/2006) and Guidelines of MOEW on the evaluation of the impact on the environment of investment proposals, determine:

- consultations with competent institutions on the problems of the environment;
- consultations with local and national public organizations, local associations of employers and with the local business representatives;
- consultations with associations, trade unions, NGO;
- consultations with local public groups, citizens and all the other interested parties.

as especially useful and necessary for informing on time the public about the investment proposal and for taking into account all considerations, proposals and ideas in the elaboration of the EIA report on the investment proposal by independent experts, in this case this is the construction of a wind farm on the territories of the villages of Bulgarevo, Hadji Dimitar, Sveti Nikola, Rakovski and Porouchik Chounchevo, the municipality of Kavarna.

In connection with Art.9 of the regulations on performing the evaluation of the impact on the environment on investment proposals for construction, activities and technologies, adopted by Governmental act No 59/2003, the investor at the earliest possible stage – in August 2005, has sent a notice to the RIOEW – Varna about his future investment intention as well as a demand for evaluation the necessity to elaborate an EIA of the investment proposal. Letters were sent asking for consultations on the investment proposal to the following specialized units and NGO: MOEW - Sofia; RIOEW – Varna, the Regional Inspectorate for Preservation and Control of Public Health – Dobrich, the Water supply and sewerage company – Dobrich, the Kavarna region, the company Irrigation systems, Dobrich, the regional directorate “Agriculture and forestry” – Dobrich, the State Game-Breeding Station – Balchik, the town’s museum of history , Kavarna, the punitive and fishing battalion – Kaliakra, the town of Kavarna, the punitive and fishing battalion of the village of Bulgarevo, Geo-Protection Ltd., Varna, Bulgarian union of the protection of the birds – the town of Sofia, the union Chirakman – the town of Kavarna, the municipalities in the villages of Sveti

Nikola, Bulgarevo, Hadji Dimitar, Investigation and production of oil and gas Ltd., Pleven.

The following opinions and recommendations were taken into account:

- RIEW – Varna

The Investor has submitted to the RIEW – Varna a request for evaluation the necessity of performing EIA for the investment proposal for the construction of a wind farm on the territories of the villages of Bulgarevo, Hadji Dimitar, Sveti Nikola, Rakovski and Porouchik Chounchevo, the municipality of Kavarna, under No 127/30.08.2005

By decision No 162 – PR/2005 under No 43355/13.10.2005 of the Director of RIEW – Varna it was determined EIA to be performed of the investment proposal;

- RIEW – Varna

By letter No 782/17.02.2006 of RIEW – Varna an assessment was made of the submitted Assignment of the scope and the contents of the EIA report. Recommendations were made on the assessments and forecast that the report must include and the consultations that must be performed.

- MOEW - Sofia

In connection with the recommendation of RIEW – Varna to perform consultations with Directorate of the National Nature Protection Administration – of the MOEW, a meeting was organized of the Investor with the Director of the National Nature Protection Administration on March 15, 2006.

The Director Mr. Bozhinov had got acquainted with the investment intention and had made the following statements:

- He agreed to the necessity of performing and EIA;
- MOEW supported projects of environmentally friendly production of energy from alternative sources;
- He recommended monitoring of the ornitho-fauna to be performed not only in the process of designing the wind farm, but after its construction as well.
- Regional Inspectorate for Preservation and Control of Public Health (RIPCPh) – Dobrich

The Investor has sent a letter to the RIPCPh on 12.01.2006 with an advice of delivery from 17.01.2006 asking for an opinion on determining the hygienic – protection zone for the wind farm near the neighboring villages.

The Investor in an earlier project of the construction of a wind farm had received a statement of the Ministry of Health (letter No 47 – 22 – PSK –

0009/17.01.2005) determining a hygienic protection zone of 500 m. It was this recommendation that he had taken into account in the present investment proposal.

The letters – answers from RIPCPH – Dobrich are attached for each of the wind generators. Copies of those letters are attached to the EIA Report, Vol.2 – Attachments.

By letter No 47-22 PSK – 467/08.05.2006 to the Ministry of Health the Investor has submitted these answers about the hygienic protection distances between the generators and the residential places and considers that the same hygienic – protection zone will be approved as that around the park near Sveti Nikola village.

- the Water supply and sewer company – Dobrich, the Kavarna region

By a letter to the company the Investor has asked for information about the location of the eventually existing network for drinking water supply on the territory of the wind farm, as well as for an opinion on the investment proposal.

