Monitoring of wintering geese in the AES Geo Energy Wind Farm "Sveti Nikola" territory and the Kaliakra region in winter 2011/2012

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Contents

Introduction

This report updates outline ornithological work carried out as prescribed by the AES Geo Energy Environmental Management and Monitoring Plan (EMMP), and also the Environmental and Social Action Plan (ESAP) for the site. The work follows the Owner Ornithological Monitoring Plan.

The present document reports on the results and activities of the ornithological monitoring at Saint Nikola Wind Farm (SNWF) in the period 01.12.2011-15.03.2012. The winter bird survey was started in December and continued through January to February in order to minimize the potential impacts of SNWF on red-breasted geese *Branta ruficollis* (RBG) and other rare bird species.

The ornithological monitoring in the reported period was focused on the wintering bird fauna with special emphasis on the geese. Combination of the radar study of movements through the wind park territory, visual observations and carcass searches was applied in order to investigate numbers of the birds, feeding grounds as well as specific concentrations in the wind park territory.

Methods used in the monitoring

Methods were the same as in previous winter surveys. Detailed observations were made daily on the location, feeding behavior, counts and species composition of any flocks at the main feeding sites in the wind park. Crop types of the feeding site were also recorded.

Itinerant observations were made of feeding flocks outside the wind park to increase sample size of the species composition of flocks.

Searches under turbines for collision victims were undertaken according to the previously agreed protocol. The objective was for searches to take place at all turbines once per 4 days during the periods when geese were present in the region and at risk of collision with the turbine blades. Turbine searches were not made when no geese were present in the vicinity of the wind farm because collision risk for geese was the focus of the winter studies.

Itinerant checks were made periodically to check if birds were using areas nearest to the wind park territory and any use of Kavarna Bay as an overnight roost area.

Special counts were made once per week at the Shabla, Durankulak and Shabla Tuzla lakes in order to record total numbers of geese wintering in the region. The surveys were made during the morning at the start of the birds leaving the roosting sites and at their evening return to the lakes, in a standard interval of time.

The radar was set-up so that the beam is in an approximately east to west axis, in order to intercept the most frequent flight paths of geese flying through SNWF (Fig. 2). The radar was operating continuously during daylight hours (06-21 hrs GMT) and 15 minute period of every hour in the rest of the night in the reported period. All radar observations were at 30 mills (equivalent to approximately 25-275 m elevation at 5 km distance). The radar data were used for evaluation of nocturnal flight activity and

were not used for quantification of bird numbers in the present survey, so as to maintain consistency in methods across all years, including those when the radar was not operational.

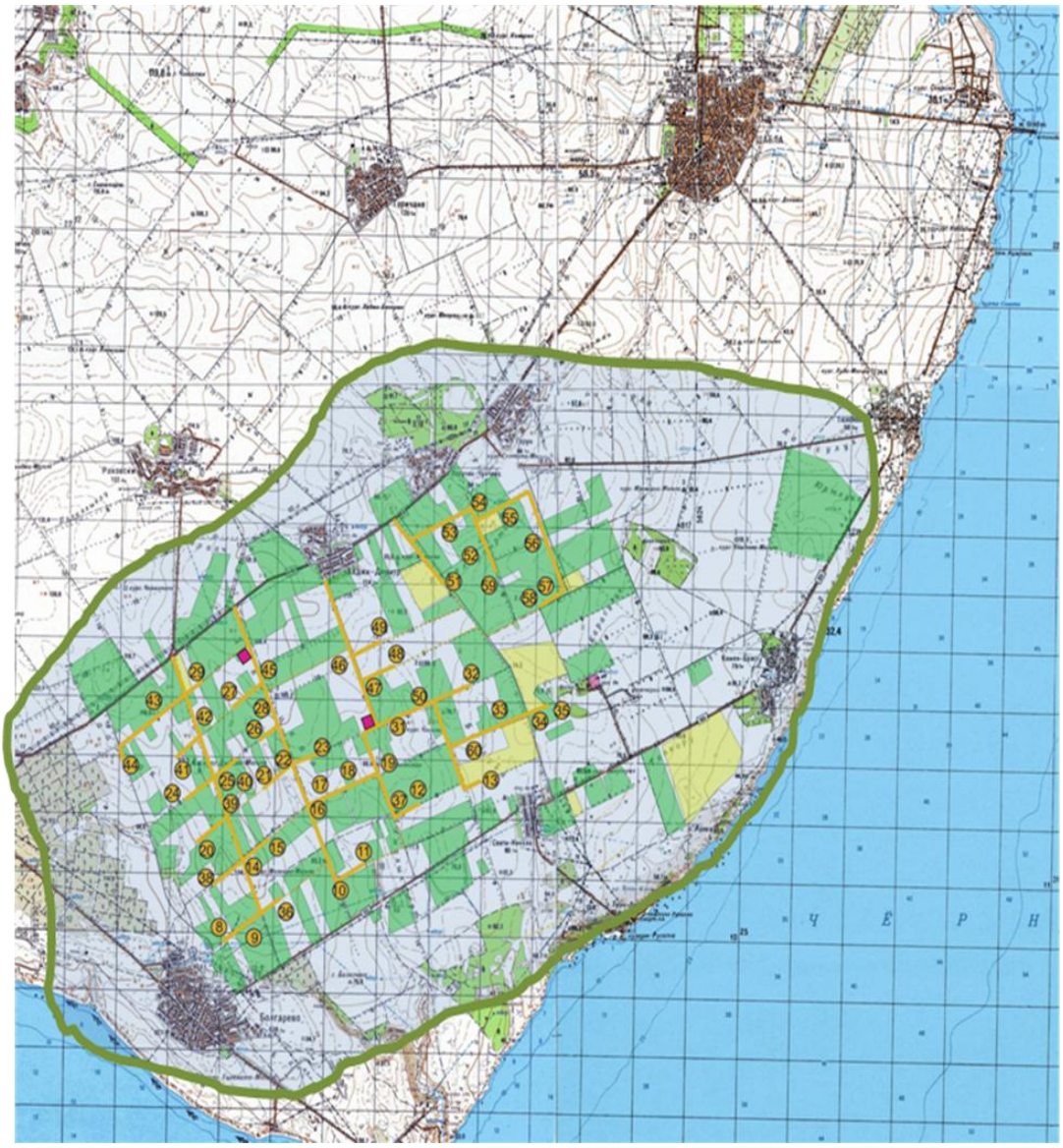

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Figure 1. Map of the fields potentially suitable for feeding of geese in winter 2011 – 2012 (green – wheat, white – sunflower and corn, yellow – rape), and core study area monitored in winter seasons 2009 - 2012 .

The feeding grounds within the wind park territory identified in the winter surveys were investigated daily and the number of feeding geese at these sites and weather conditions were the bases of decisions for the TSS (Turbine Shutdown System) for reduction of the collision risk.

For the period of winter monitoring a plan for coordinated stops of the wind park turbines was applied. Detail description of methods and the TSS for switching off those turbines presenting a risk of bird collisions is described in a number of previous reports and in the Owner Ornithological Monitoring Plan.

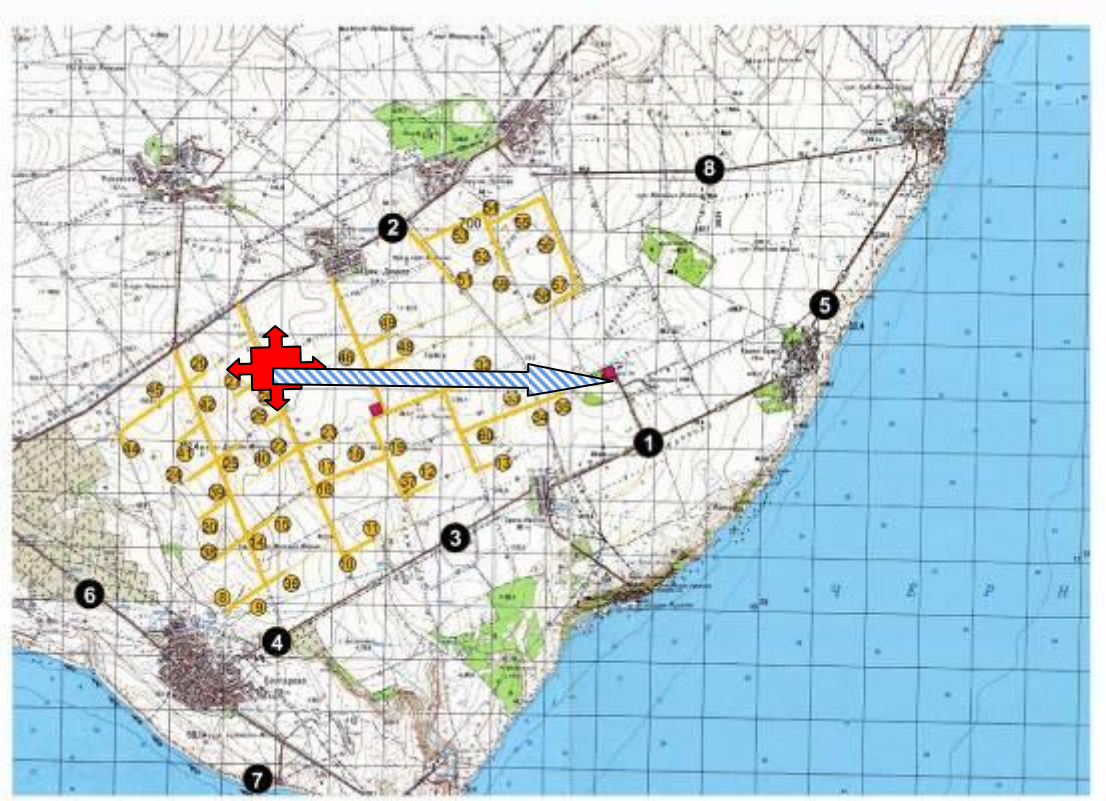

Figure 2. Location and coverage of the BirdScan Radar System during the winter monitoring 2011/2012

List of participants in the observations

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RESULTS

The 75 days of the study encompassed the whole period when geese were recorded in the SNWF territory during 2011/12. The observations were made all days of the reported period. The geese were observed in the wind park territory between 08 of January and 22 of February. Three rare species were registered in the region in winter 2011/12. One Barnacle Goose (*Branta leucopsis*) was observed several times in a mixed flock of geese around Gorun outside the wind park territory. On 26th of January a Little Bustard (*Tetrax tetrax*) was observed near the road GORUN – TULENOVO in semi steppe habitat. One Great bustard (*Otis tarda*) was found killed by hunters near Karapec in January. Typical for the season birds of prey were observed in the wind park in similar numbers as previous winter surveys. Single individuals were seen of: Buzzards (*Buteo buteo*), Kestrels (*Falco tinnunculus*), Sparrowhawks (*Accipiter nisus*) and Hen harrier (*Circus cyaneus*).

Total number of observed goose species and their numbers

Over 168,500 individual goose observations were recorded during the surveys (Table 1). In total, two species of goose were observed: Red Breasted Goose *Branta ruficollis* (RBG) and Greater White-fronted Goose *Anser albifrons* (GWFG). Additionally swans (*Cygnus olor*) were observed (Table 1), but in such small numbers that their presence was not considered further. No Lesser White-fronted Geese were seen.

Table 1. The number of observed birds of different species in the SNWF territory (data from visual observations Figures 1 and 2).

Species	January	February	Total
A. albifrons	33241	15183	48424
Anser anser		2	2
Anser/Branta	24705	75063	99768
B. ruficollis	4898	15723	20621
Cygnus olor		19	19
Grand Total	62844	105990	168834

The recorded numbers of all registered geese species were markedly lower than in 2008/09 and 2009/10 winter seasons and similar to those in 2010/11.

Spatial distribution of feeding geese in the wind farm territory

The numbers of geese species observed in the wind farm territory and its vicinity in January and February are presented in Table 1 (these exclude counts at Shabla, Durankulak and Shabla Tuzla lakes, and itinerant observations away from the core study area). The first GWFG were recorded by observers in the territory in the beginning of January followed by an influx of RBG in the middle of the month. No geese were registered visually in the wind farm territory within periods 19 – 21 January and 05 - 06 February. Day by day appearance and movements of the geese within the wind park territory are given in detail in the APPENDIX at the end of this report. The feeding and roosting sites in the wind park and surrounding territories are presented in Figure 3.

Figure 3. Distribution of roosting sites (black line) of mixed flocks of GWFG and RBG in the wind farm and surrounding territory as observed in winter 2011 – 2012. Dashed lines indicate temporary roosting sites.

The observed flight directions in the mornings, when geese will have been coming from the roosting sites indicates a change in the behaviour of the geese, insofar as data collected during the 2008/09, 2009/10 and 2010/11 winters and the known 'typical' freshwater roost sites to the north of the Project area. Moreover, a significant proportion of such flights were also along a similar E-W axis in the periods when geese were abundant in winter of 2011/12. The direction of these flights indicated a radical change in the behaviour of geese to roost in the sea along the coast (compared to records gathered in previous winters) (Fig. 3). Only around 10% of registered flights indicated movements along the coast in south or north directions that would be consistent with birds coming from the 'traditional' freshwater lake roost sites.

The records collected in the last three winter seasons strongly suggested that the majority of the geese were roosting on the sea, and without any of the spatial concentrations in incoming flights that would be expected if their origin was based at the locations of freshwater lakes to the north of the wind farm. Such adaptive behaviour probably reflects increasing long term hunting pressure and disturbance for

the last decade in the previously known main roosting sites – lakes Durankulak, Tuzla and Shabla.

The data collected in the wind farm area for the last three winter seasons suggested that the geese which appeared in the vicinity of the wind farm had been roosting on the sea, and not on the freshwater lakes to the north. The most likely explanation for this shift in behaviour is increased hunting pressure (and associated disturbance) at the lakes, because geese intrinsically prefer freshwater sites to roost (e.g. to allow access to drinking water).

This use of the Black Sea as a roost site, indicated by observations in the vicinity of the wind farm, is also confirmed independently by the records of an adult male individual satellite-tagged in 2011/12 winter (http://www.redbreastedgoose.org/ Fig. 4) as well as from birds in the 2010/11 winter (see link: http://bspb-redbreasts.org/?p=562) (Fig. 5 – 6).

It is apparent from the distribution of geese within and in the vicinity of the wind farm that the preferred "feeding" locations (see APPENDIX in the present report and winter survey reports of 2009/10 and 20010/11 at the website of AES Geoenergy http://www.aesgeoenergy.com/site/Studies.html) are not governed by the presence of turbines (see reports from previous winters, and Fig. 3). The most likely factor attracting geese to the vicinity of the wind farm was the presence of freshwater at ground level in the fields and presence of feeding sources around it. The present season survey confirmed once more that the need for freshwater, in the absence of hunting disturbance, could become increasingly important if geese are forced away from more traditional sources of safe freshwater lake roost sites by hunting disturbance.

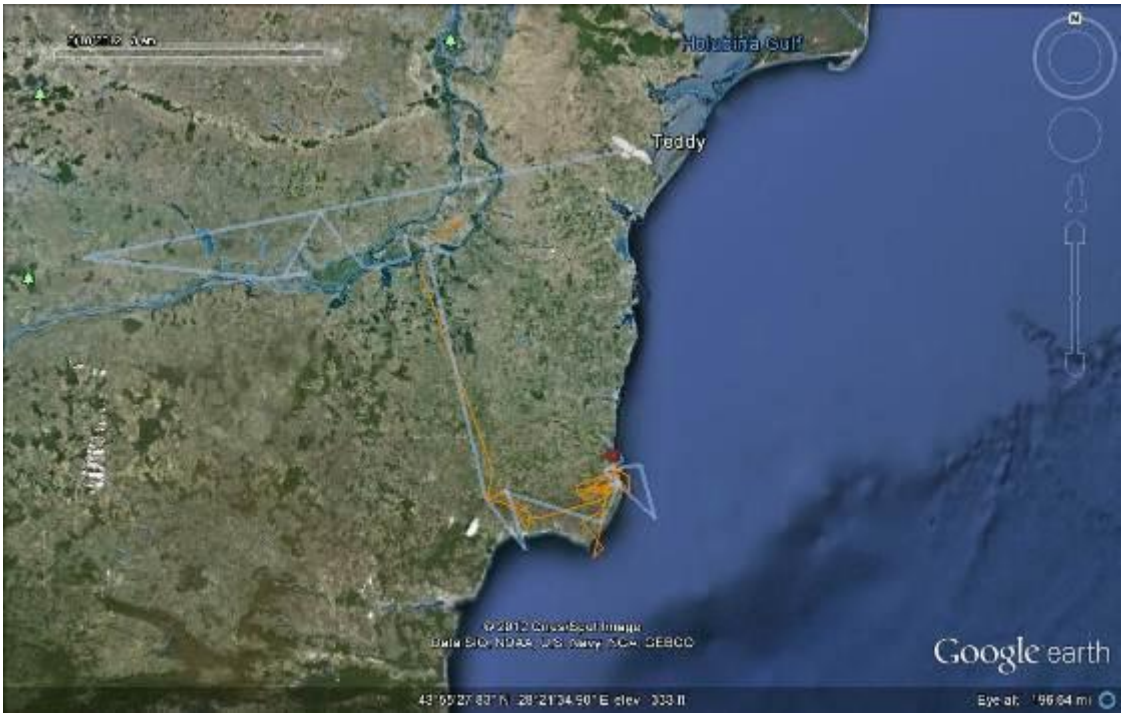

Figure 4. Winter range of a satellite tagged RBG in the region of St Nikola Wind park in winter 2011/12 (see link: http://www.redbreastedgoose.org/)

Figure 5. Winter range records in 2010/2011 of a satellite-tagged RBG near the Romania-Bulgaria border (see link: http://bspb-redbreasts.org/?p=562).

Figure 6. Winter range records in 2010/2011 of a satellite-tagged RBG near the Kaliakra Cape (see link: http://bspb-redbreasts.org/?p=562).

Altitudinal distribution of flying geese

152,311 observations of geese were available for the analysis of the visually observed flight altitudes. The majority of birds were observed flying at altitudes between 100 and 150 metres above ground level (Table 2). The species differences in the flight altitudes are not statistically significant. This distribution includes birds observed during all hours of the day. Therefore, the altitudes of the bird flights represented all kinds of functional flights and the whole spectrum of spatial trends seen during the winter season 2011/12.

Table 2. Comparative distribution of the flight altitudes of all geese species observed in the wind farm territory from the vantage points (N = 152,311 birds).

Altitude of the bird	A. albifrons	Anser/Branta	B. ruficollis	Grand Total
0-49	8%	7%	12%	8%
50-99	12%	37%	31%	30%
100-149	11%	21%	16%	18%
150-199	20%	13%	15%	15%
200-249	26%	16%	17%	19%
250-299	18%	2%	9%	8%
300-349	5%	3%	0%	3%

Similar results for flight altitudes were registered in winter 2008/2009, 2009/2010, 2010/11 and 2011/12.

Species composition of goose flocks

The species composition of mixed flocks varied during wintering period of the observed goose species. In the beginning of January flocks were composed mainly of GWFG and about only 10% RBG. This ratio remained relatively constant until the end of January. The proportion of RBG in the mixed flocks increased in February and varied between 20 and 40%. The proportion of the RBG in the period when it was greatest during winter 2011/12 is presented in Figure 7a, b, c.

