ECOLOGICAL PROBLEM OF SHATSK NATURAL PARK AND WAYS OF ITS SOLUTION BY MEANS OF GEODETIC METHODS

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Key words: network, water level gauge, deep well, dispersion zone, depression cone.

Setting of the problem: There exist the high rocketing increase in the engineering and economics development of sand and cretaceous deposit in Khotyslavsk. Also the existence of the active and deep tectonic fault can cause ecological disaster at the territory of Shatsk National park that is the lowering of the water surface level in Shatsk lakes. At the territory of park the observation of the relative fluctuation of the lakes water surface levels, and ground and underground waters is being conducted. However, any of the wells is not linked to the absolute heights of systems.

Setting of the task: The most actual tasks are: construction of the levelling signs network with the absolute heights according to the unique state heights systems; creation of the geodynamic test-field intended for the observation of the Earth surface deformation and casters processes; determination of the absolute heights of the water surface levels of lakes and ground water bearing horizon by the dynamic of their changes with time.

Presentation of major information about the problem: Khotyslavsk sand and cretaceous deposit is located at the territory of Belarus 300 kilometer from Ukrainian border. Increasing of the development of the deposit to 45 meter can lead to ecological disaster at the territory of western Polissya. The deposit is being developed using quarry means at the area of 4,5 hectare. Nowadays the output of sand is being conducted to the depth of 10-11 meters that reaches to the level of cretaceous deposits. Also the pipeline drainage of ground waters to the river Rita is provided at the quarry. The amount of bailing is 12 thousands cubic meters per day [3].

In 2015 the second stage of deposit development will start. The cretaceous deposits development is planned to be performed by 3 ledges to the depth of 45 meters, with front of exploitation to 100 meters, with water influx of 27,5 thousands cubic meters per day. At this stage it is planned to make antifiltration curtain to the south of quarry with general length of 1,5 kilometers. Prior modeling of exploitation condition of deposit has shown that water lowering in case of the increasing of the depth of quarry development to 45 meters will cause the forming of depression cones. They will be formed in the Upper Cretaceous and Quaternary water bearing horizons with length of 10,5 kilometers in meridional and of 15 kilometers latitudinal directions[1].

Intensive water filling of quaternary deposits and significant amount of quarry water lowering will lead to the forming of inflows to the open quarry space as a result of the intensive spending of capacitive ground water reserves [6].

Institute of Hydraulic Engineering and Land Reclamation of Ukrainian Academy of Agrarian Sciences claims that the filtration coefficient of the active zone of the joining of the Cretaceous deposits is equals to 3-6 meter per day. So, the join zone of cretaceous deposit is main source of the underground water flow. In order not to get active underground inflows a zona of active joining shouldn't be opened by the quarry. That is why it is not recommended to deepen the project depth for more than 30 meters.

The application of hydraulic «curtain» as a protective measure can lead to the activation of karst-suffosion process which will only strengthen the negative effect.

The Belarusian specialist offered the mathematical model of hydrogeological process according to the materials of «Assessment of influence on the environment of Khotyslavsk deposit». The three-dimensional maps of hydrodynamic changes of deposit exploitation in 2014, 2019, 2024 and 2040 have been made. By the results of modeling of Belarusian specialist during the exploitation in 2024 year the limit impact of developing quarry will cross Ukrainian border between highway in village Tur – along of Joseph mountain to the village Sushitnisa (Belarus). When its exposure limit deepens at the territory of Ukraine for 3 kilometers, it would have a width of 2 kilometers. The Belarusian specialist published map of suggested lowering level of underground water during the process of the development of Khotyslavsk quarry from 2014 till 2040 with and without applying anti filtration protection (Fig. 1a),b),c),d); 2a),b),c),d)) [5].

Given maps show that in the case of antifiltration protection while quarry exploitation all lines of foreseen deeps of ground waters with occurrence of 0,1, 0,5, 1,0, 5,0 and 12,0 meters are mapped at the territory of Belarus, except 0,1 meter, in spite of the fact that quarry is located 300 meters away from the border with Ratne district of Volyn region. By this information development of quarry will not cause the lowering of the ground waters level at the territory of Ukraine. In the case of the absence of anti filtration protection the reduction zones of the lowering of the ground waters level are significantly bigger than those with anti filtration protection for all foreseen deeps – 0,1, 0,5, 1,0, 5,0, 12.0 meters.