By letter No PTO – 555-2/14.02.2006 the company has expressed its opinion that it does not object against the construction of the park and recommends the technical design to be approved by the Water supply and sewer company – Dobrich.

- the company Irrigation systems – Dobrich

the Investor has sent a letter to the company on 12.01.2006 with an advice of delivery from 17.01.2006 asking for information about the location of any irrigation systems on the territory of the park and for an opinion.

The company has not answered this letter by 01.06.2006.

- the Regional directorate Agriculture and Forestry – Dobrich

By letter to the Directorate the Investor has asked for an opinion on the implementation of the investment proposal.

By letter No RD-13-681/ 17.03.2006 the regional directorate has informed the Investor, that an opinion could be expressed only after the submission of the set of documents, required by Article 40 of the regulation of applying the Law on preservation of agricultural lands – for changing their purpose. It was pointed out that the sites must be in compliance with the main purpose of the lands – the production of agricultural products.

- State game-breeding station – Baltchik

By a letter the Investor has asked for information on the forest belts on the territory of the park and their characteristics.

By letter No 477/15.03.2006 the SGBS has submitted the necessary information pointing out that the belts have a special purpose and are state public property.

- the town's History Museum – Kavarna

The Investor has sent a letter to the Museum, asking for an opinion on the implementation of the investment proposal.

By letter No RD-01-01-02/19.01.2006 the Museum has informed the Investor that in the zone of the future park there are archeological villages included in the National archeological map of Bulgaria with a different statute.

The Museum expressed a positive opinion on the construction of the park, mentioning explicitly that in case a wing generator was placed within the borders of an archeological object, the archeological investigations would be performed at the expense of the Investor, or the equipment would be removed to another site.

- the Punitive and Fishing Battalion – Kaliakra, the town of Kavarna

By letter No 38/30.01.2006 the Investor was informed that there are no objections to the implementation of the investment proposal, proposing assistance in the protection of the environment.

- the Punitive and Fishing Battalion of the village of Bulgarevo

By letter No 158/12.01.2006 with advice of delivery from 26.01.2006 the Investor has asked for an opinion on the future wind farm.

By 01.06.2006 no answer has been received.

- Geoprotection Ltd., Varna

By letter No 159/12.01.2006 with advice of delivery from 16.01.2006 the Investor has asked for an opinion on the possibilities for the implementation of the investment proposal from the standpoint of the geological protection with attached cartographic material.

By 01.06.2006 no answer has been received by the Investor.

- Bulgarian Union on the Protection of Birds – branch Sofia

By letter No 160/12.01.2006 with an advice of delivery from 18.01.2006 the investor has asked for an opinion on the investment proposal.

By 01.06.2006 no answer has been received, though the branch of the Union by letter No 9000/102-012/20.10.2005 has expressed its request to be included in

the EIA consultations and in the expert council as an interested party. Copy of this letter was submitted to RIOEW – Varna as well.

- Chirakman Union – the town of Kavarna

The Investor asked for an opinion on the investment proposal by letter No 161/12.01.2006.

The answer by letter No 1/15.03.2006 says that the Union will express an opinion only after getting acquainted with the whole information about the investment proposal.

- the Municipality of the village of Bulgarevo

By letter No 163/12.01.2006 with an advice of delivery from 26.01.2006 the opinion of the mayor of the village of Bulgarevo was asked for, which had to express the opinion of the public.

By 01.06.2006 the municipality of Bulgarevo has expressed no opinion and no answer has been received.

- the Municipality of the village of Sveti Nikola

By letter No 153/12.01.2006 with an advice of delivery from 28.01.2006 the opinion of the mayor of the village of Sveti Nikola was asked for, which had to express the opinion of the public.

By 01.06.2006 the municipality of Sveti Nikola has expressed no opinion and no answer has been received.

- the Municipality of the village of Hadji Dimitar

By letter No 165/12.01.2006 with an advice of delivery from 17.01.2006 the opinion of the mayor of the village of Hadji Dimitar was asked for, which had to express the opinion of the public.

By 01.06.2006 the municipality of Hadji Dimitar has expressed no opinion and no answer has been received.

- the Municipality of the village of Rakovski

By letter No 166/12.01.2006 with an advice of delivery from 16.01.2006 the opinion of the mayor of the village of Rakovski was asked for, which had to express the opinion of the public.