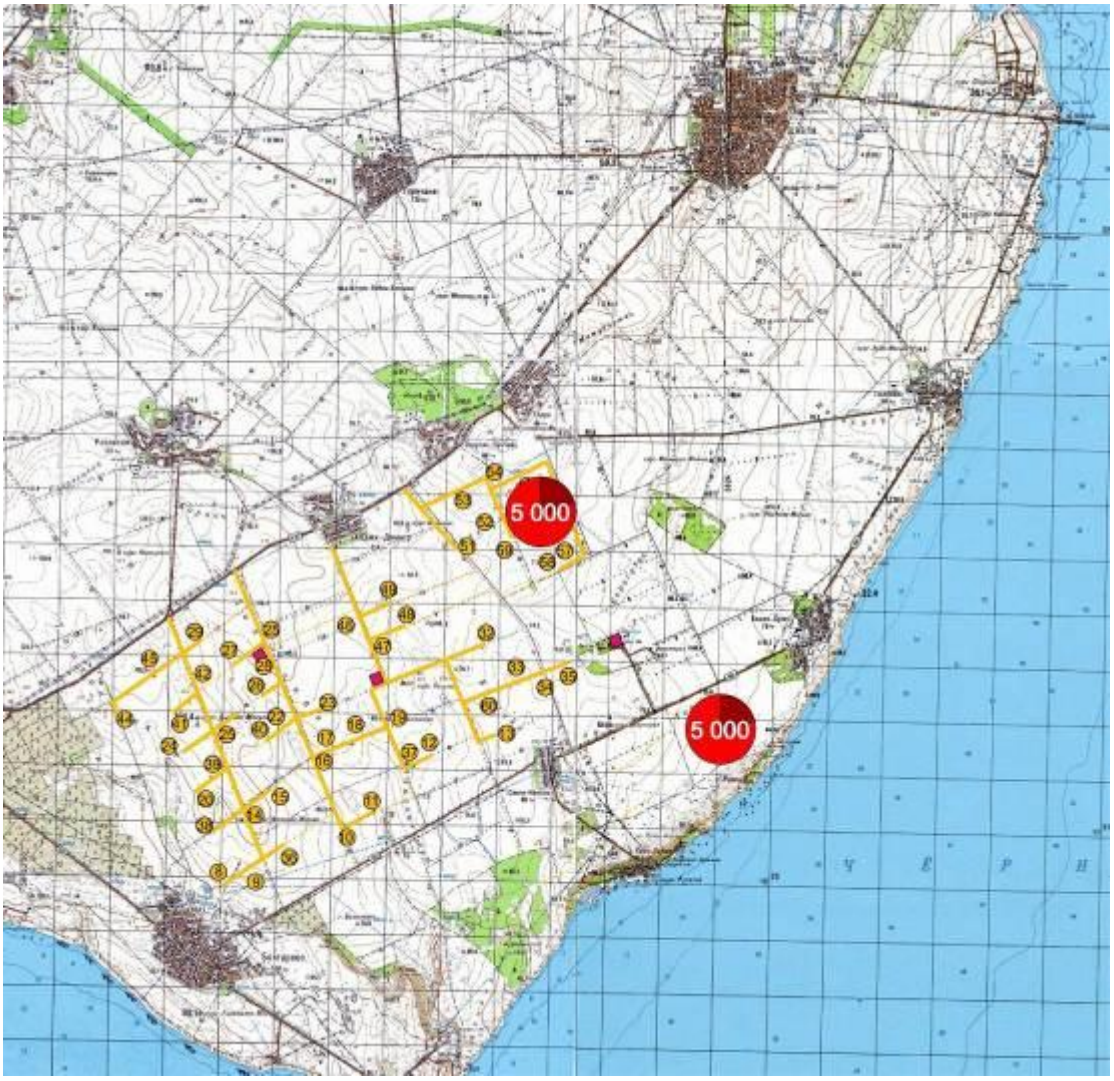

Figure 7a. Proportion of the RBG (dark red) and GWFG in the feeding flocks 21.02.2012.

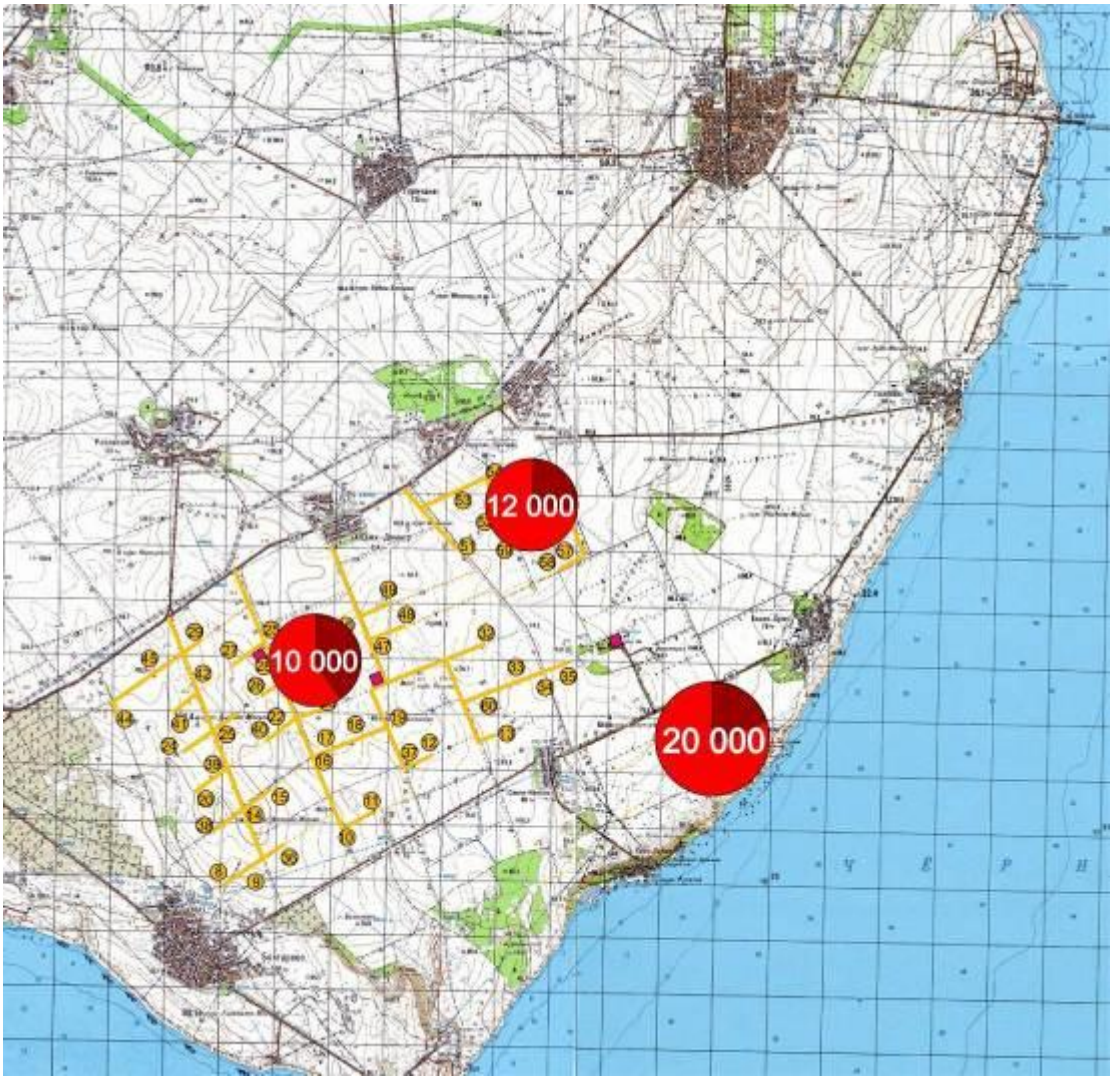

Figure 7b. Proportion of the RBG (dark red) and GWFG in the feeding flocks 20.02.2012.

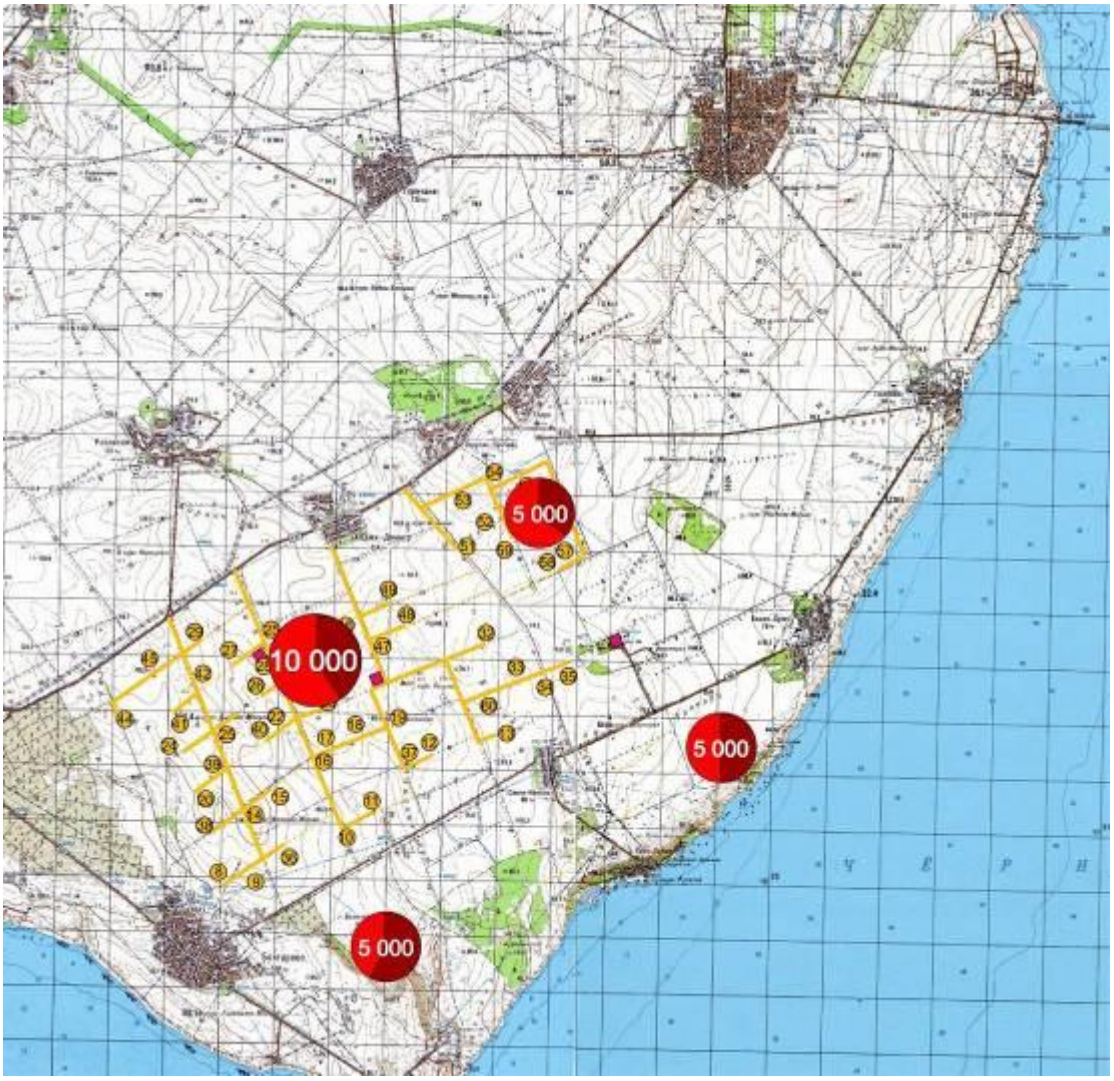

Figure 7c. Proportion of the RBG (dark red) and GWFG in the feeding flocks 19.02.2012.

Comparison of the results after three winter seasons of monitoring in SNWF territory after construction of the wind farm with the distribution of geese in the period 1995 – 2000 (Report of BSPB: Dereliev, S. 2000. Results from the monitoring of wintering geese in the region of lakes Durankulak and Shabla for the period 1995-2000. BSBCP & BSPB/BirdLife Bulgaria), when no wind farms were constructed in the region, does not indicate any displacement of geese as a result of the operation of SNWF (Figures 8a – f). It is apparent from Dereliev (2000) that during 1995 – 2000 SNWF and its immediate vicinity was not classed as an important area for RBG (Figure 8f), as it was not a regular haunt of wintering geese (Figures 8a-e). Even so, the frequency of registrations and numbers observed by Dereliev (2000) in the winters 1995 – 2000 in the SNWF area, as well as proportions of RBG and GWFG, when compared with results obtained immediately before and after the operation of SNWF, does not indicate an adverse effect of the wind farm on the winter distributions of these species. For example, large numbers of RBG and GWFG were observed within SNWF 19 – 21 February 2012 (Figure 7): day by day distributions of feeding geese in SNWF territory for the winter 2011 – 2012 is given in the APPENDIX.

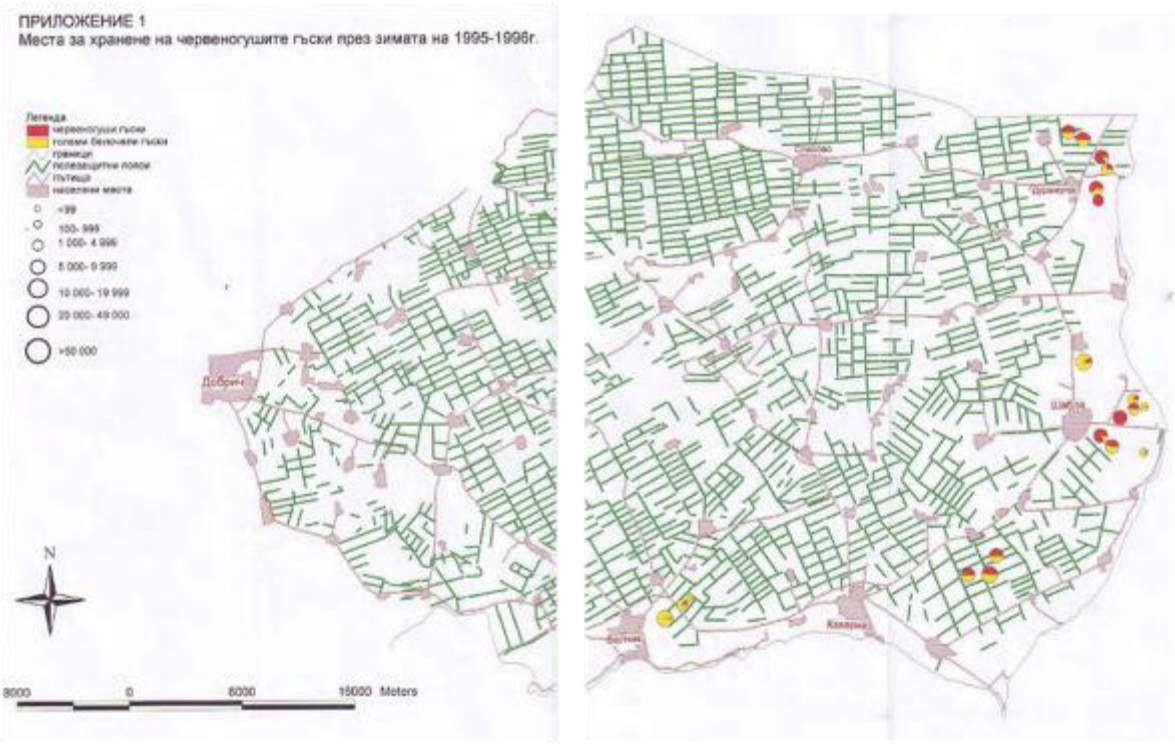

Figure 8a. Localities of feeding geese in winter season 1995– 1996 according to Report of BSPB (Dereliev, 2000).

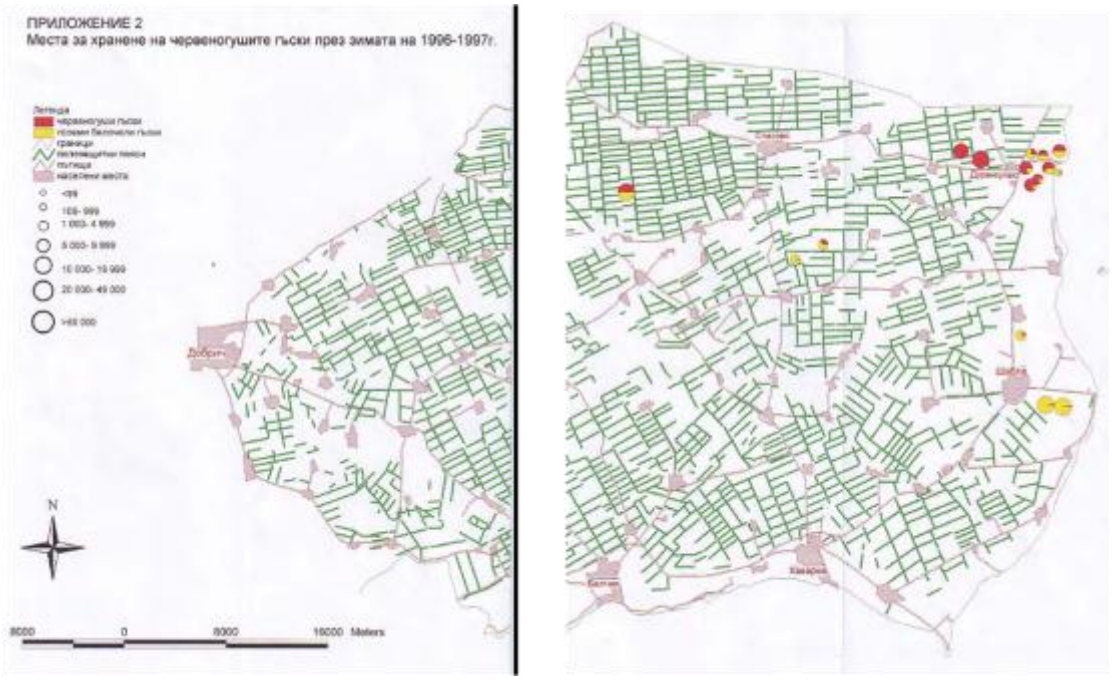

Figure 8b. Localities of feeding geese in winter season 1996– 1997 according to Report of BSPB (Dereliev, 2000).

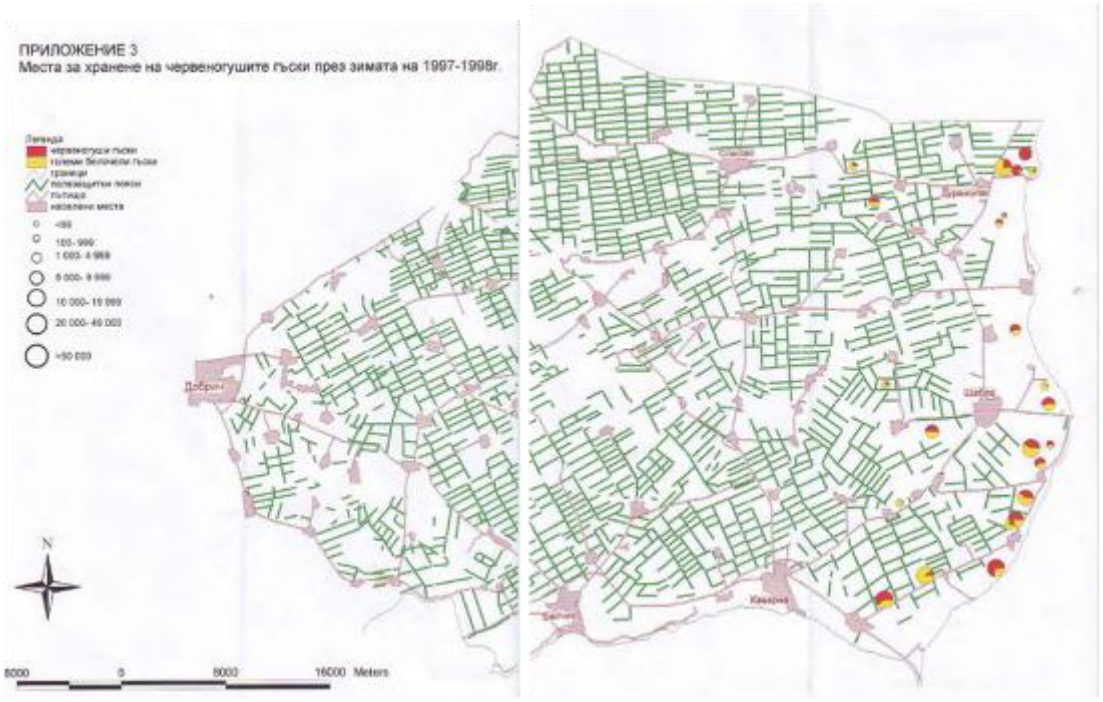

Figure 8c. Localities of feeding geese in winter season 1997– 1998 according to Report of BSPB (Dereliev, 2000).