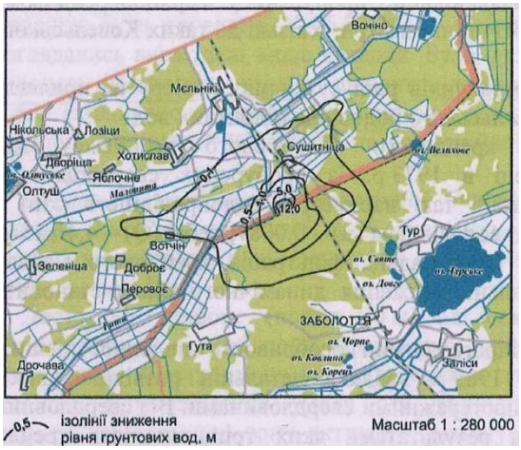

Fig. 1a) 2014 year

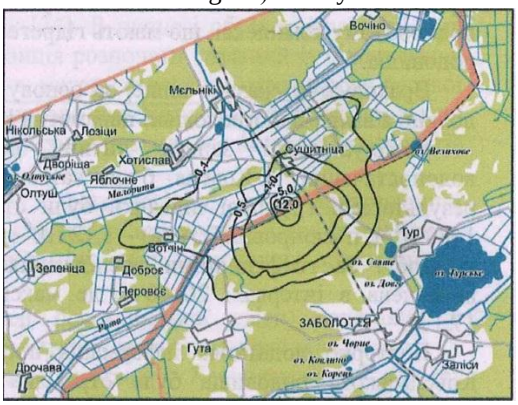

Fig. 1b) 2019 year

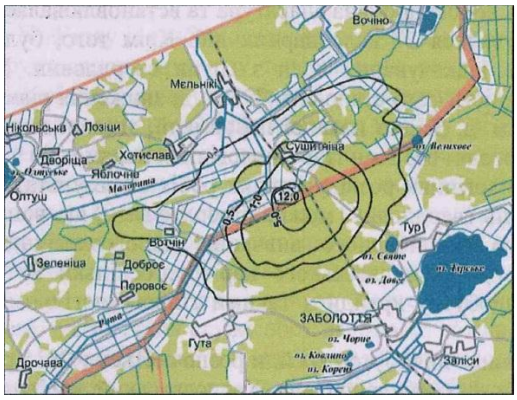

Fig. 1c) 2024 year

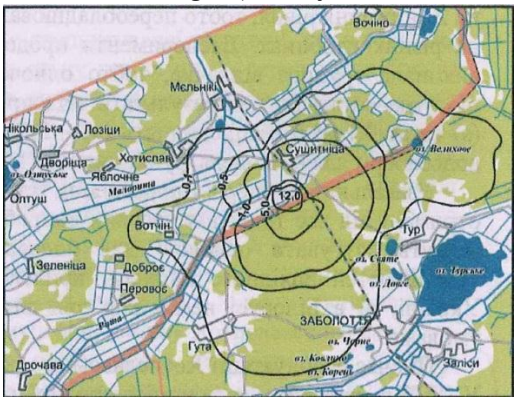

Fig. 1d) 2040 year

Fig. *1.a),b),c),d) Foreseen lowering level of underground water during the process of the development of Khotyslavsk deposit from 2014 till 2040 without applying anti filtration protection.*

The impact limits are shown also at the nearby Ukrainian territories. Especially with ground waters level lowering of 0,1 meter that usually doesn't have impact on the environment [2].

Belarusian specialist claim that at the final stage of the deposit exploitation (2040p.), the dispersion zone of underground water will get onto the territory of Volyn region for 7 kilometers, that is not likely to happen.

Taking into account the information of Belarusian scientists, I. Zaleski made a map of foreseen lowering of the underground waters level at the 2nd stage of the exploitation of Khotyslavsk quarry in 2024 and 2040 years (Fig.3). In the first case the process of water level lowering will cover the territory, southern border of which will go through villages Guta, Zabolottya, Tur, and at the second case far more to the south to the village Zalisy in particular.

Natural surface and underground waters which run into intake in the process of exploitation of Khotyslavsk sand and cretaceous deposit also may influence the changes of underground waters quality and can be the potential source of pollution.