By 01.06.2006 the municipality of Rakovski has expressed no opinion and no answer has been received.

- the Municipality of the village of Porouchik Chounchevo

By letter No 167/12.01.2006 with an advice of delivery from 18.01.2006 the opinion of the mayor of the village of Porouchik Chounchevo was asked for, which had to express the opinion of the public.

By 01.06.2006 the municipality of Porouchik Chounchevo has expressed no opinion and no answer has been received.

- Investigation and production of oil and gas Ltd., Pleven

By letter No 168/12.01.2006 with an advice of delivery from 17.01.2006 the Investor has asked for an opinion and information on the eventual gas supply networks or concessions of the Company on the territory of the future wind farm.

By 01.06.2006 the company has not answered to this letter.

- Directorate Bowels of the Earth, Ores and Minerals, MOEW, Sofia

By letter No 181/10.05.2006 the Investor has asked for information on the deposits of natural resources on the territory of the future wind farm.

The answer by letter No ZDOID -8128/17.05.2006 includes the following information: 1) the mentioned locations of the wind generators do not coincide with any deposits of natural resources, reported in the National balance of the deposits; 2) part of the objects are to be located within the concession for the production of petroleum and gas from the Tyulenovo deposit. It was recommended the investment proposal to be coordinated with the concessionaire of the Tyulenovo deposit.

- MOEW, Sofia

By letter No 94-00-739/25.05.2006 the team of experts who have elaborated the present EIA report has asked for information about the necessity of submitting the following documents: program in compliance with art.29, para1, item 3 of the Waste management act; an application under art.37 of the Waste management act for the permission of the activities of temporary storage of dangerous wastes and a contract for further treatment of the dangerous wastes, on the grounds of art.5 of the WMA, with a person, owning a document required under art.12 of the WMA, at the stage of performing the assessment of the environmental impact of the investment proposal, which were demanded by letter No 1766/20.04.2006 of RIOEW – Varna.

The answer by letter No 94-00-739/09.06.2006 pointed out that .."at the stage of elaborating the EIA report there are no grounds to require obligatory and there is no practical possibility to ensure the elaboration and the submission of the said documents by the Employer..".

Copies of the sent and received letters and opinions were attached in Vol.2 of the present EIA report, Annex III.

The following Table 41 includes information on the performed consultations and the motives for the accepted or rejected notes and recommendations, in compliance with art.95, Para. 2 of the Regulation on Performing EIA of an Investment Proposal of Construction, Activities and Technologies, adopted by a Governmental act No 59/2003.

Table 41: Information on the performed consultations

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
1	RIOEW - Varna	Consultation about the necessity of elaborating an EIA report	By decision No 162-PR/2005 the Director of RIOEW – Varna determines the necessity of performing EIA of the investment proposal	The motives were accepted
2	RIOEW - Varna	Consultation on the assessment of the scope and contents of the EIA report	The submitted assignment for the scope and contents of the EIA report was approved. The following recommendations were made: - the EIA report must include a forecast of the Ambient air only for the period of the construction, installation, transportation works); Wastes – during the construction and the operation (types, amounts, treatment – by other companies possessing the necessary documents under art.12 of the Waste management act; Flora and fauna – during the construction and the operation; Geological environment – taking into account the consultations with Geoprotection Ltd. – Varna, Soils – the necessity of recultivation of the soils and the restoration of their initial quality must be reviewed, Harmful physical factors – during the operation – noise, vibrations, non-ionizing radiation, Health and hygienic aspects – during the operation with the evaluation of the psychological and visual discomfort from the	All recommendations were taken into account and the problems were reviewed in the respective parts of the EIA report

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
			dimensions and the movement of the generators. - The cumulative impacts must be reviewed concerning the migration routes of the birds Via Pontica, the pollution of the landscape and the health and hygienic conditions; - The alternatives of the locations, the number, the height and the power of the equipment must be considered with motives of the made choice and the impact on the environment \the migration process and the health of the people). - In connection with the requirements of art.95 para 3, consultations must be performed with the Directorate of the National Nature Protection Administration, of MOEW, the Ministry of Health, the Regional directorate of Agriculture and forestry, the NEC – about the possibility of joining the existing electric power transition network, the National institute for the cultural monuments to the Ministry of culture, Geoprotection Ltd., Varna, the Ecological NGO; - The EIA report must include a detailed cartographic material in scale – plan situation with the WPP and the closest residential areas with the numbers of the properties; - The structure of the EIA report shall be in compliance with the requirements of art. 96, para 1 of the Environmental protection act, and	