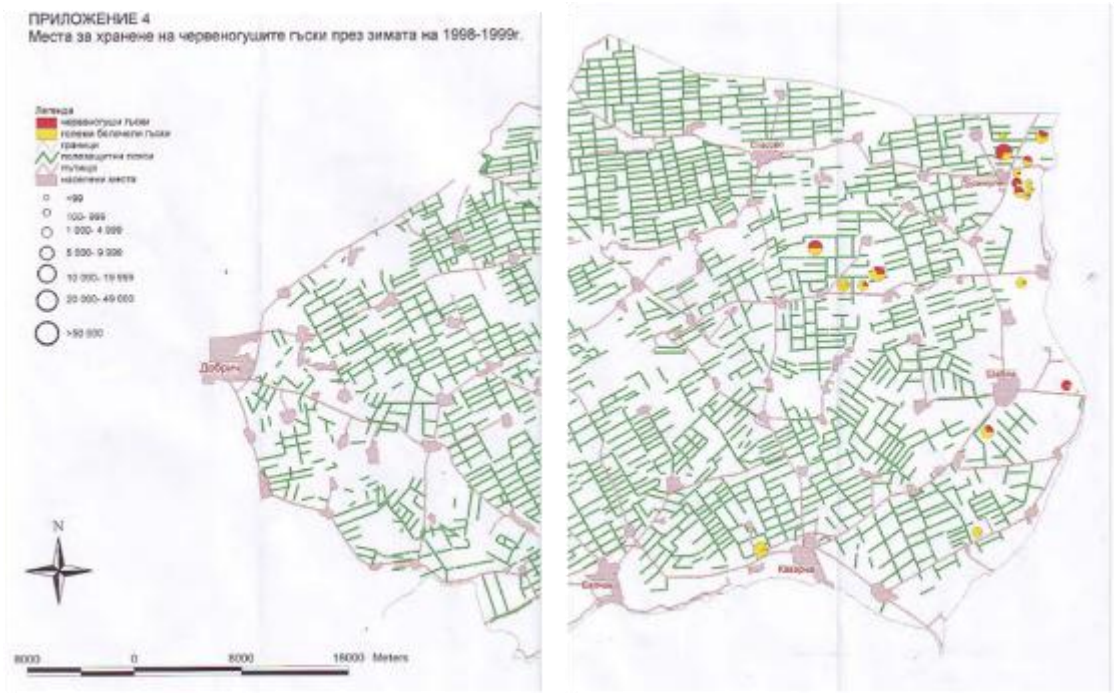

Figure 8d. Localities of feeding geese in winter season 1998– 1999 according to Report of BSPB (Dereliev, 2000).

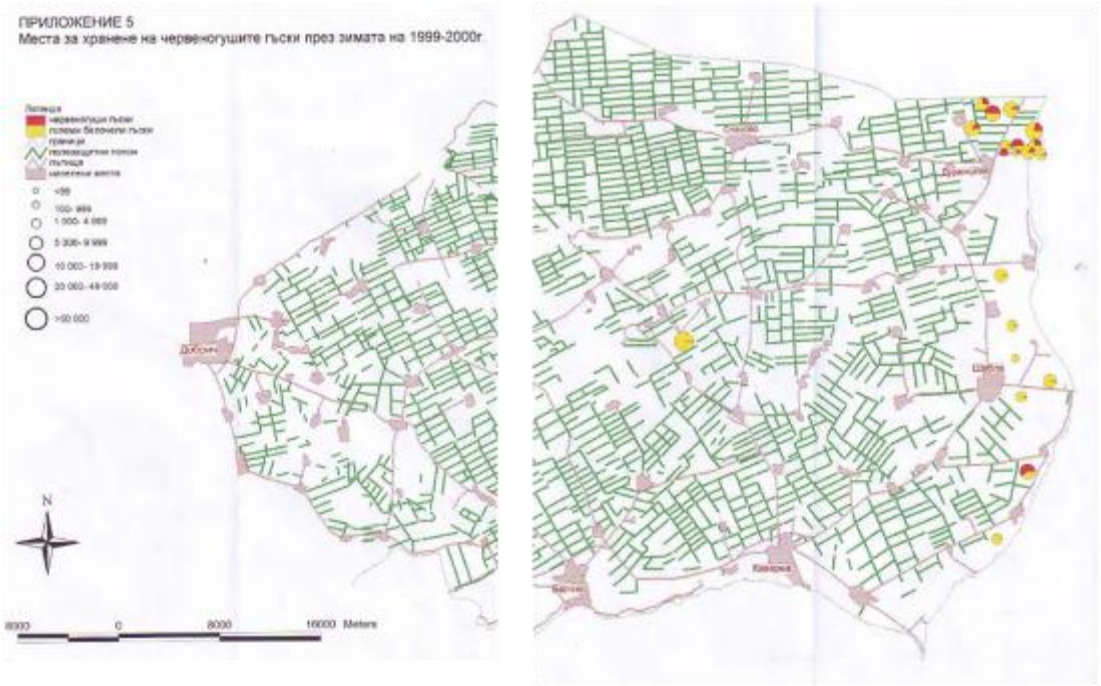

Figure 8e. Localities of feeding geese in winter season 1999– 2000 according to Report of BSPB (Dereliev, 2000).

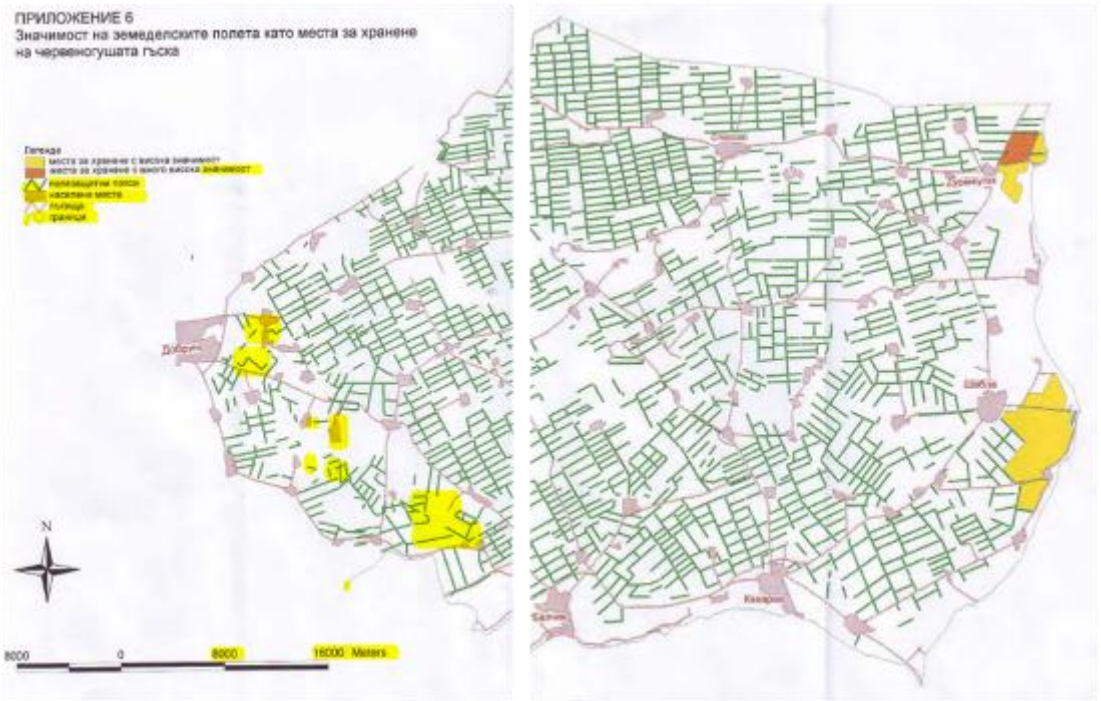

Figure 8f. Significance of the feeding grounds for Red Breasted Geese 1995 – 2000 according to Report of BSPB (Dereliev, 2000).

Diurnal variation in flight activity

According to observers, the peak of flight activity occurred early in the day, as in winter 2008/9, 2009/10 and 2010/11 (Figure 9). The geese arrived from their nocturnal roost sites in the first two hours after sunrise. The smaller 'departure' peak infers that geese took different flight routes when returning to roost and so were not detected by observers concentrating on the wind farm area (see Appendix). The radar data support the visual observations of flight activity. Low activity, limited to the first two hours after sunset was registered by radar at the wind park territory when single birds and small flocks were detected.

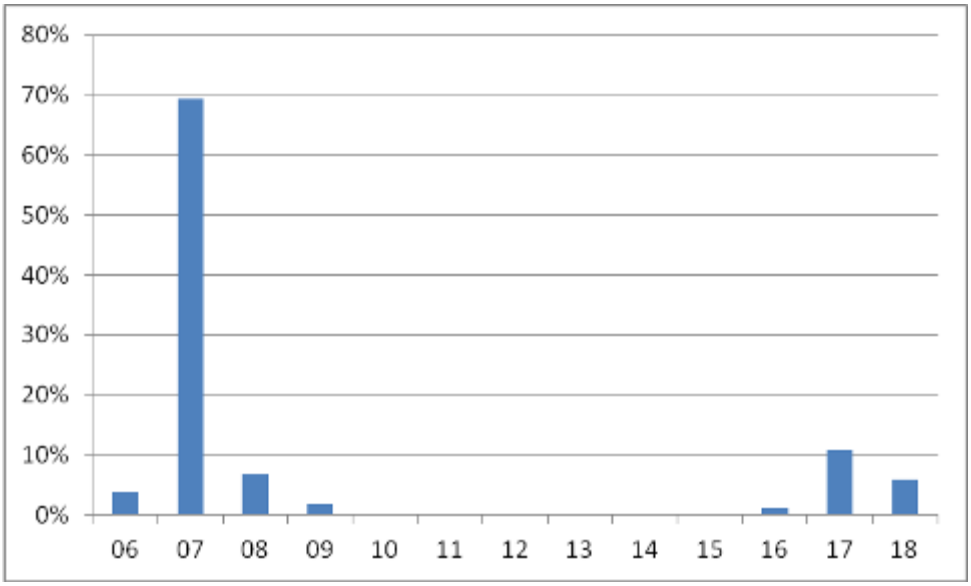

Figure 9. Circadian dynamics of flying geese through the core study area as registered by visual observations in the winter season of 2011/12 (x axis gives time of day (by hour), y axis gives proportion of observations).

Carcass monitoring results

All 52 turbines were searched for carcasses during the whole winter survey period. The main limitation in the reported period was the limited access because of weather conditions. The number of searches per turbine is given in following table:

Table 3. The numbers of turbines searched for collision victims in winter season 2011/2012.

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Turbine	Number of searches
8	7
9	7
10	10
11	10
12	9
13	8
14	7
15	7
16	10
17	10
18	9
19	10
20	10
21	4
22	5
23	4
24	6
25	7
26	6
27	4
29	9
31	7
32	8
33	7
34	8
35	7
36	7
37	9
38	7

Turbine	Number of searches
39	6
40	5
41	7
42	9
43	9
44	8
45	6
46	10
47	9
48	9
49	10
50	9
51	9
52	9
53	9
54	9
55	9
56	9
57	9
58	9
59	9
60	8
28	1
Total	406

There was one intact carcass found in the reported winter season: a starling (*Sturnus vulgaris*) was found dead under turbine 28 on 08 February 2012 at 18 m distance in NE direction from the turbine base. Three more remains of birds were recorded in the winter period. A bunch of feathers of domestic chicken was found at turbine 49. Feathers of unidentified bird species were also found at turbines 47 and 19; these could not be identified to species but were clearly not from geese. Therefore, no evidence for collision of geese species, including RBG, was found in the winter survey period when geese were present.

In order to reduce the risk of collision with the rotors of the wind turbines during the period of most intensive flights through the wind park territory and especially in conditions of reduced visibility different groups of turbines as well single turbines were stopped during the reported period.

Figure 10. Example of reduced visibility when the turbines were stopped for the period of flight activity in the wind park territory.

Figure 11. Typical mixed flocks of geese in the wind park territory as usually observed during the survey.

Figure 12. No evidence for a displacement effect of the turbines through disturbance has been observed after four seasons of winter surveys in SNWF.

CONCLUSIONS

The methods applied to this study were similar to those in the winter seasons of 2008/2009, 2009/2010 and 2010/2011. The comparative approach provided important information concerning the species composition of geese and their spatial and temporal distribution within the Project area in four consecutive winter seasons.

The wintering period of the geese starts in the middle of December and ceases by the end of February, as observed in all four winter seasons. GWFG was the most common species recorded, and the percentage of occurrence of RBG varied between 0 % and 40 % within each winter, on average about 10 % across all winters. Greylag Goose was recorded sporadically and in small numbers and was not therefore considered at risk from the project. There was also a single Barnacle Goose observed in 2011/2012. The duration of the winter stay in the study area was similar for both RBG and GWFG. However, there was a definite 'peak' period of activity with a concentration of over 90% of RBG being seen within 20 days; this concentration corresponds to the coldest period of the winter in all four surveyed seasons.

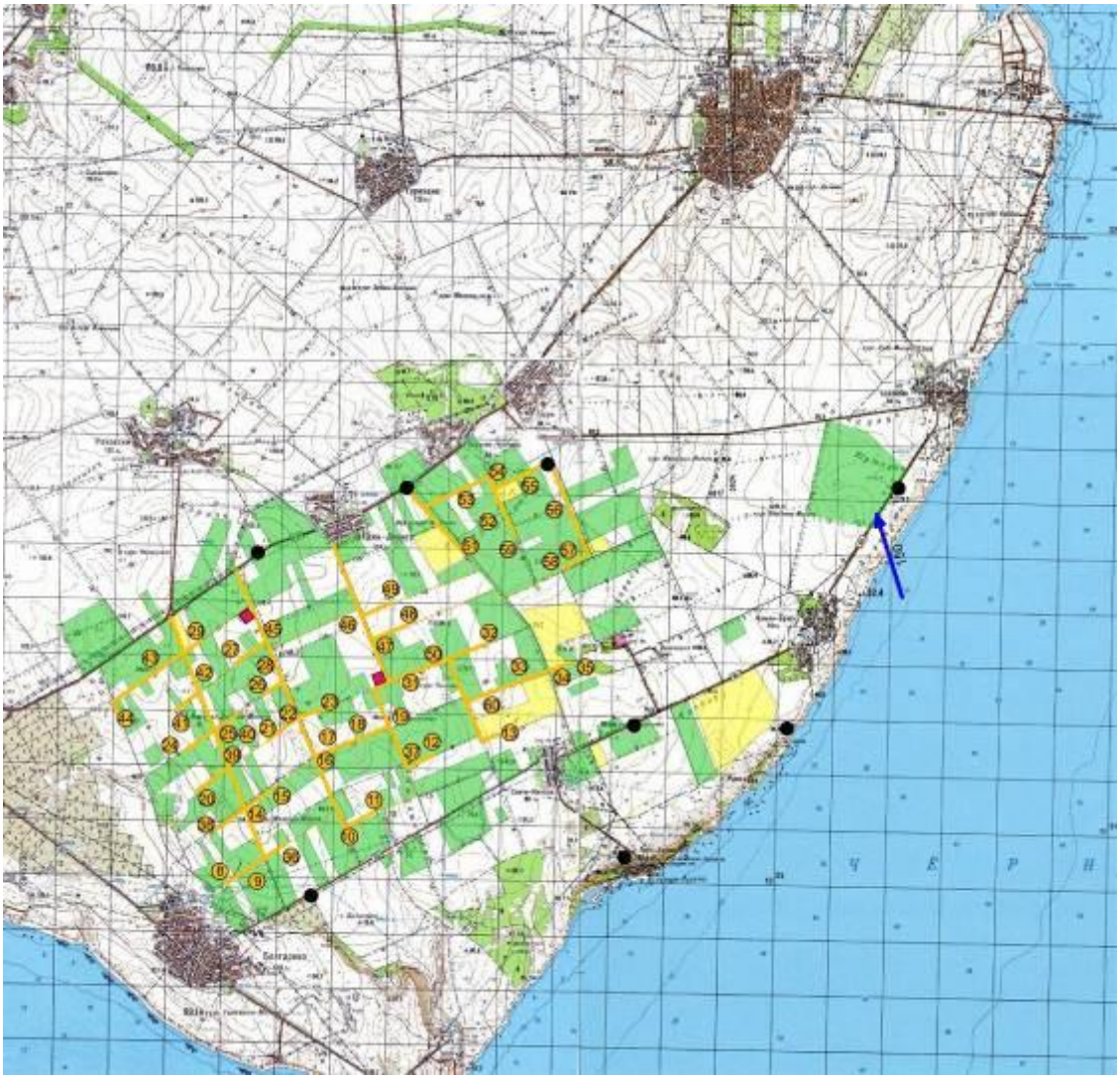
The flight altitudes of the geese from all species observed crossing the Project area were most intensive between 50 and 100 m above ground level in all four winter seasons. Diurnal activity of the geese generally indicates two periods of intensive flights: morning (7-9 h) and, to a lesser extent, evening (16-18 h). No systematic nocturnal flight activity is registered during the winter surveys.

The intra-seasonal patterns in number of goose flights varied across the winters of our study. This partially depended on the time period when the geese were present in the region. The main concentrations of geese in the vicinity of the Project over the three winters have not changed as a result of the construction and operation of the wind farm. There is no evidence for a scaring effect and displacement of the feeding geese from the wind park territory.

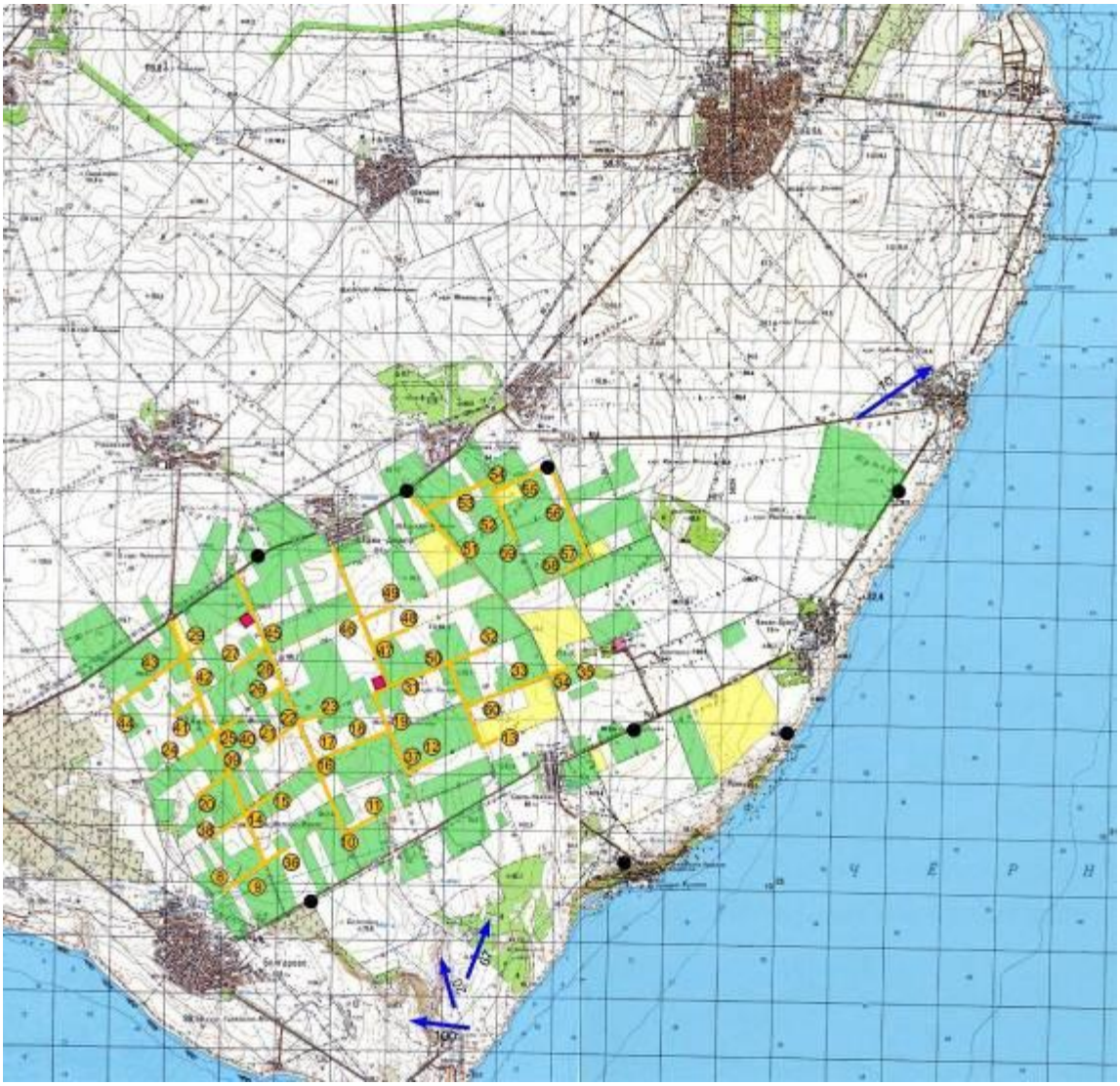
Majority of geese of all species shifted overnight roost sites from the two fresh water lakes Durankulak and Shabla to the sea surface in a large area along the Black Sea coast in the last 10 years. While this did not apparently increase the risk of geese dying through collision with turbine blades in the wind farm, it was of concern in indicating an increasing hunting pressure around the two main fresh water roosting sites of the wintering geese in the region. This will probably have an adverse effect on these wintering geese populations far greater than any effect of SNWF.