So, we can suggest Khotyslavsk sand and cretaceous deposit to be a potential threat for Western Polissy in general and for Shatsk natural national park in particular.

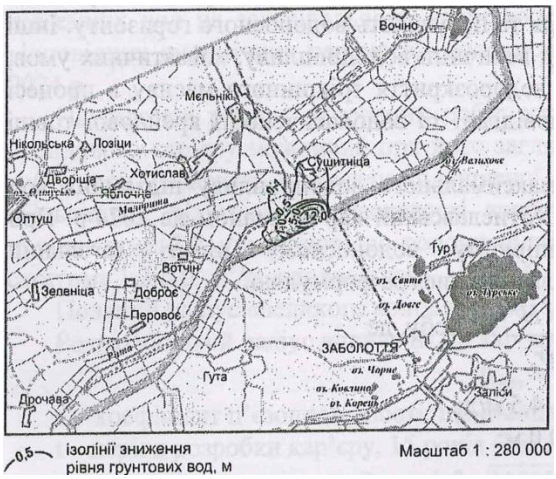

Fig. 2a) 2014 year

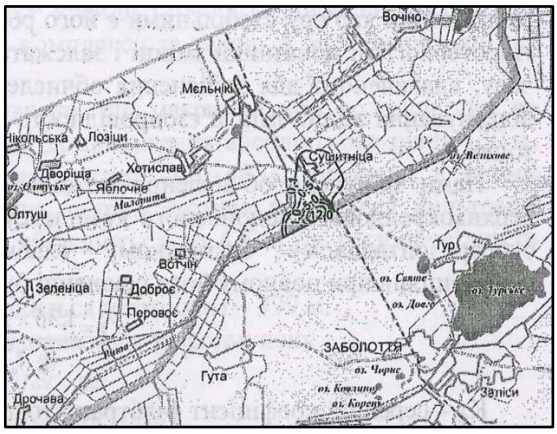

Fig. 2b) 2019 year

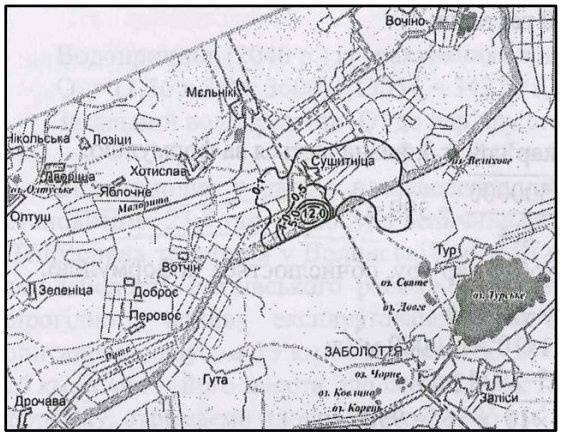

Fig. 2c) 2024 year

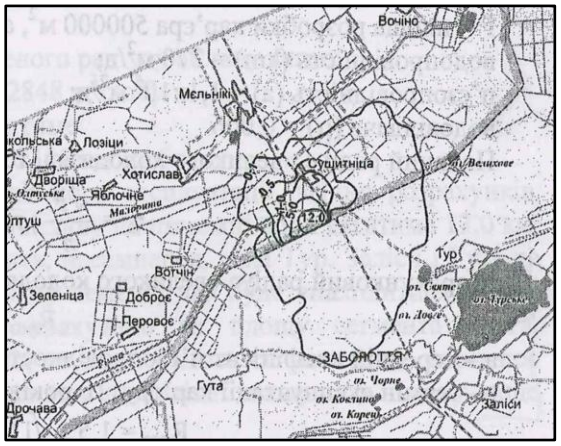

Fig. 2d) 2040 year

Fig. 2a),b),c),d). Foreseen lowering level of underground water during the process of the development of Khotyslavsk deposit from 2014 till 2040 with applying anti filtration protection.