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
			art.12 of the Regulation on performing EIA (Governmental act No 59/2003 with amendments and supplements) - The non-technical summary of the report must be elaborated in compliance with art.12 para 2 of the regulation and item 27 and §1 of the additional regulations of the Environmental protection act as a single document, available to the public.	
3	MOEW - Sofia	Consultation with the Directorate of the National Nature Protection Administration – of the MOEW by the recommendation of RIOEW - Varna	The Director Mr. Bozhinov had got acquainted with the investment intention and had made the following statements: - He agreed to the necessity of performing and EIA; - MOEW supported projects of environmentally friendly production of energy from alternative sources; - He recommended monitoring of the ornithofauna to be performed not only in the process of designing the wind farm, but after its construction as well.	The recommendation was accepted by the Investor
4.	RIPCPH - Dobrich	Consultation about the determination of the hygienic protection zone of the WPP (Ordinance No 7 of	The Investor in an earlier project of the construction of a wind farm had received a statement of the Ministry of Health (letter No 47 – 22 – PSK – 0009/17.01.2005) determining a hygienic protection zone of 500 m. It was this recommendation that he had taken into account in the present investment proposal.	In the elaboration of the EIA report a minimal distance of 500 m was accepted

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
		the MPH)	The letters – answers from RIPCPH – Dobrich are attached for each of the wind generators. By letter No 47-22 PSK – 467/08.05.2006 to the Ministry of Health the Investor has submitted these answers about the hygienic protection distances between the generators and the residential places and considers that the same hygienic – protection zone will be approved as that around the park near Sveti Nikola village.	
5	Water supply and sewer company - Dobrich	Information about the eventual location of drinking water supply networks on the territory of the WPP	By letter No PTO – 555-2/14.02.2006 the company has expressed its opinion that it does not object against the construction of the park and recommends the technical design to be approved by the Water supply and sewer company – Dobrich.	Due to the lack of information in the answer it was accepted that on the territory of the WPP there is no water supply network and this was taken into account in the respective section of the report
6.	Irrigation systems - Dobrich	Information about the location of any irrigation systems on the territory of the WPP	By 01.06.2006 no answer has been received	Due to the lack of information it was accepted that there are no irrigation systems on the territory of

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
				the WPP.
7.	Regional directorate Agriculture and forestry - Dobrich	Opinion on the implementation of the investment proposal	By letter No RD-13-681/ 17.03.2006 the regional directorate has informed the Investor, that an opinion could be expressed only after the submission of the set of documents, required by Article 40 of the regulation of applying the Law on preservation of agricultural lands – for changing their purpose. It was pointed out that the sites must be in compliance with the main purpose of the lands – the production of agricultural products.	The Investor is going to prepare the necessary documentation and will submit it for an opinion
8.	State game-breeding station - Balchik	Information on the presence of forest belts on the territory of the WPP and their characteristics	By letter No 477/15.03.2006 the SGBS has submitted the necessary information pointing out that the belts have a special purpose and are state public property.	The data were used in the elaboration of the respective part of the report
9.	Town's history museum - Kavarna	Opinion on the implementation of the investment proposal	By letter No RD-01-01-02/19.01.2006 the Museum has informed the Investor that in the zone of the future park there are archeological villages included in the National archeological map of Bulgaria with a different statute. The Museum expressed a positive opinion on the construction of the park, mentioning explicitly that in case a wing generator was placed within the borders of an archeological object, the archeological investigations would be performed at the expense of the Investor, or the equipment would be removed to another site.	A positive decision was obtained and the data were accepted and used in the elaboration of the EIA report