No intact carcasses or remains of any goose species was found in winter period of three winter surveys after wind park construction, during several hundred searches per season under operational turbines. The implication of predictive collision risk modelling in relation to the results of searches for collision victims is that geese have a near-perfect ability to avoid collision with wind turbines. There is no evidence of any adverse effect of the wind farm on populations of the geese species using wind farm territory in the winter season.

APPENDIX: Day by day movements of the geese observed in January and February. Blue colour represents morning flights. Red colour represents evening flights.



08.01.2012



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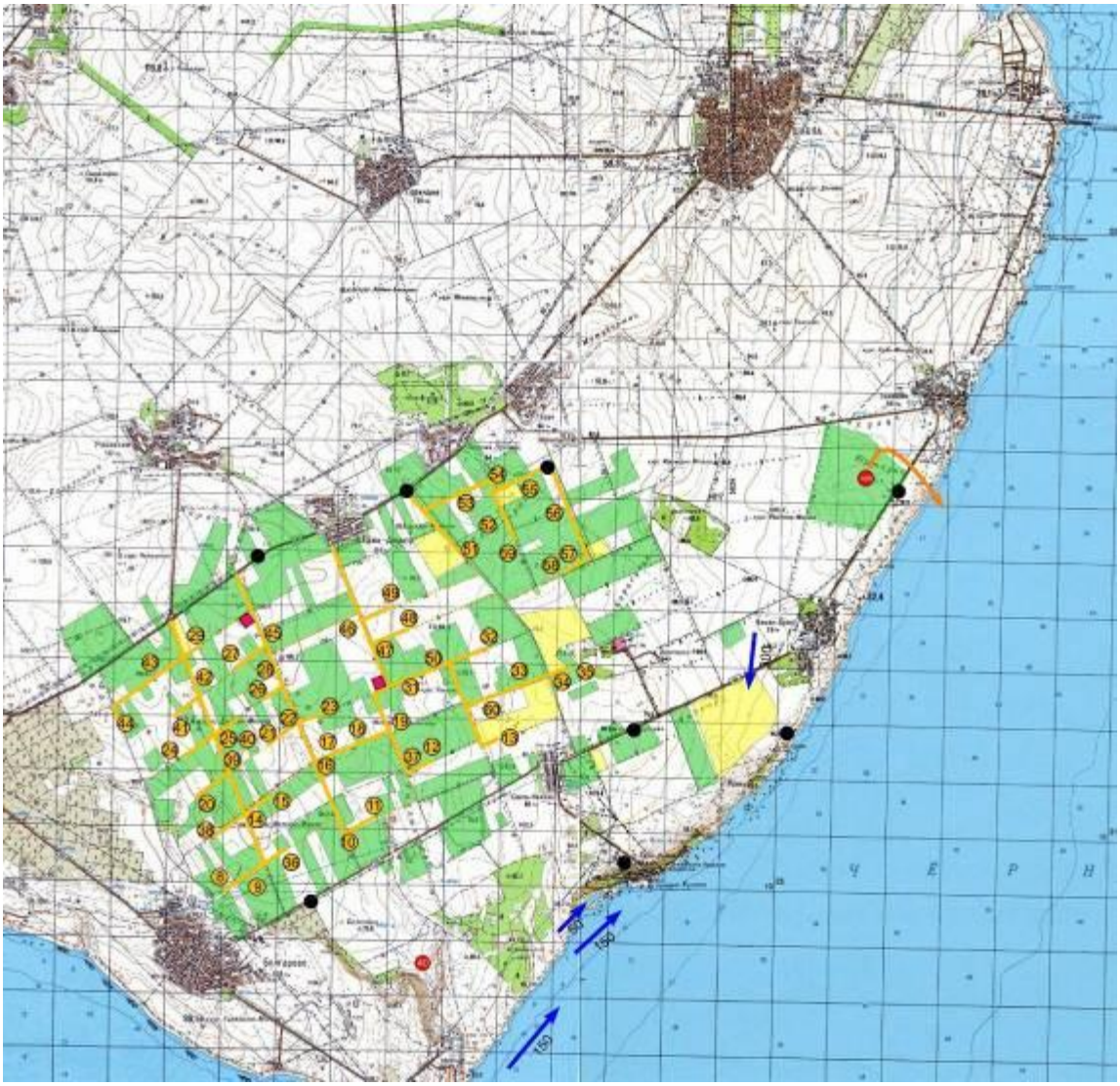

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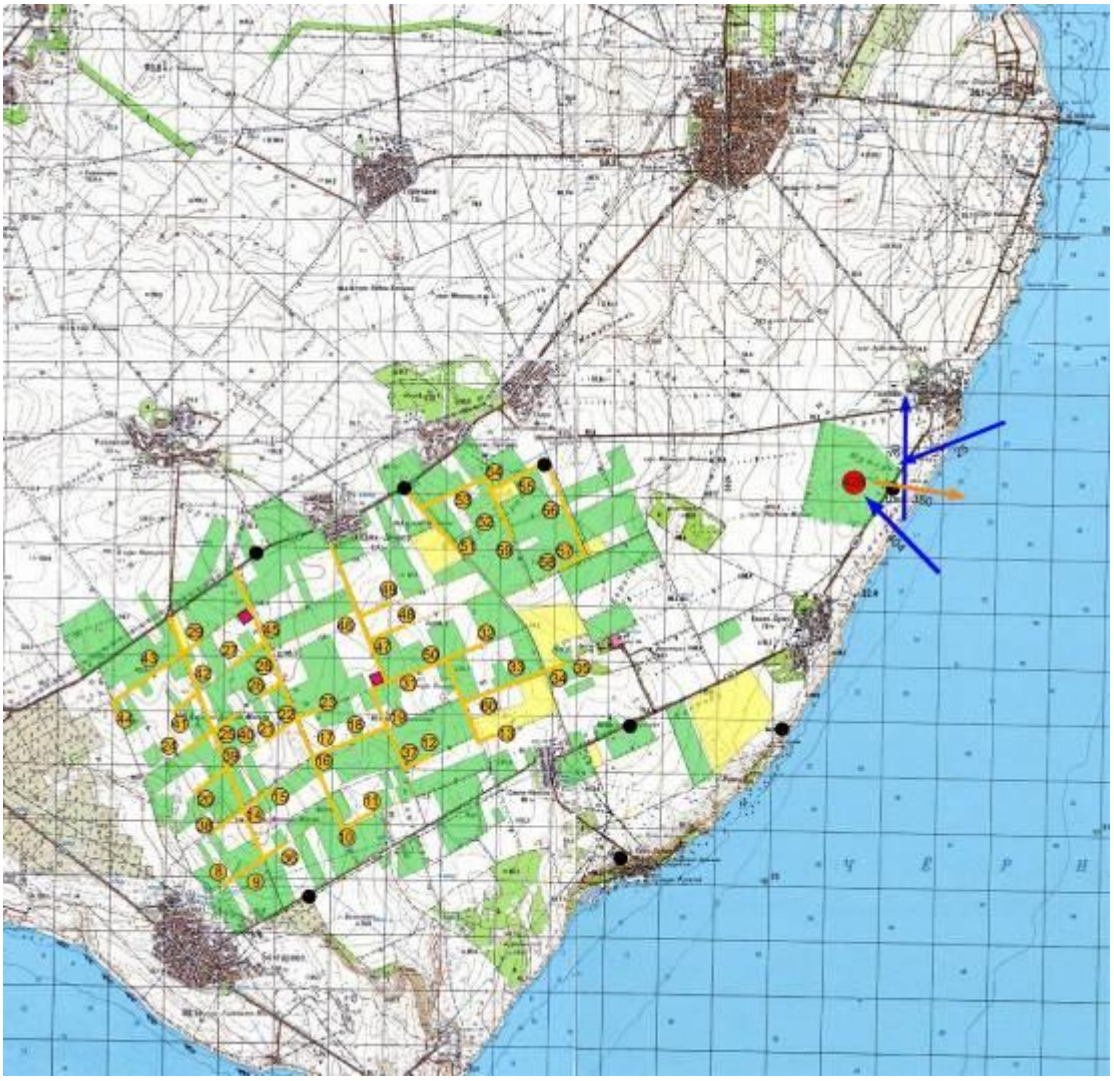

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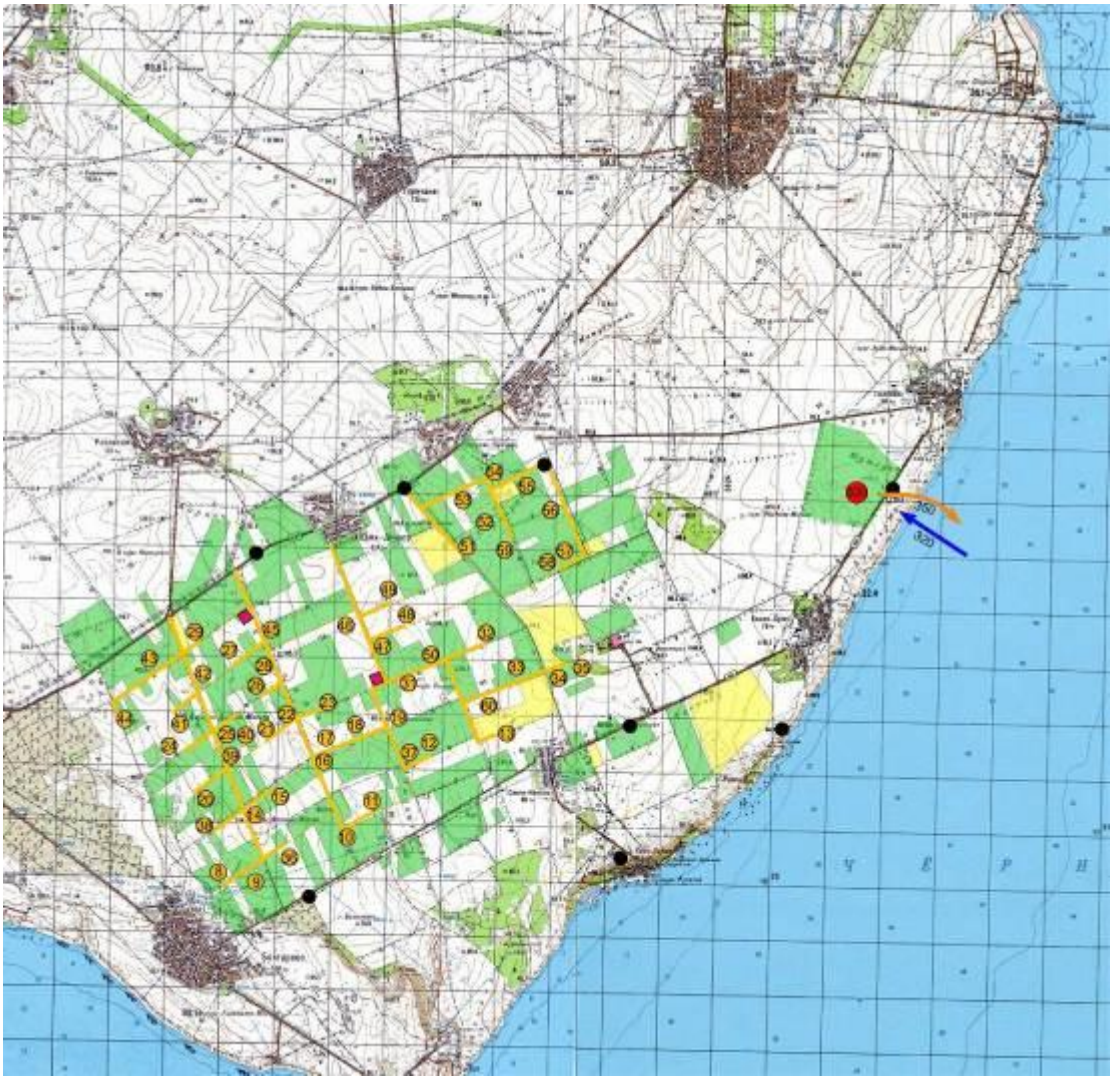
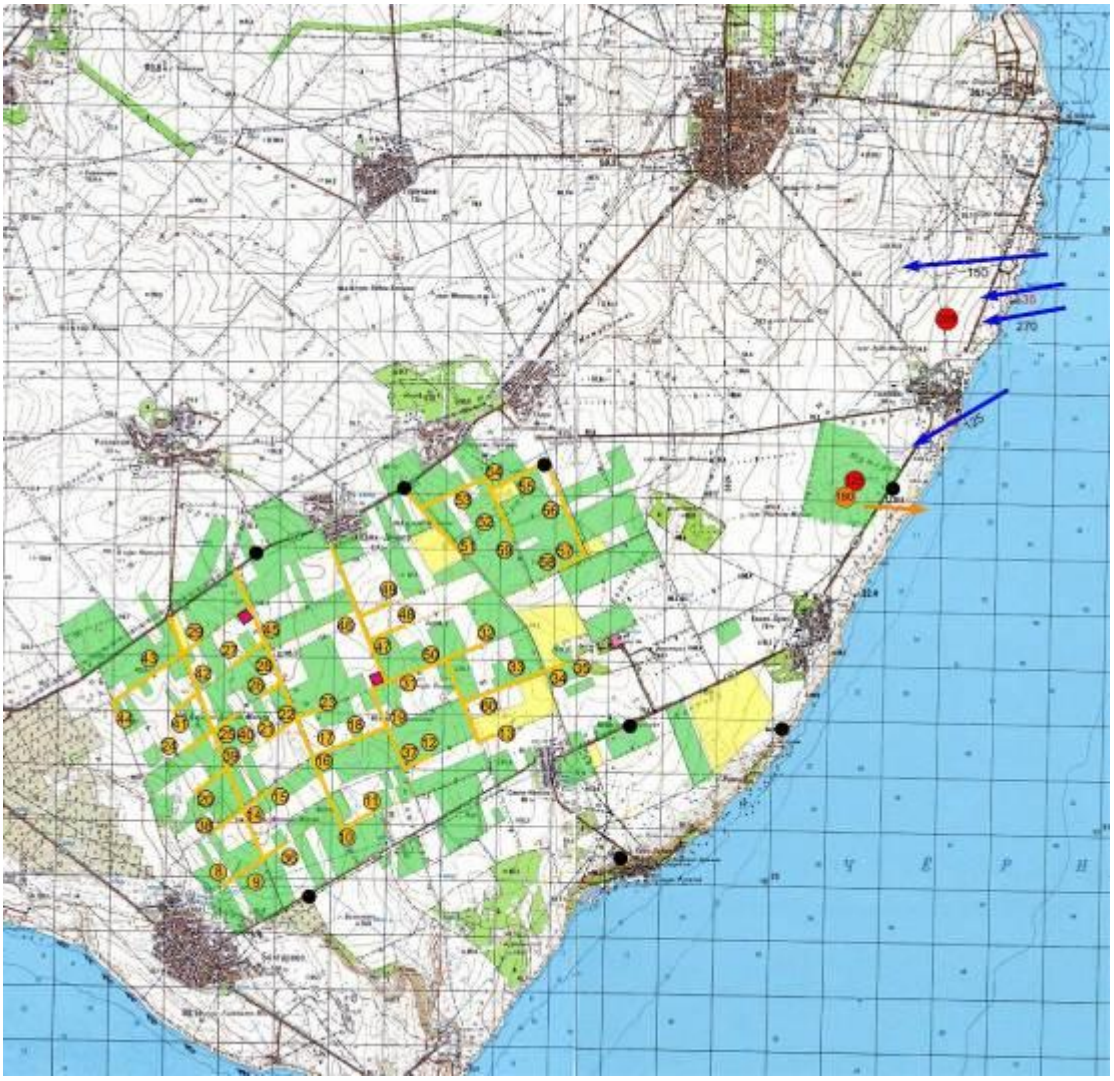


13.01.2012



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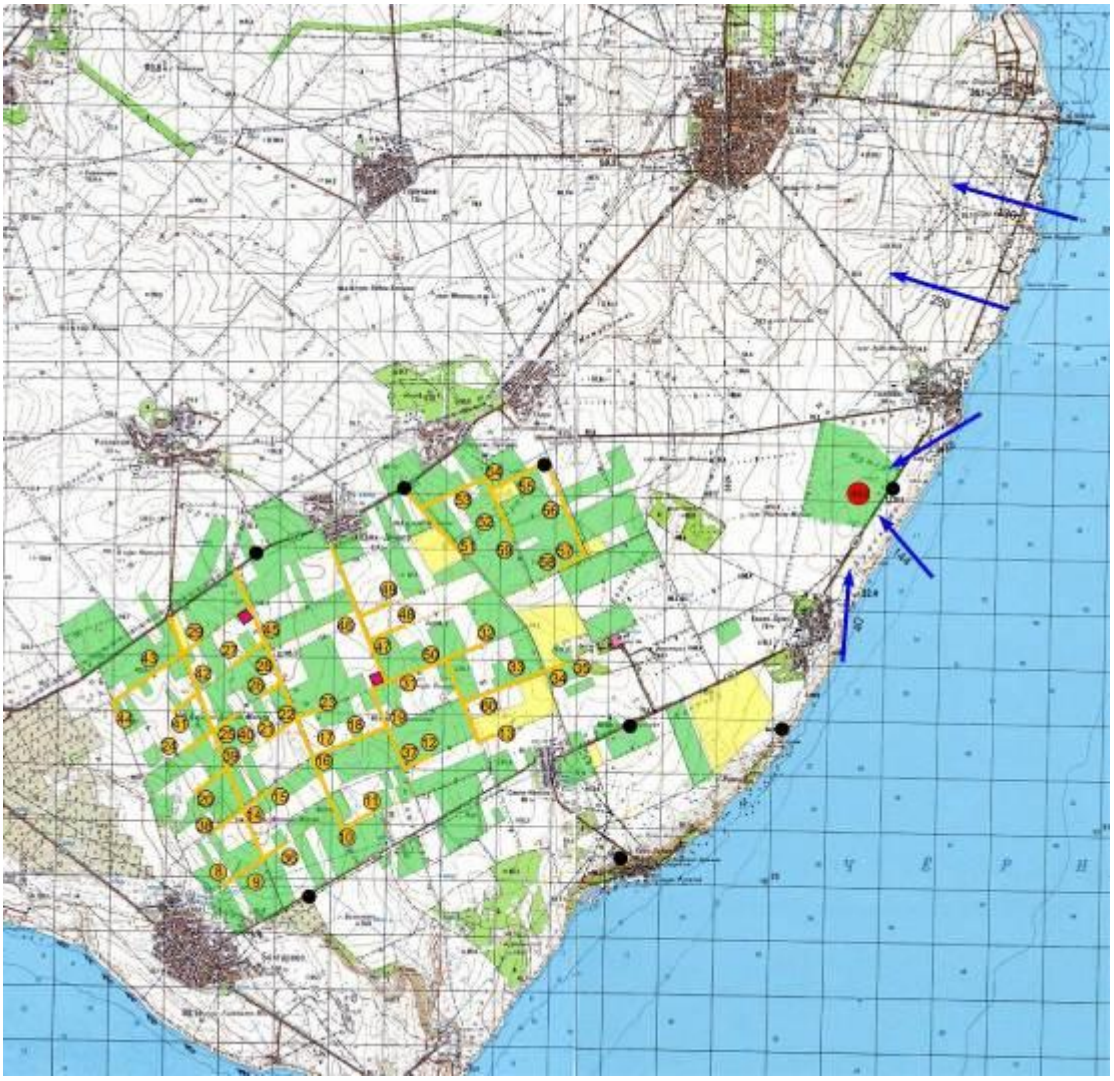