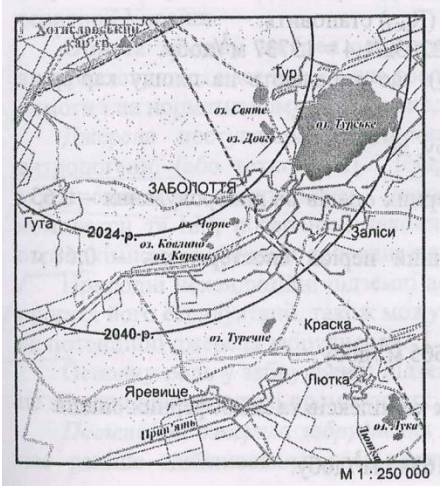

Fig. 3. Foreseen radiuses of influence at the 2 stage of the exploitation of Khotyslavsk deposits in 2024 and 2040 years

Shatsk natural national park is a unique Ukrainian territory of great supply of pure spring water and also with a variety of flora and fauna. At this territory there are located 23 lakes with a general area of 6 thousands hectares. The table shows morphometric parameters of the lakes of Shatsk natural national park. The biggest lakes are Svitiaz (2750 hectares), Pulemetske (1640 hectares) and Luki (450 hectares), and the smallest ones are Navrattya and Linovets (two hectares each). The deepest lake is Svitiaz (58,40 m) and shallowest is Zvedenka (1 meter depth). [4].

Table1

Morphometric parameters of the lakes

Name of the lake	Area, km^2	Length, km	Width, km	Depth, m
Svitiaz	27,5	9,3	4,8	58,40
Pulemetske	16,4	6	3,6	19,2
Luki	6,8	5,9	3,1	3,5
Lyutsymer	4,5	2,97	2,00	11,20
Ostriv'yanske	2,57	2,6	1,7	3,4
Peremut	1,5	1,9	1,4	3,5
Krymne	1,44	2,0	0,72	6,0
Pisochne	1,38	2,0	1,9	16,0
Chorne Velike	0,7	1,35	0,65	3,2
Somenets	0,46	1,25	0,55	3,2
Chorne Male	0,37	0,9	0,6	1,5
Moshne	0,36	0,6	0,6	3,0
Klymivske	0,32	0,8	0,48	3,0
Karasynets	0,16	0,5	0,32	3,0
Ozertse	0,14	0,9	0,9	2,0
Dovge	0,12	1,2	0,4	3,0
Plotychchya	0,11	0,6	0,5	2,0
Krugle	0,09	0,5	0,3	1,5
Zvedenka	0,04	0,25	0,25	1,0
Gerasimove	0,03	0,2	0,2	1,2
Ritets	0,03	0,24	0,14	3,0
Navrattya	0,02	0,2	0,2	2,0
Linovets	0,02	0,22	0,4	1,5

The nearest lakes to Khotyslavsk sand and cretaceous quarry are Krymne (18,5 kilometers away), Plotychchya (21,8 km) and Moshne (20 km), the farthest ones are Ritets (40km), Zvedenka (37,5km), Pulemetske (32 km) та Svitiaz (27,5km).

Aiming to determine the changes of lakes water surface level and movements of the Earth crust, it is needed to conduct the geodynamic research at the territory of Shatsk natural national park [7]. To do this we should traverse network of the second order levelling (Fig.4) and connect it to national network of the first order of the Brest-Krasne line. Control can be done to the fundamental bench marks [8]. The fundamental bench mark 6035 is located in the village Vydranytsya Ratne district of Volyn region. It is located 6 kilometers away from district center and 30 kilometers from railway station Zabolottya. Another fundamental bench mark is located in the village Romanove at Brest –Kartolisy –Kovel crossroad. Each lakes should be provided with water level gauges, which consist of 3 bench marks: 2 primary bench marks and 1 working bench mark. Projected network of the second order levelling should consist of 5 polygons and be connected to water level gauges and deep wells.