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
10.	The punitive and fishing battalion Kaliakra - Kavarna	Opinion on the implementation of the investment proposal	By letter No 38/30.01.2006 the Investor was informed that there are no objections to the implementation of the investment proposal	A positive opinion was obtained
11.	The punitive and fishing battalion Bulgarevo	Opinion on the implementation of the investment proposal	By 01.06.2006 no answer was received	
12.	Geoprotection Ltd., Varna	Opinion on the implementation of the investment proposal from the standpoint of the geological protection	By 01.06.2006 no answer was received	
13	Bulgarian union for the protection of the birds	Opinion on the implementation of the investment proposal	By 01.06.2006 no answer was received, though the Sofia branch by letter No 9000/102-012/20.10.2005 has expressed its request to be included in the EIA consultations and in the expert council as an interested party. Copy of this letter was submitted to RIOEW – Varna as well.	
14.	Union Chirakman - Kavarna	Opinion on the implementation of the investment proposal	The answer by letter No 1/15.03.2006 says that the Union will express an opinion only after getting acquainted with the whole information about the investment proposal.	No negative opinion was expressed

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
15	The municipality of the village of Bulgarevo	Opinion on the implementation of the investment proposal of the mayor and the population	By 01.06.2006 the municipality of Bulgarevo has expressed no opinion and no answer has been received.	
16.	The municipality of the village of Sveti Nikola	Opinion on the implementation of the investment proposal of the mayor and the population	By 01.06.2006 the municipality of Sveti Nikola has expressed no opinion and no answer has been received.	
17.	The municipality of the village of Hadji Dimitar	Opinion on the implementation of the investment proposal of the mayor and the population	By 01.06.2006 the municipality of Hadji Dimitar has expressed no opinion and no answer has been received.	
18.	The municipality of the village of Rakovski	Opinion on the implementation of the investment proposal	By 01.06.2006 the municipality of Rakovski has expressed no opinion and no answer has been received.	
19.	The municipality of the village of Porouchik Chounchevo	Opinion on the implementation of the investment proposal of the mayor and the population	By 01.06.2006 the municipality of Porouchik Chounchevo has expressed no opinion and no answer has been received.	

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
20.	Investigation and production of oils and gas JSC - Pleven	Opinion on the implementation of the investment proposal and information about eventual concessions of the company on the territory of the future WPP	By 01.06.2006 the company has not answered to this letter	
21	Directorate "Bowels of the Earth, Ores and Minerals" with the Ministry of Environment and Waters	Information about the location of any deposits of natural resources on the territory of the WPP	The answer by letter No ZDOID -8128/17.05.2006 includes the following information: 1) the mentioned locations of the wind generators do not coincide with any deposits of natural resources, reported in the National balance of the deposits; 2) part of the objects are to be located within the concession for the production of petroleum and gas from the Tyulenovo deposit. It was recommended the investment proposal to be coordinated with the concessionaire of the Tyulenovo deposit.	The recommendation was accepted
22	MOEW	Information about the necessity of supplying the documents, demanded by letter No 1766/20.04.2006	The answer by letter No 94-00-739/09.06.2006 pointed out that .."at the stage of elaborating the EIA report there are no grounds to require obligatory and there is no practical possibility to ensure the elaboration and the submission of the said documents by the Employer..".	

No	Organization	Motives for the consultation	Statements, opinions, recommendations	Accepted/rejected notes and recommendations
		from RIOEW - Varna		

SP “EKOEM – K”

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7. CONCLUSION

After the detailed analysis of the individual components of the environment, performed by the Experts, the following could be noticed:

- By the opinion of the experts concerning the components ambient air, climate, water, geological base, vegetation, landscape, protected natural objects, cultural and historical heritage, wastes, dangerous substances and health and hygienic aspects of the environment, the implementation of the investment proposal would not exert an adverse impact on the environment;
- The soils resources in the area for the construction of the wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo are presented mainly by the black earth type – carbonate and leached black earth with high natural fertility (I-st group class – very good soils, II-nd group class category under non-irrigation conditions). In this case the problem is to locate 60 wind generators in agricultural lands (permanently used as cornfields). The implementation of the investment proposal on the said territories of the municipality of Kavarna does not necessitate the change of the purpose of the land and its permanent use within the borders of the park, in case the recommendations and the requirements in performing the construction and installation works are observed and the necessary restoration and recultivation works are carried out, including the protection of the soils from secondary compaction and preserving the fertility of the soils. The changes in the top soil layer will be made only within the excavations for the foundations of the wind generators, which makes about 0,15% of the whole area of the agricultural land within the borders of the wind farm. These changes will not result in significant changes of the other environmental components, depending on the soil conditions – vegetation and some representatives of certain animal species (from the soil fauna mostly).
- The animal world – the performed monitoring on the ornitho-fauna in the region of the future wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna, the following was established: during the migration period 139 kinds of birds were registered in the region. This is more than 1/3 of the kinds registered in our country. The nesting birds are considerably less – these could be divided into nesting in the forest belts and nesting in the agro-systems. The forest belts between Kamen bryag, Bulgarevo and Hadji Dimitar are inhabited by 37 kinds of nesting birds. The kinds of birds inhabiting the agrocenosys are few. In the investigated 7 types of monocultures 7 kinds of birds were found. This is an indicator that the artificial agro-systems have a limited number of flora and fauna components and poor mechanisms of self regulation. The amphibians in the region are only 4 kinds. These are land frogs living in the more open spaces. The reptiles are 12 kinds. There are two kinds of land turtles, 5 kinds of snakes and 5 kinds of lizards. The mammals are 32 kinds which is about 1/3 of these in Bulgaria. From these only the bats