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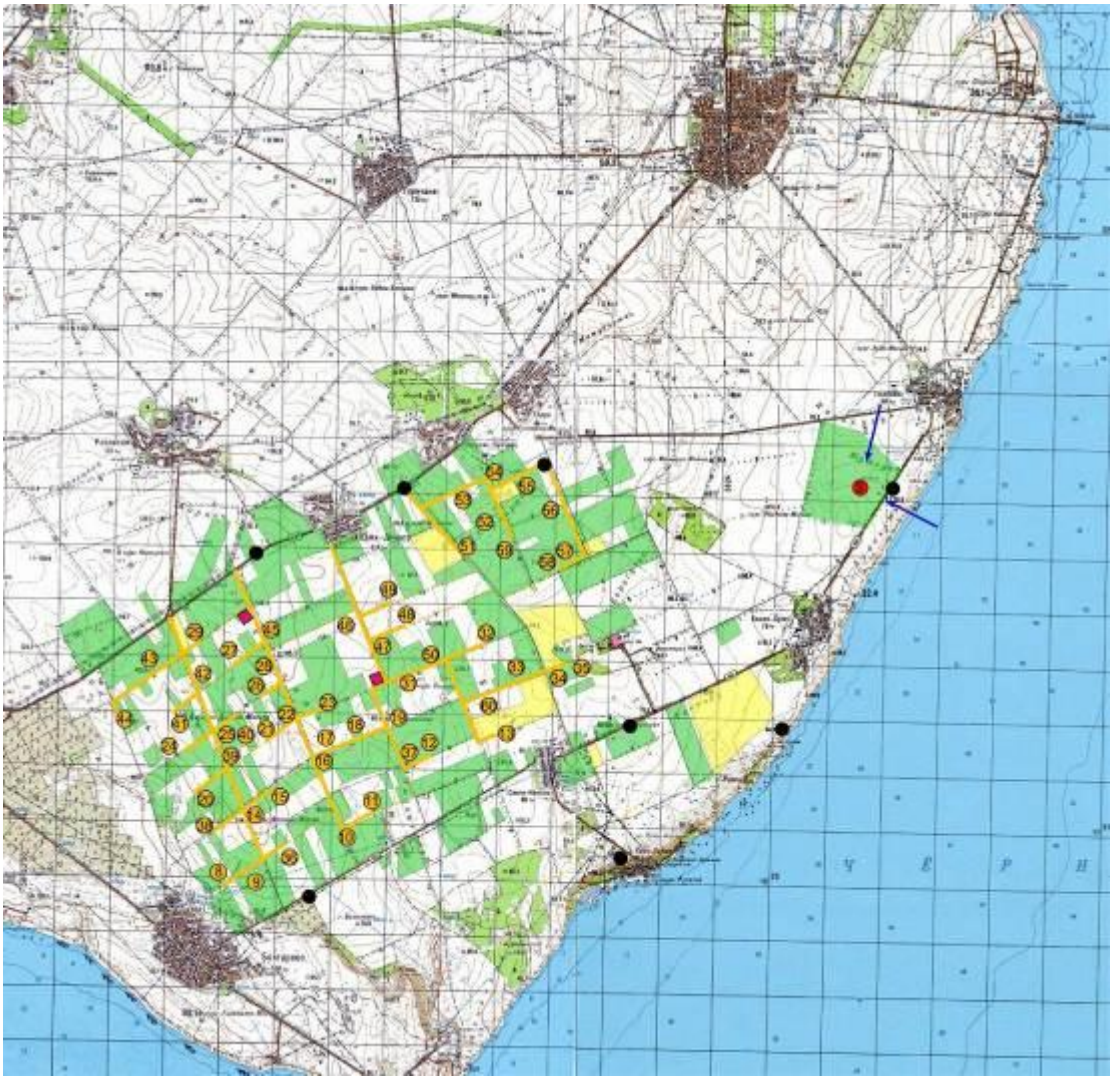

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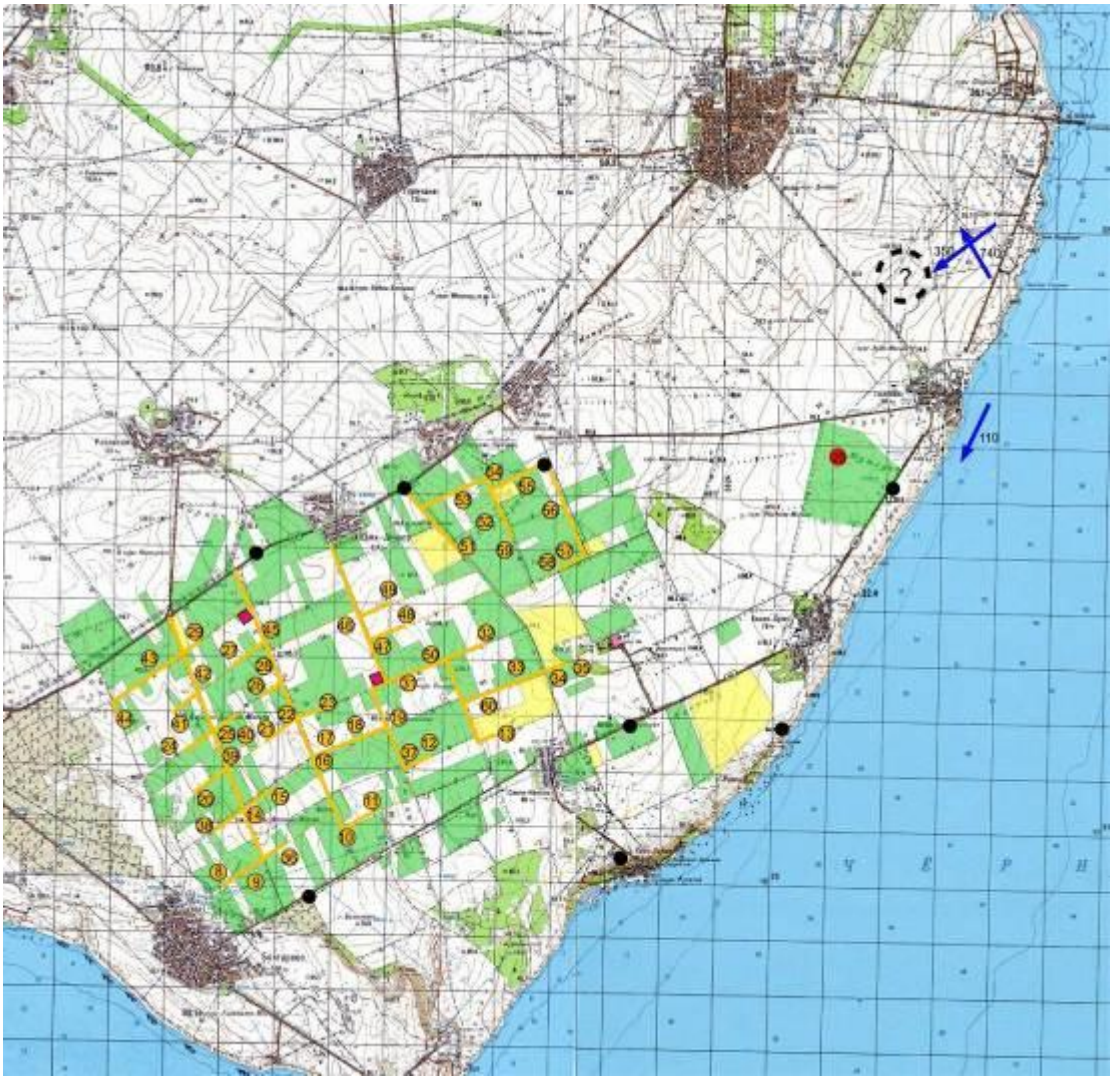

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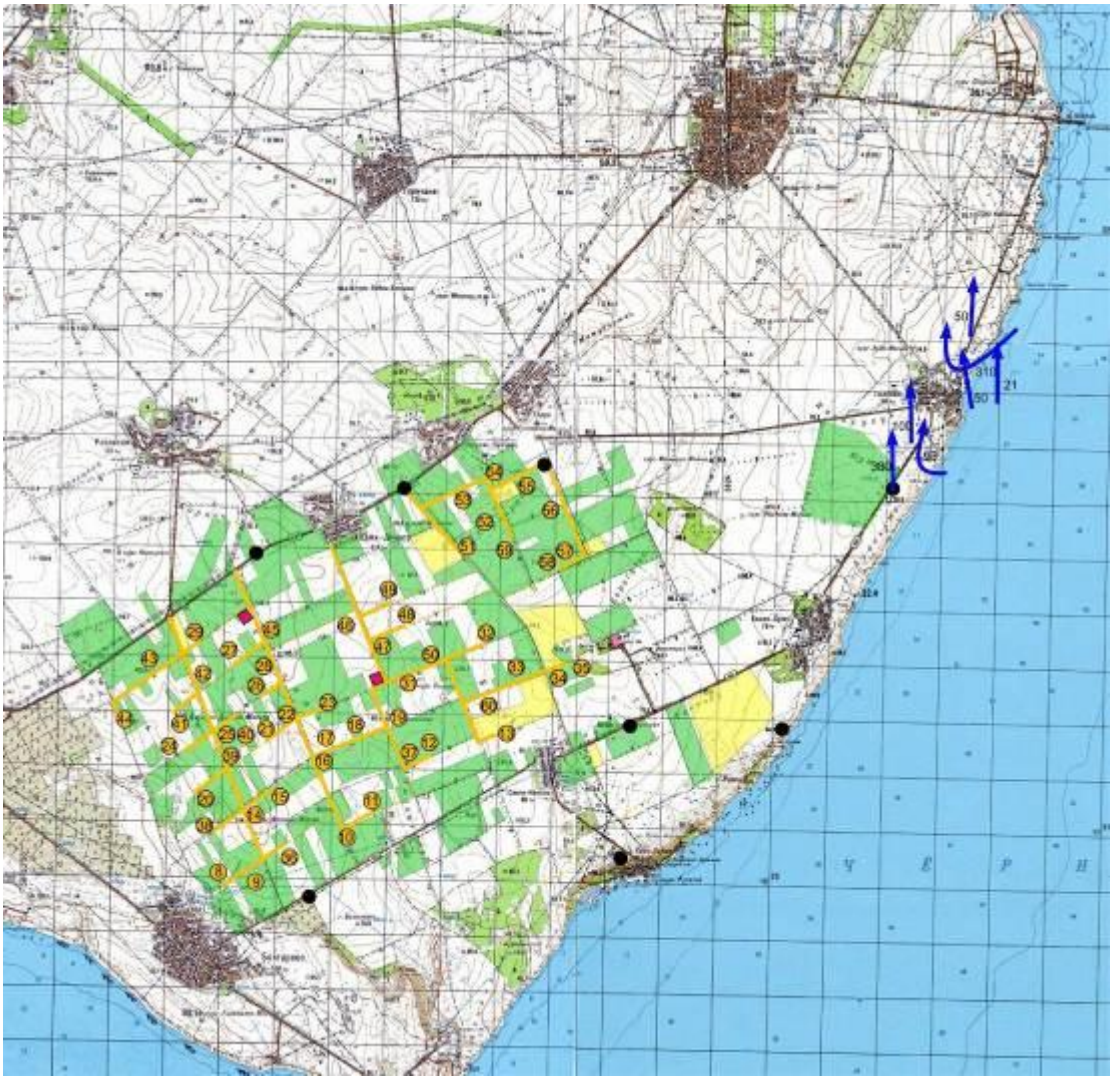

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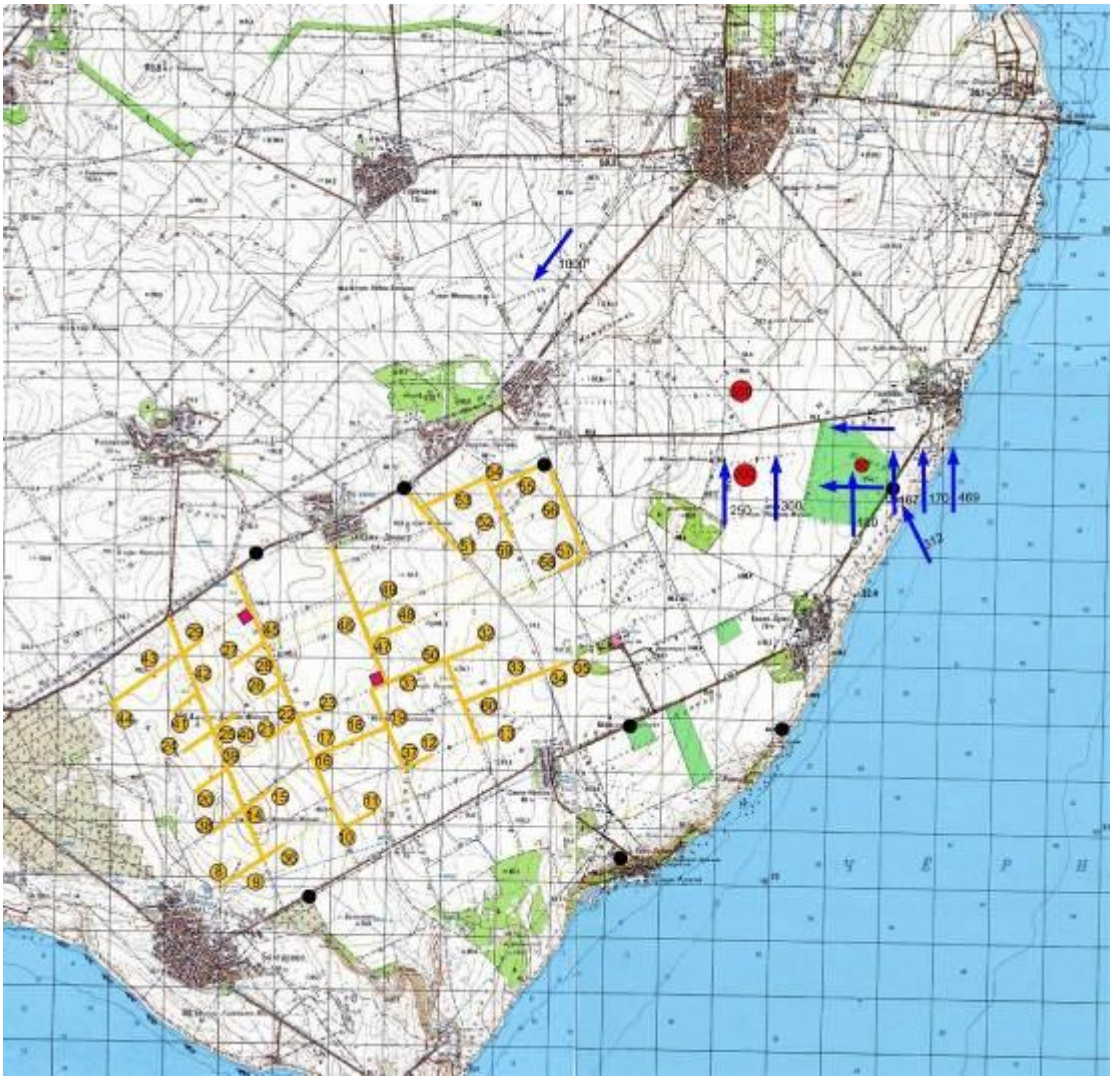

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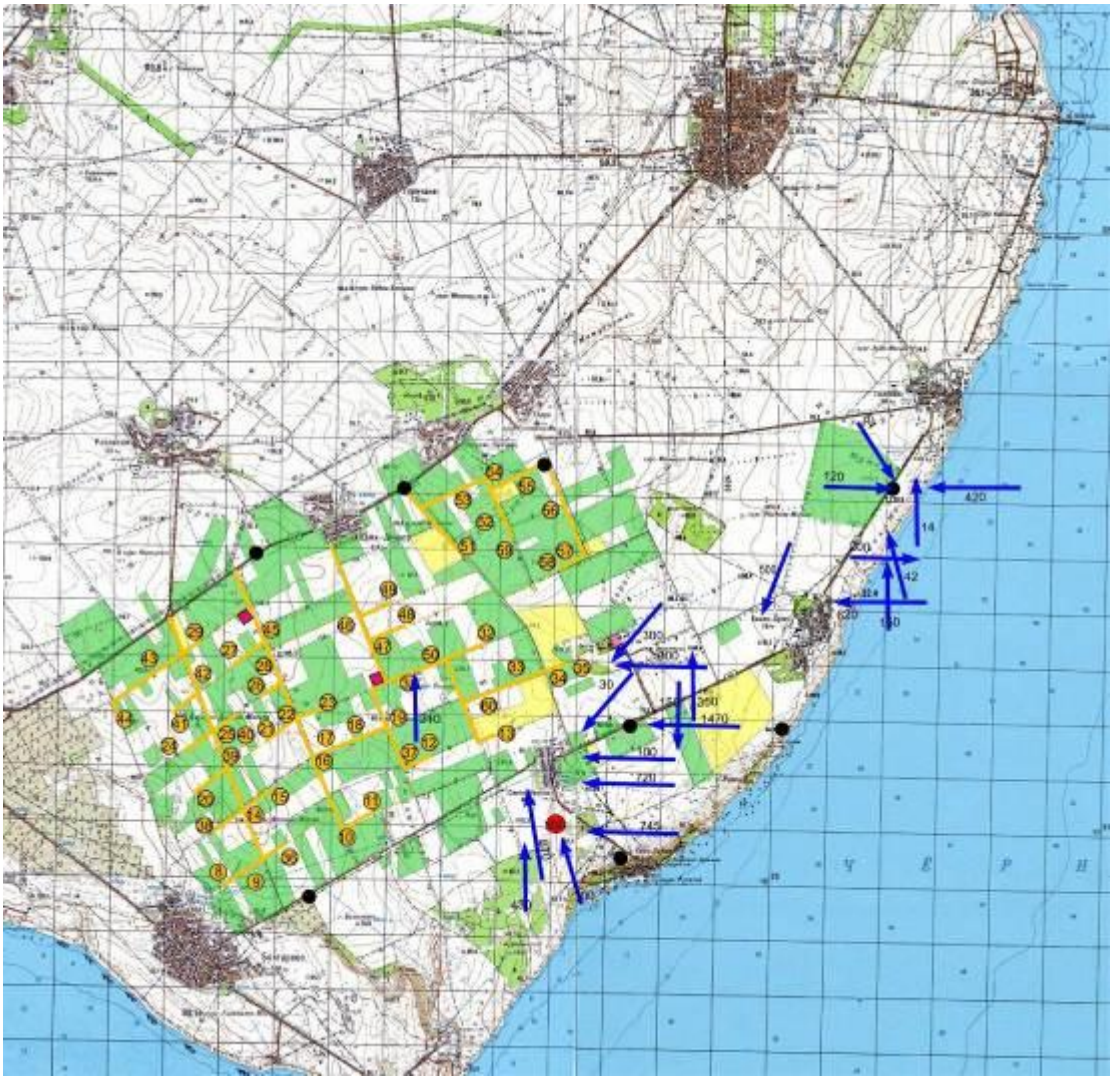