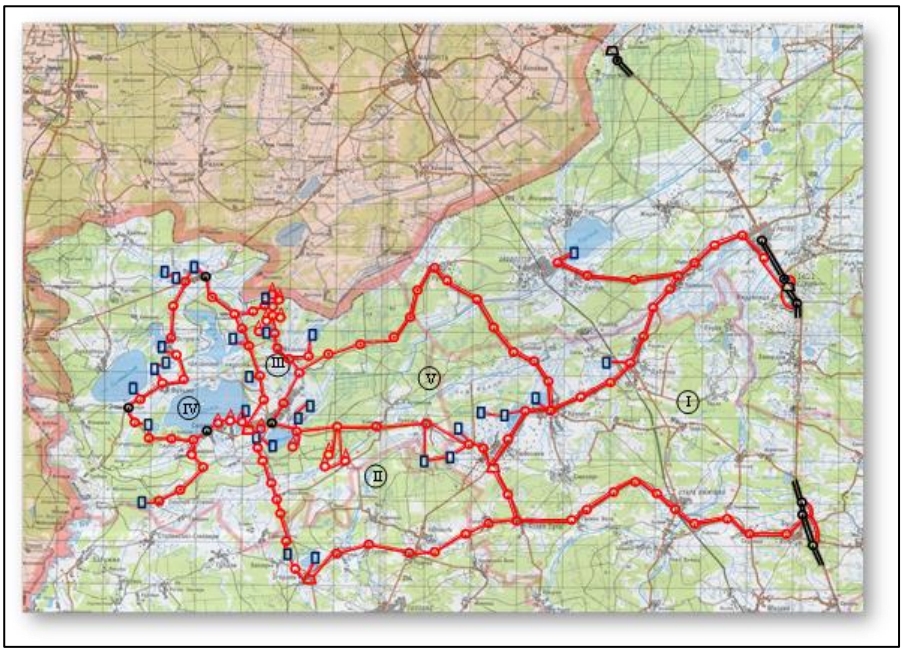

Fig. 4 Chart of the project of geodynamic test-field at the territory of Shatsk natural national park

The first polygon will be connected to the fundamental bench marks mentioned above. The second polygon will pass through villages Pripyat, Lyubohyny and around the lake Lyutsymyr. The third polygon will pass through village Melnyki and around the lake Pisochne. The fourth - around the lakes Svitiaz, Luki and villages Pulmo, Ostriv'ya and Zatyshshya. The last polygon will be transited through villages Guta and Krymne.

The first stage of this project will mean the forming of 3rd polygon, which is planned to be done in the summer of 2015 and 2016 years for this we need to set 15 wall marks, 1 ground mark and 7 water level gauges. Chart of third polygon is seen on (Fig.5).

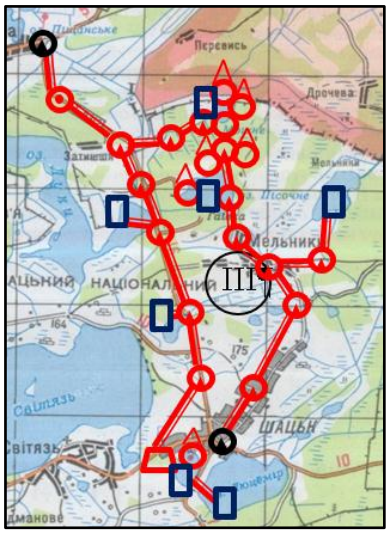

Fig. 5. Chart of the third polygon at the territory of Shatsk natural national park

- water level gauge; *- projected wall mark;*
- projected ground mark; *- existing wall mark;*
- well;

Depending on the relief, forest and swamps there can be used difference levelling methods. To determine the level of changes of water surface it is appropriate to use trigonometric levelling. At the forest the spirit levelling can be used and GPS- levelling can be used at the swaps with high visibility and large distances.

Summary

1. The Khotyslavsk sand and cretaceous deposit is a potential threat for Western Polissy in general and for Shatsk natural national park in particular.

2. The most actual tasks at the territory of Shatsk natural national park are: construction of the network of levelling signs with the absolute heights according to the unique state heights systems; creation of the geodynamic test-field intended for the observation of the Earth surface deformation and casters processes; determination of the absolute heights of the water surface levels of lakes and ground water bearing horizon by the dynamic of their changes with time.

3. Projected network of the second order levelling should consist of the 5 polygons and be connected to water level gauges and deep wells.

4. Depending on the relief, forest and swamps there can be used difference levelling methods: trigonometric, spirit and GPS- levelling

5. These researches help assess the threat and predict the intensity of ecological processes.

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Ecological problem of Shatsk natural national park and ways of its solution by means of geodetic methods

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The research intended for the threat assessment and prediction of the intensity of ecological processes will be conducted at the territory of Shatsk natural national park. It is needed to create the network of leveling signs with the absolute heights according to the unique state height system and to determine the absolute heights of the water surface level of lakes and underground waters by the dynamic of their changes with time.