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could have an immediate contact with the moving parts of the equipment. Their number and kinds on this territory are small in values and the eventual adverse impact on them would be within the admissible limits. Their developed sensor system of orientation is an additional condition of evading and localizing the rotating blades of the generators. No doubt, the construction of the generators will exert a certain adverse impact on the fauna in the region. Due to the poor diversity in the kinds in the agrocenosis the construction of the generators will not exert significant changes in the populations of the affected animal species. During the operation of the equipment the only affected species will be the birds and the bats. The monitoring during the migration period has shown that the birds fly over the park at a height of more than 150 m, so no direct contact could be expected with the rotating blades. It is necessary to develop a long term program of monitoring of the impact of the wind generators on the ornitho-fauna and an assessment of the eventual losses, in comparison with the expected growth of the populations and their annual growth in number. In case the requirements are observed and the respective measures of reducing the adverse impact on the fauna in the region are taken, we think that the adverse impacts will be within the rationally admissible limits.

- In case of high concentration of migrating birds in the conflict seasons on a narrow front over the WPP, the equipment will be switched off;
- There are no flora and fauna species on the territory of the future WPP which are not to be found in the in similar biotypes in other Dobrudja regions;
- As a conclusion, concerning the physical factors, the investment proposal for the construction of a wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna, does not contradict the existing standards and legislation and will not create additional conditions for an adverse impact on the population and the environment, in case the following recommendations are observed:

1. Observing a hygienic protection zone of 500 m (not less than 350 m) around the generators where no construction of residential buildings, hotels, hospitals, schools, etc. is allowed, as stated in art.5 of the Amendment of Ordinance No 7. This zone must be marked for limiting the access of tourists, visitors, etc.;
2. The equipment shall have installed protective systems for switching off in case the velocity of the wind is over 25 m/s or in case their mechanical integrity is broken due to poor mechanical connections or for other reasons;
3. Measurements shall be performed of the physical factors – noise, vibrations, non-ionizing radiation, electromagnetic fields, in order to evaluate the impact on the environment of the equipment during operation;
4. Dialogue must be initiated as a basis of a steady communication of the risk from the harmful physical factors to the environment and the

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people with the population, by developing a program on the communication and the risk management, in order to avoid any non-adequate reactions to the construction of the park and the eventual contradictions. This could be done after the punctual concept of the Investor on the way of installation – heights, distances, etc., so that the noise levels could be evaluated;

- Wastes – the Investor will cooperate for the modernization and the recultivation of the dunghills of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo. On the other side, the operation of these depots in the present manner makes them a preferred place for autochthonous representatives of the fauna and the migrating birds.

After the performed multi-factor analysis of the present state, the team of experts came to the conclusion, that in case of strict observation of the proposed measures for reducing and eliminating the adverse impacts , the investment proposal for the construction of a wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna, will not exert a negative effect on the environment and its health and hygienic aspects.

As a conclusion, the team of experts who have elaborated the present EIA report on the investment proposal "Construction of a wind farm on the territory of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna" proposes to the RIOEW – Varna to take a positive decision of the EIA report.

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Completed Environmental Impact Assessment Report of Investment Proposal "Construction of Wind farm on the Territory of the villages of Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, Municipality of Kavarna"

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Sofia, February – March 2006

List with the signatures of the members of the team, elaborated the EIA report on the investment proposal for the construction of a wind farm on the territories of the villages Bulgarevo, Sveti Nikola, Hadji Dimitar, Rakovski and Porouchik Chounchevo, the municipality of Kavarna

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