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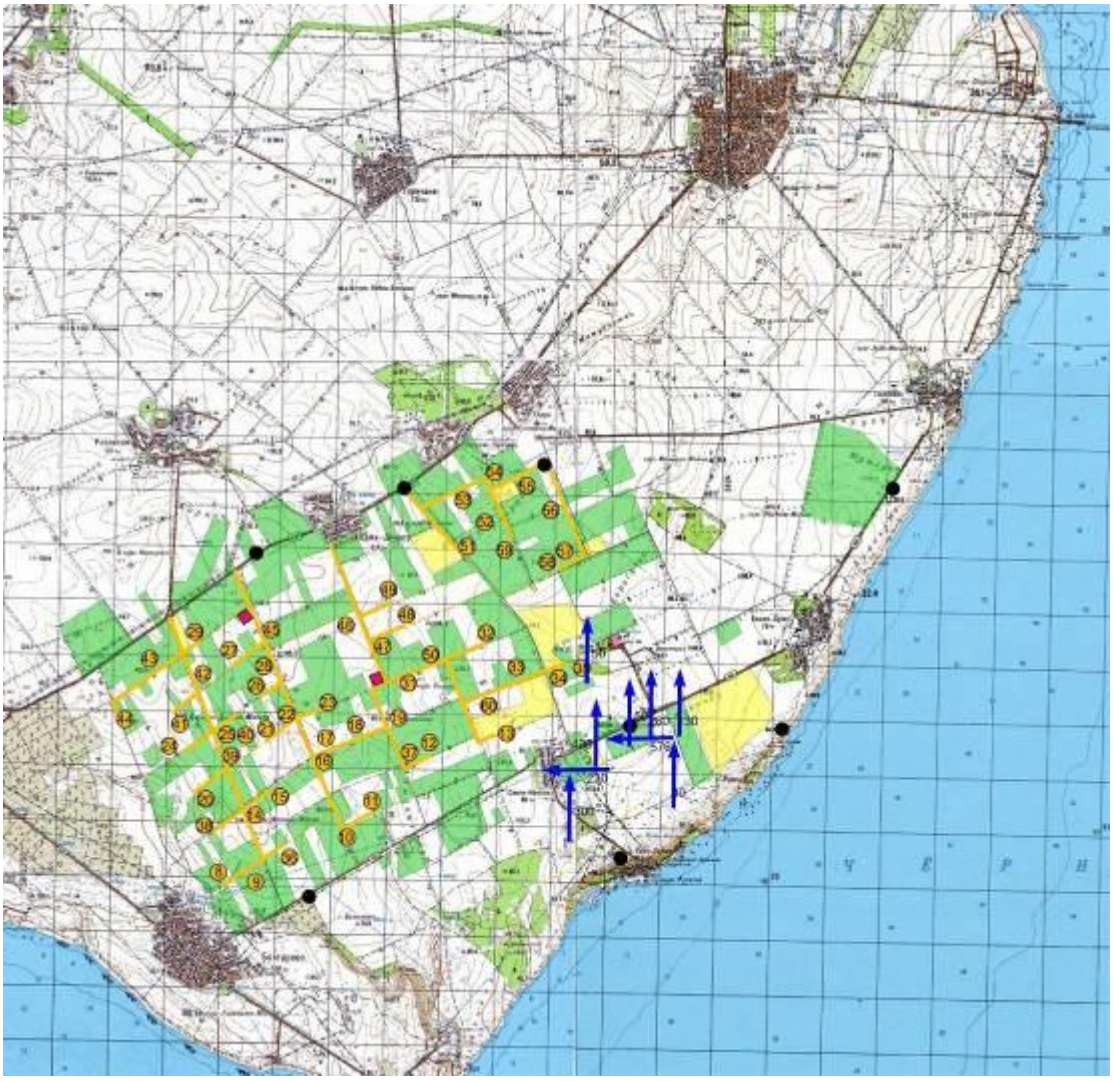

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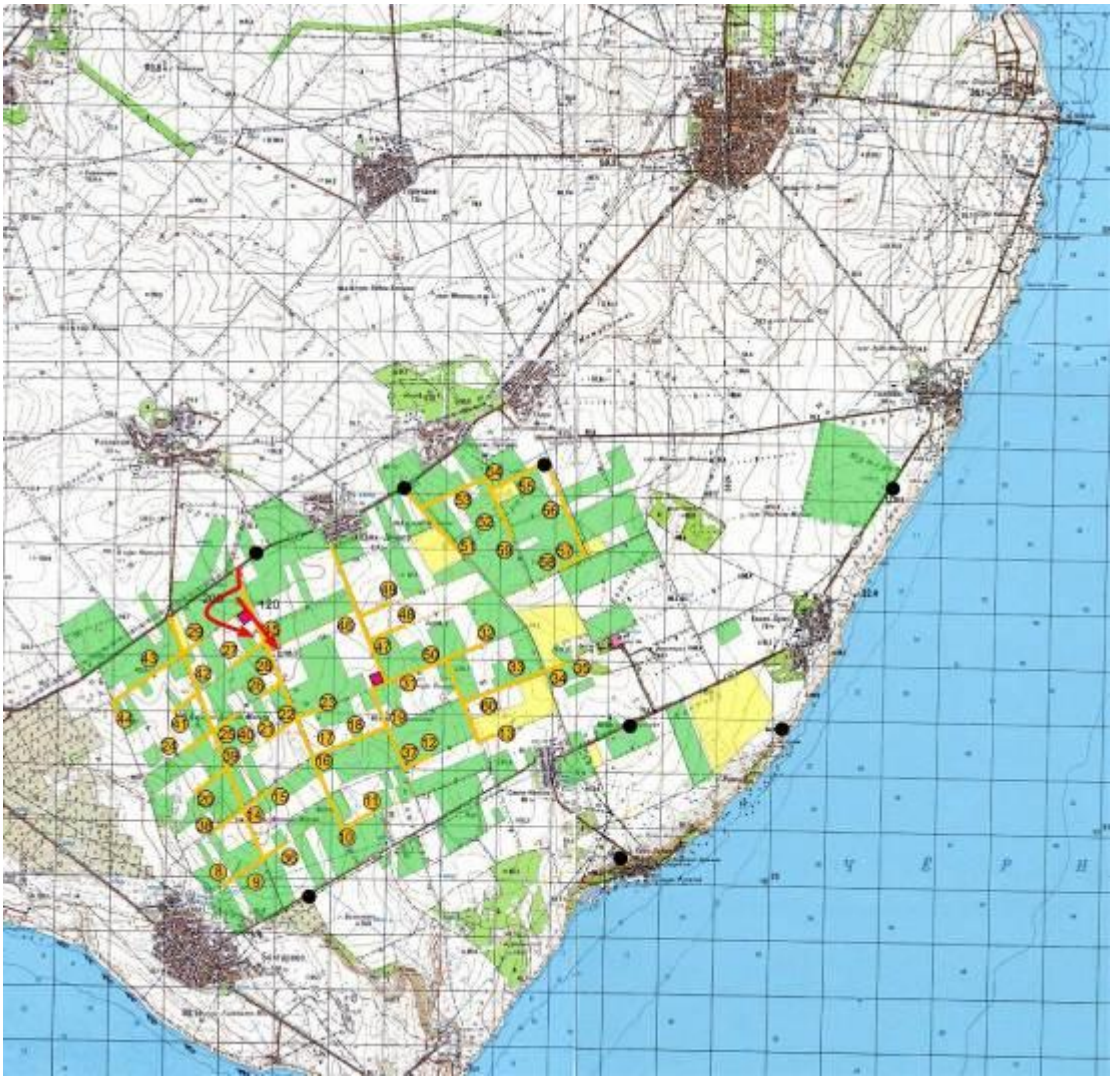

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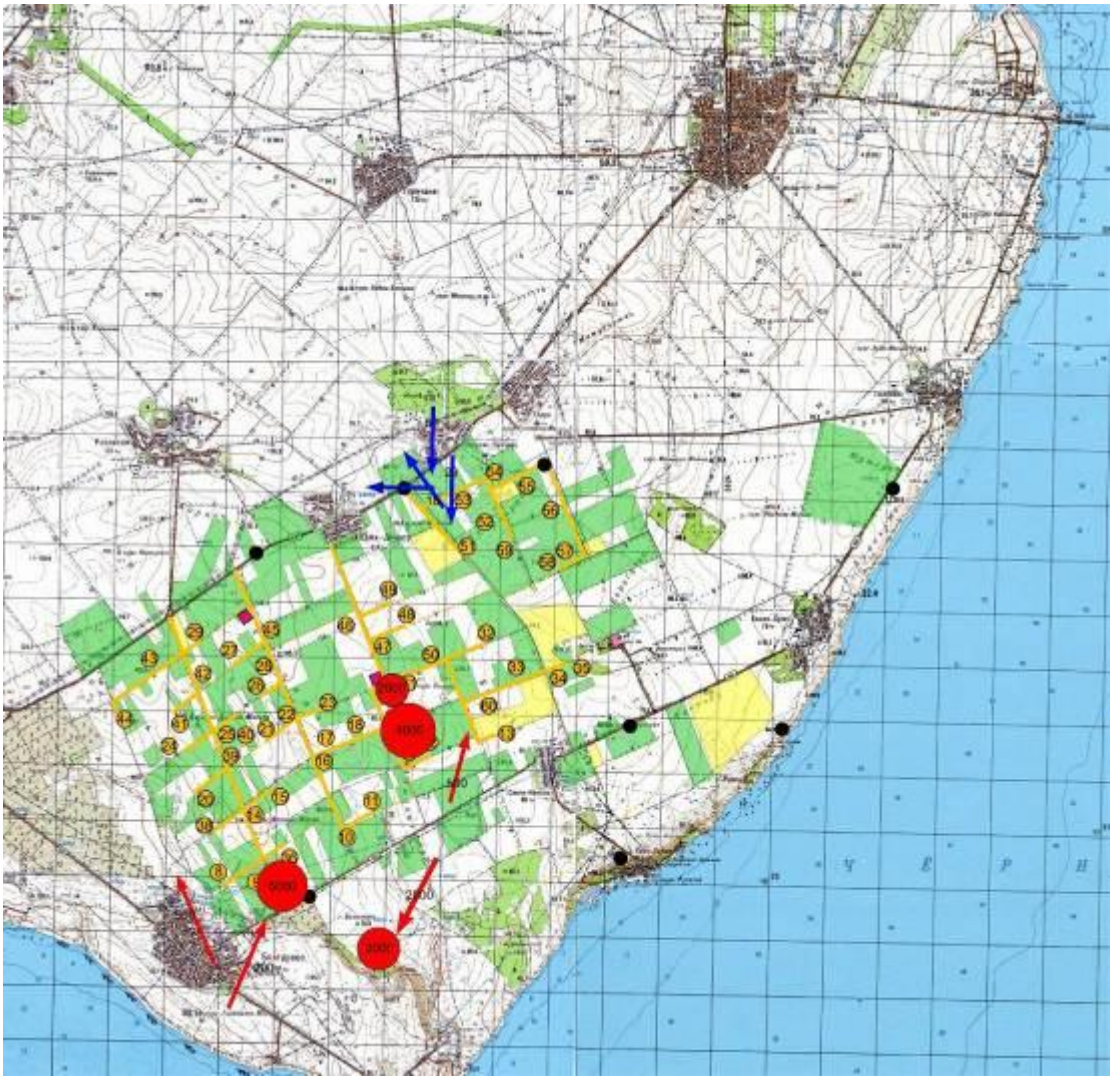

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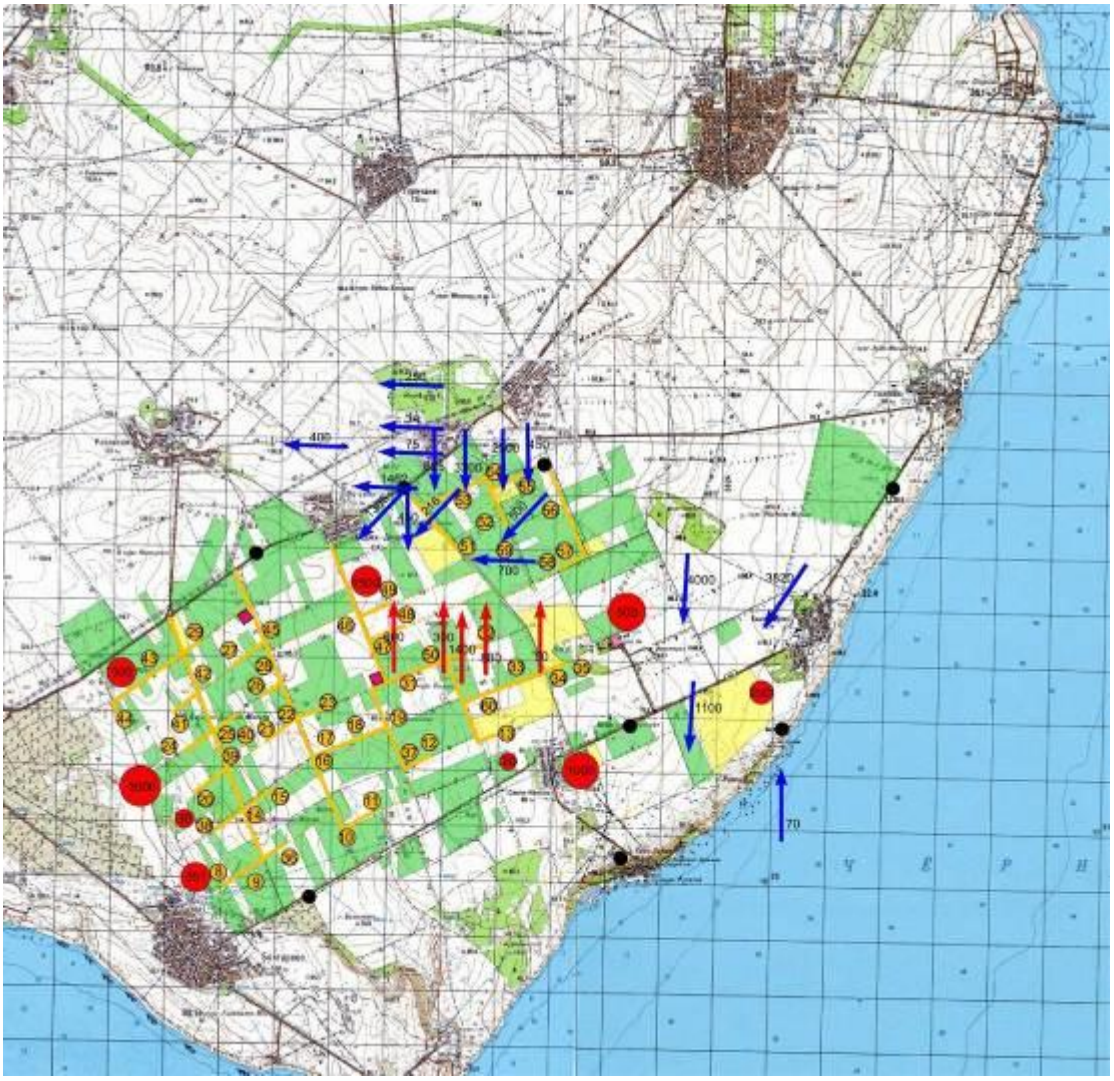

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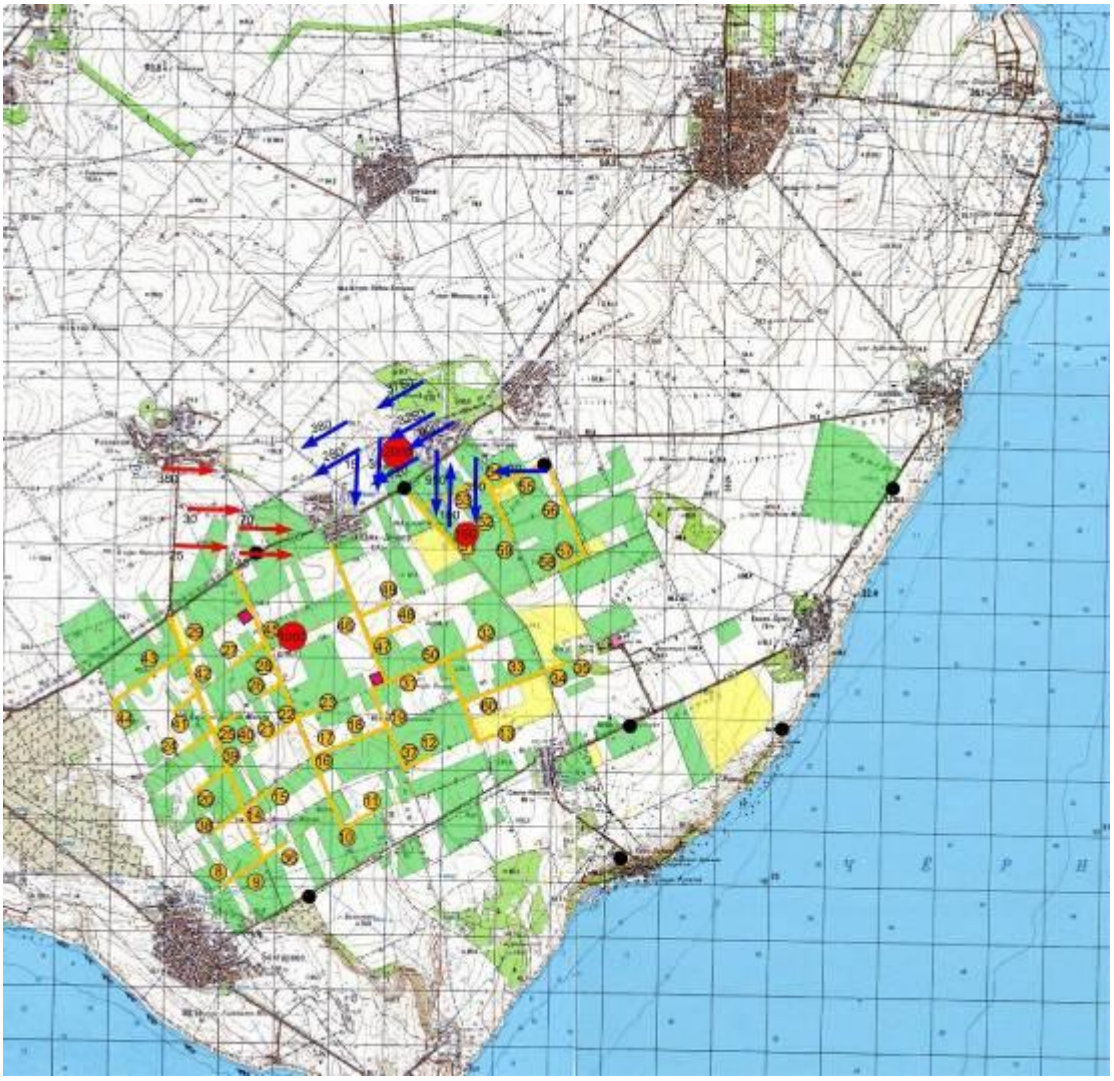

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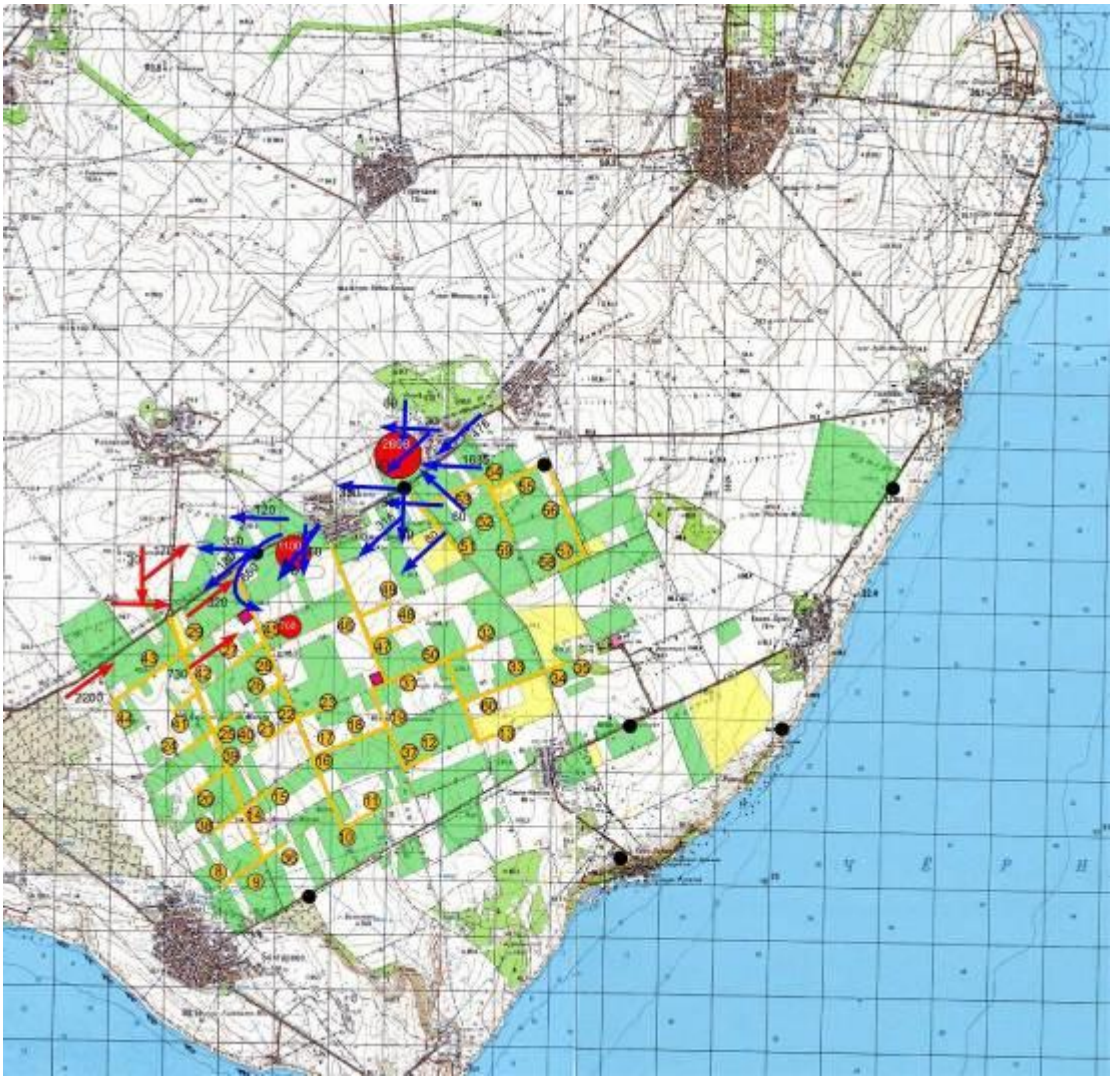

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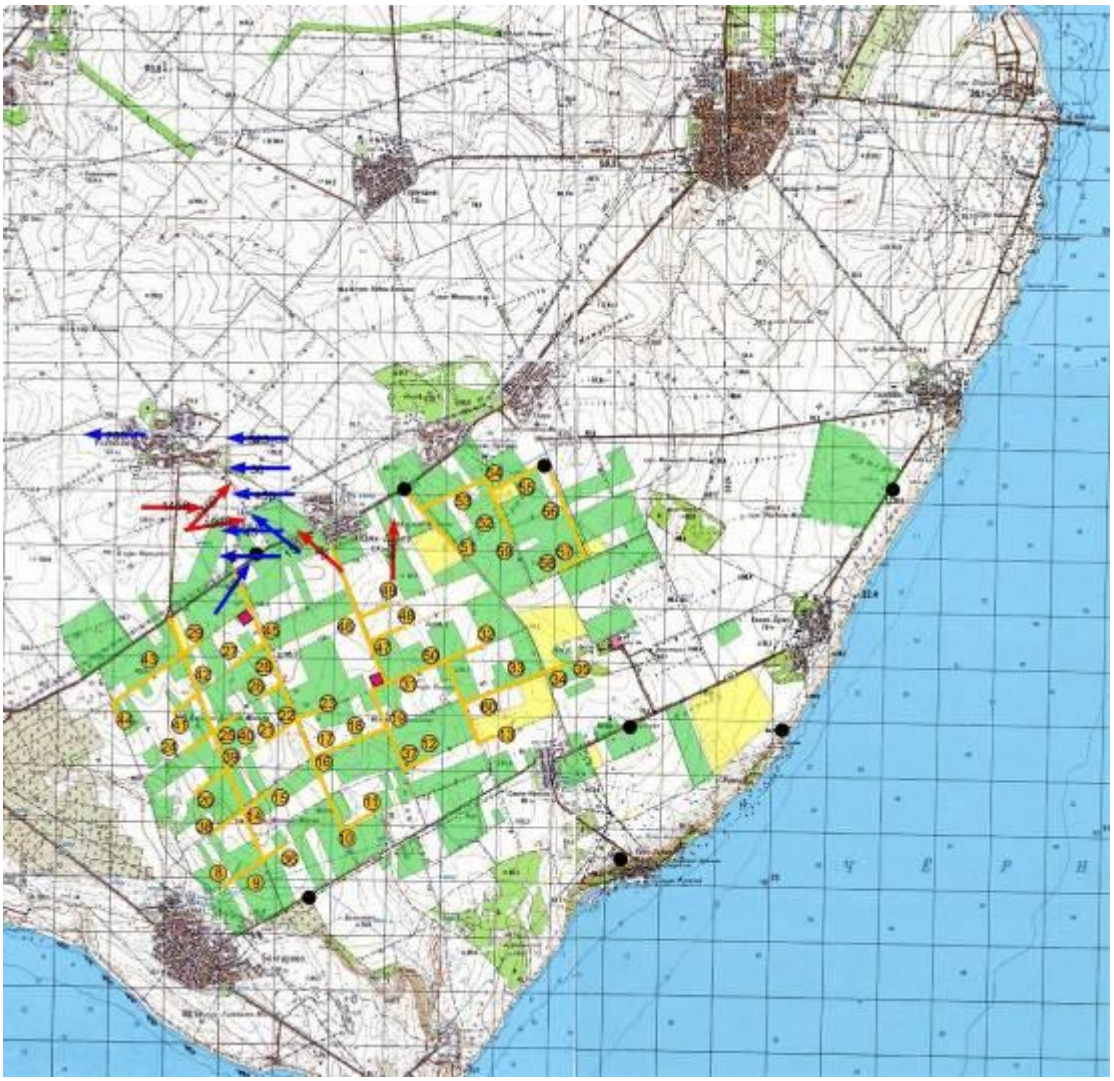

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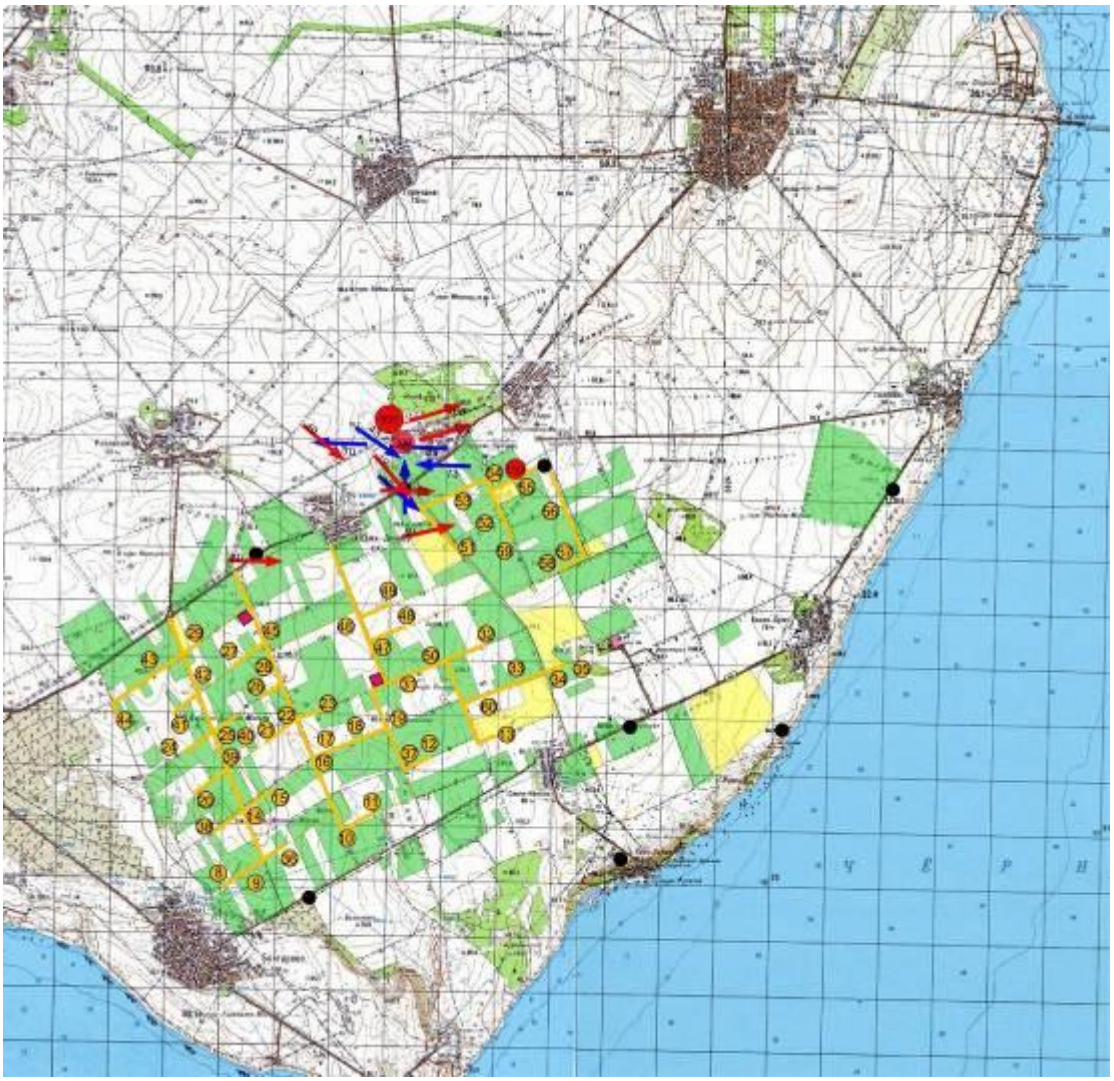

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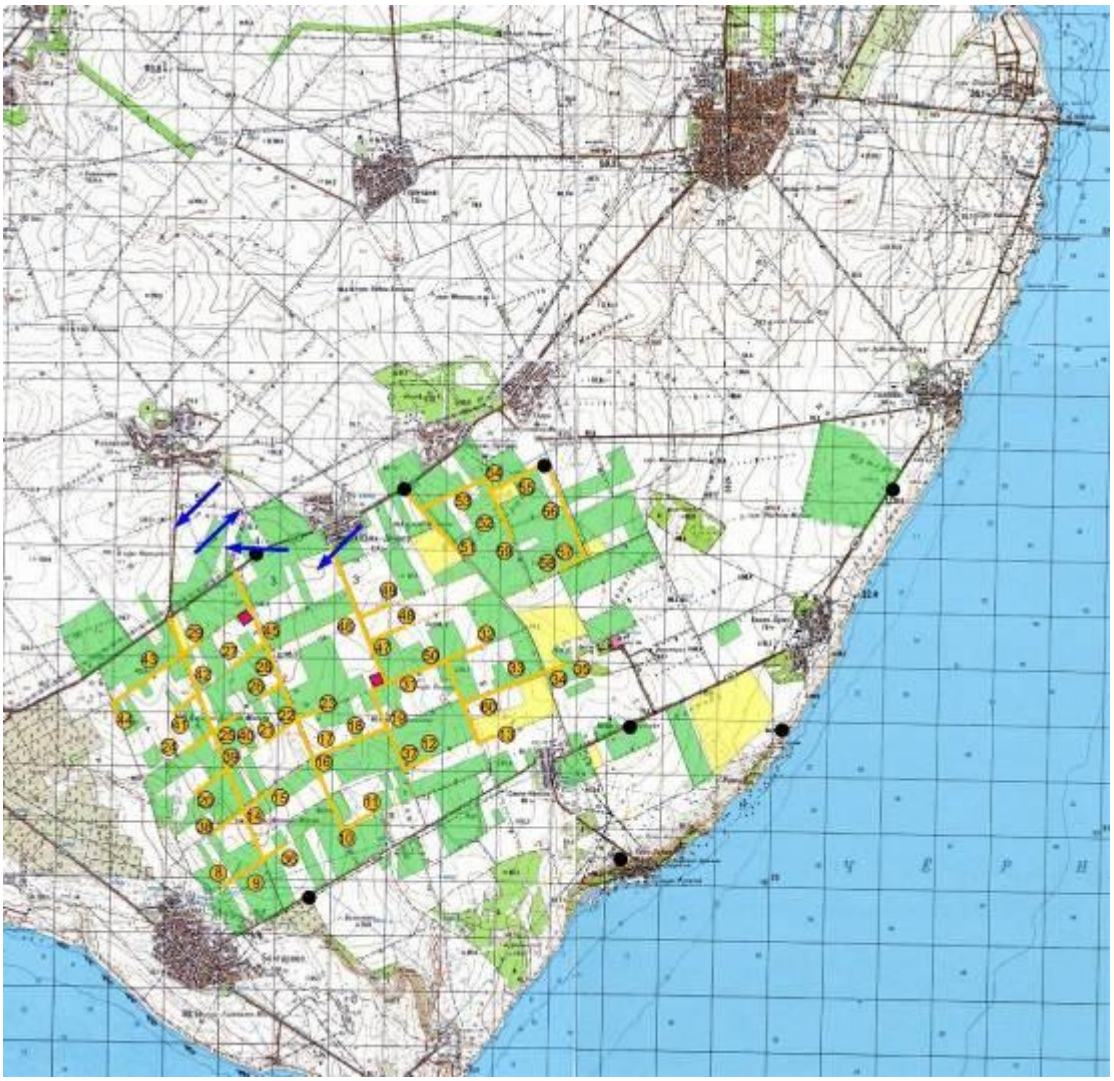

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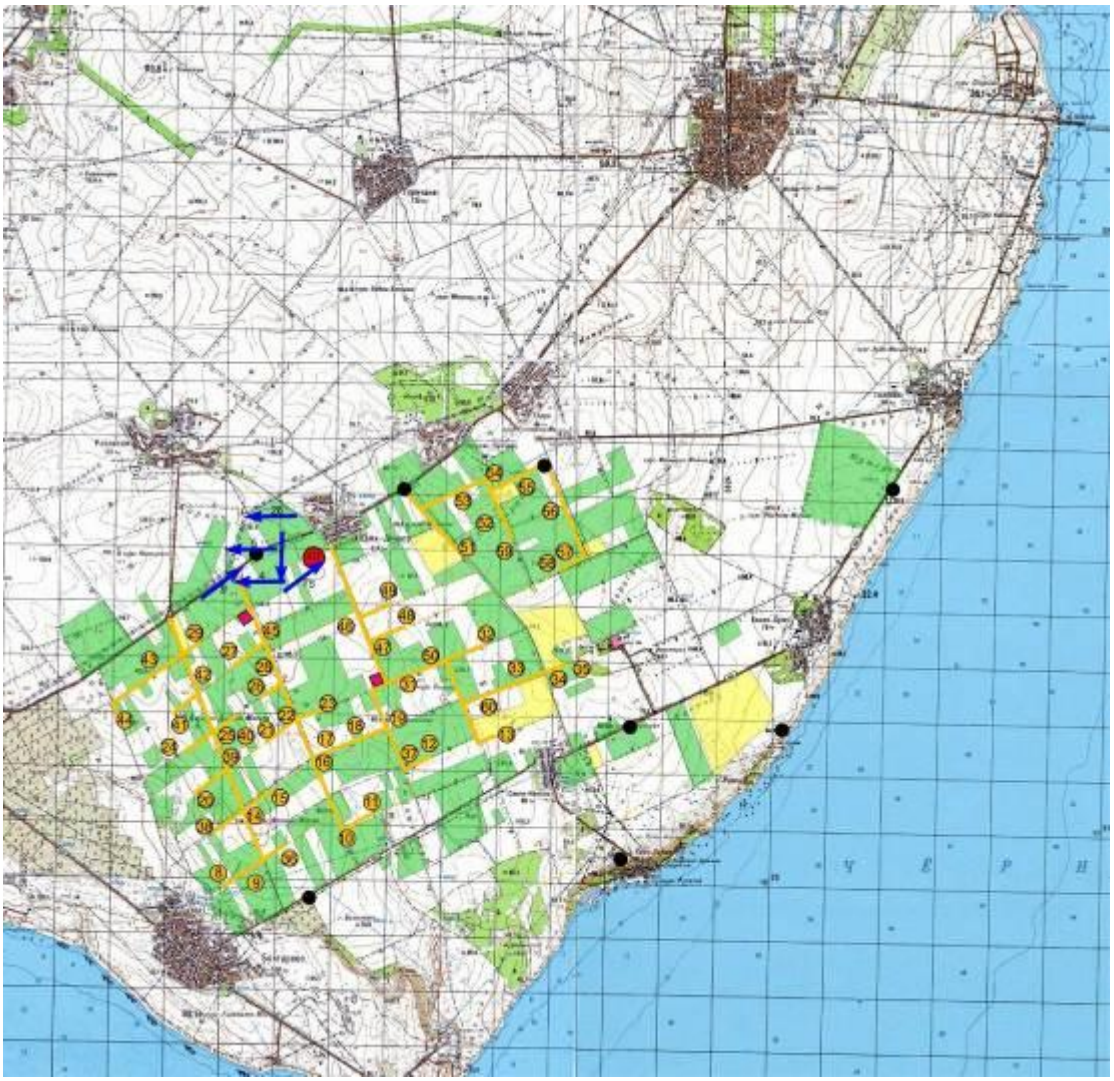

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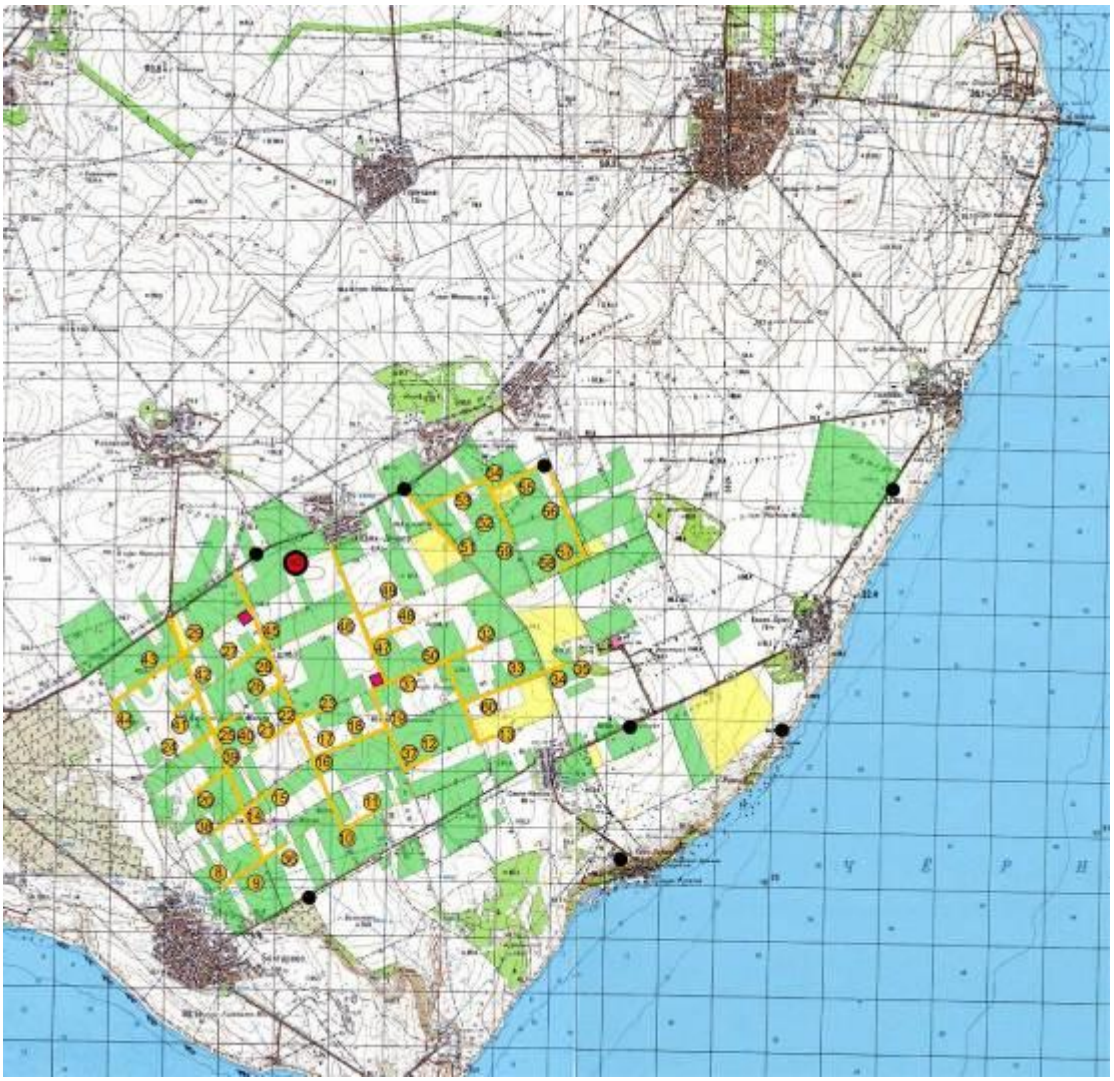

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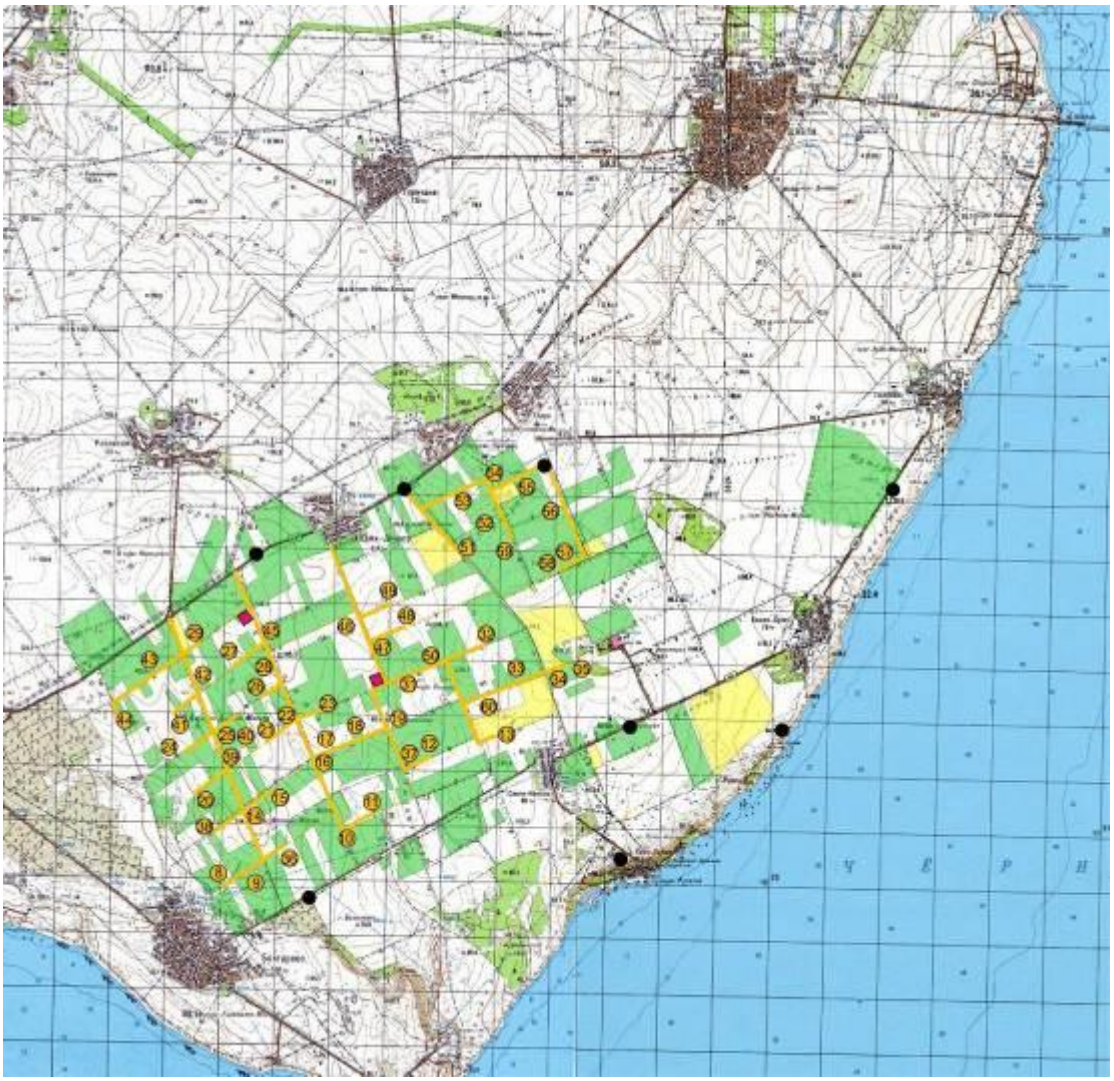

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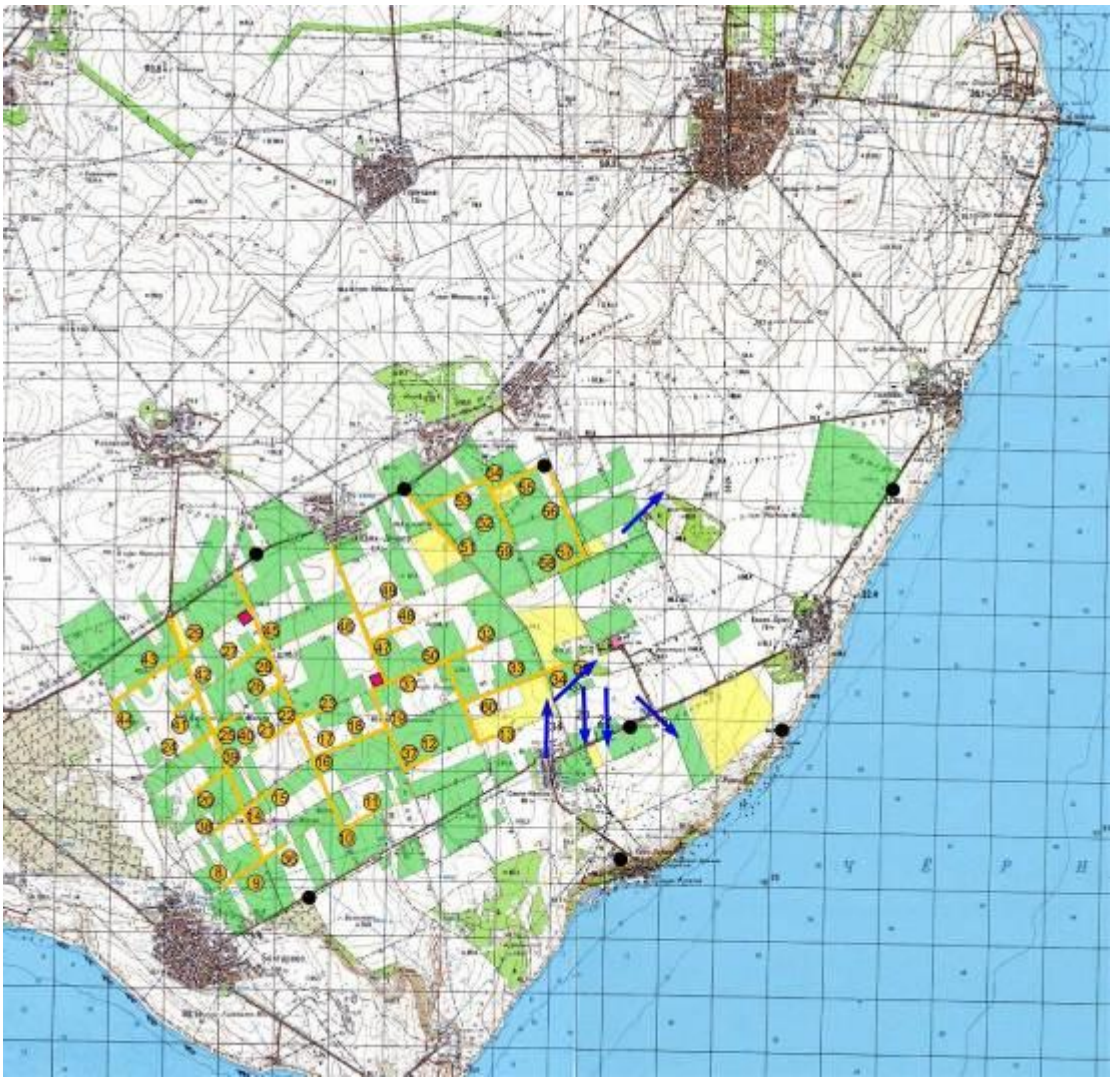

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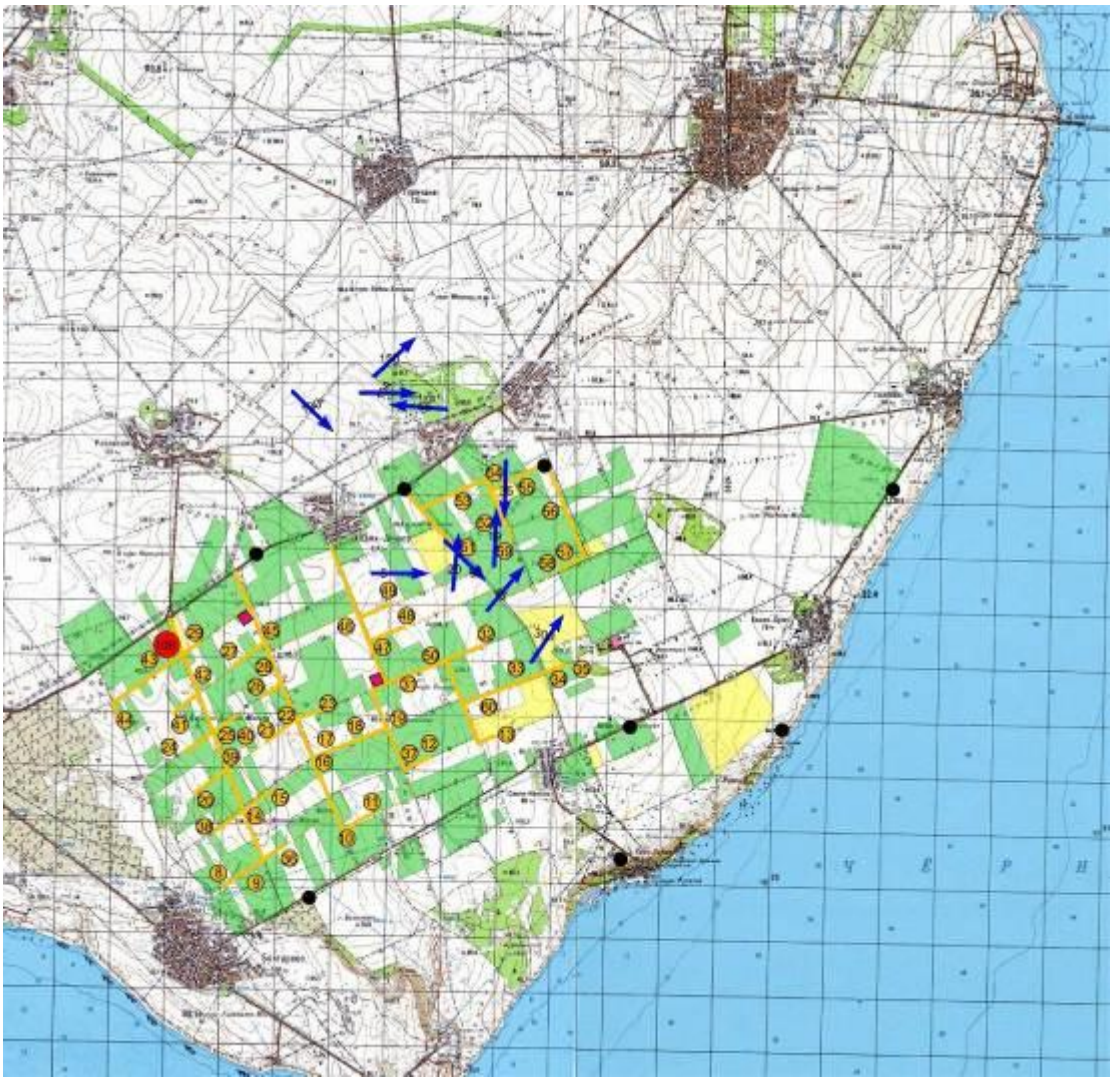

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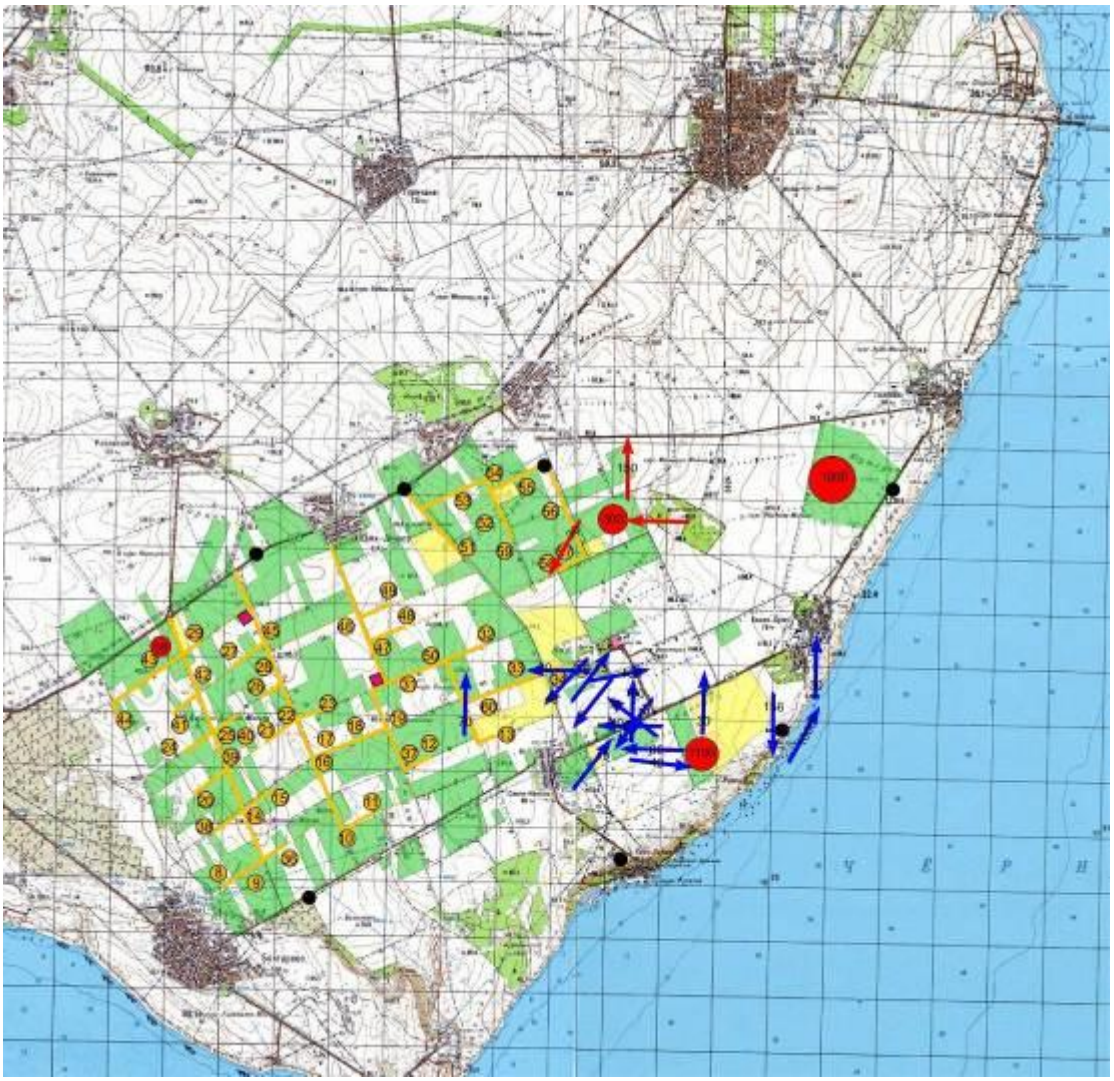

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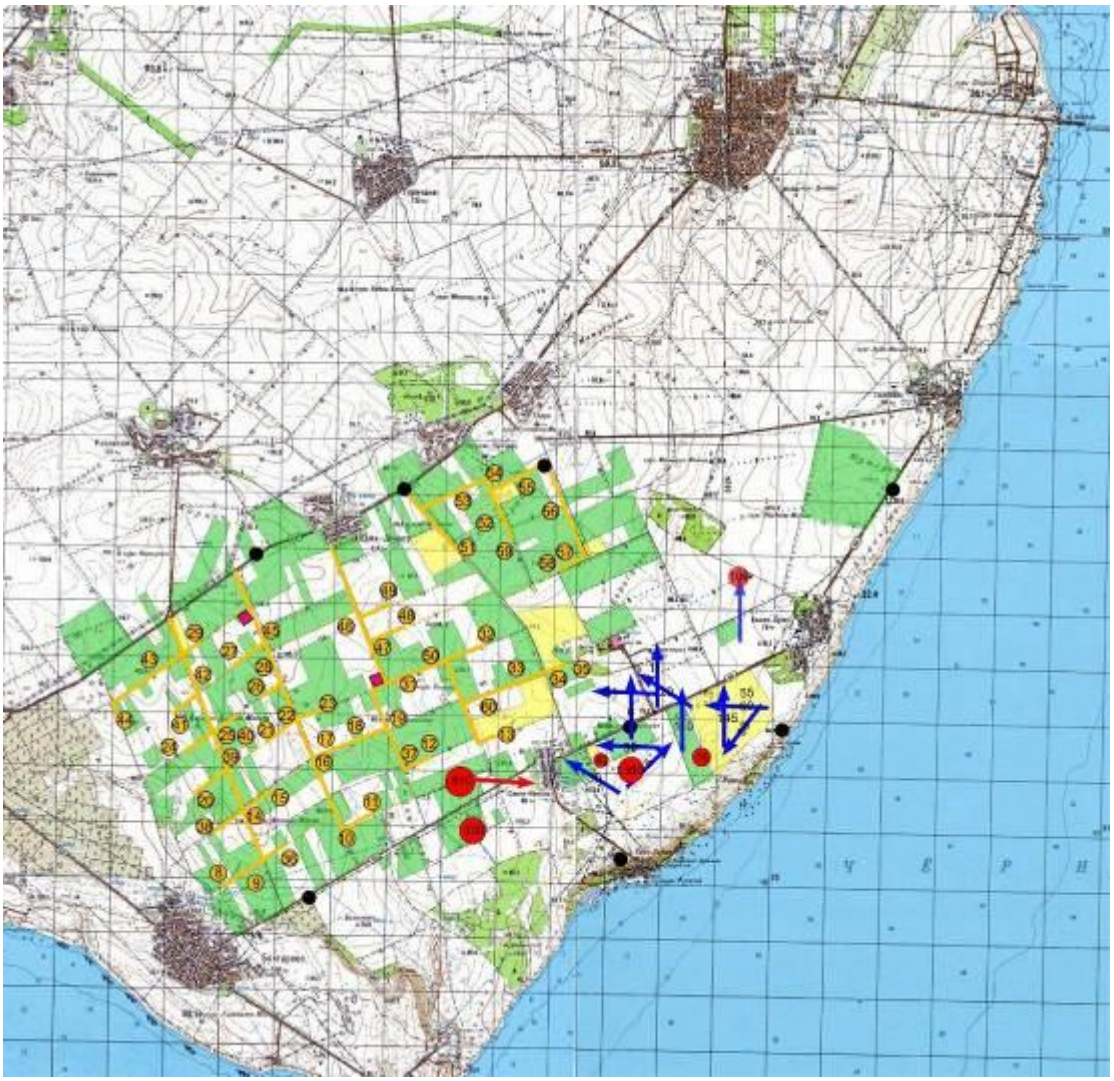

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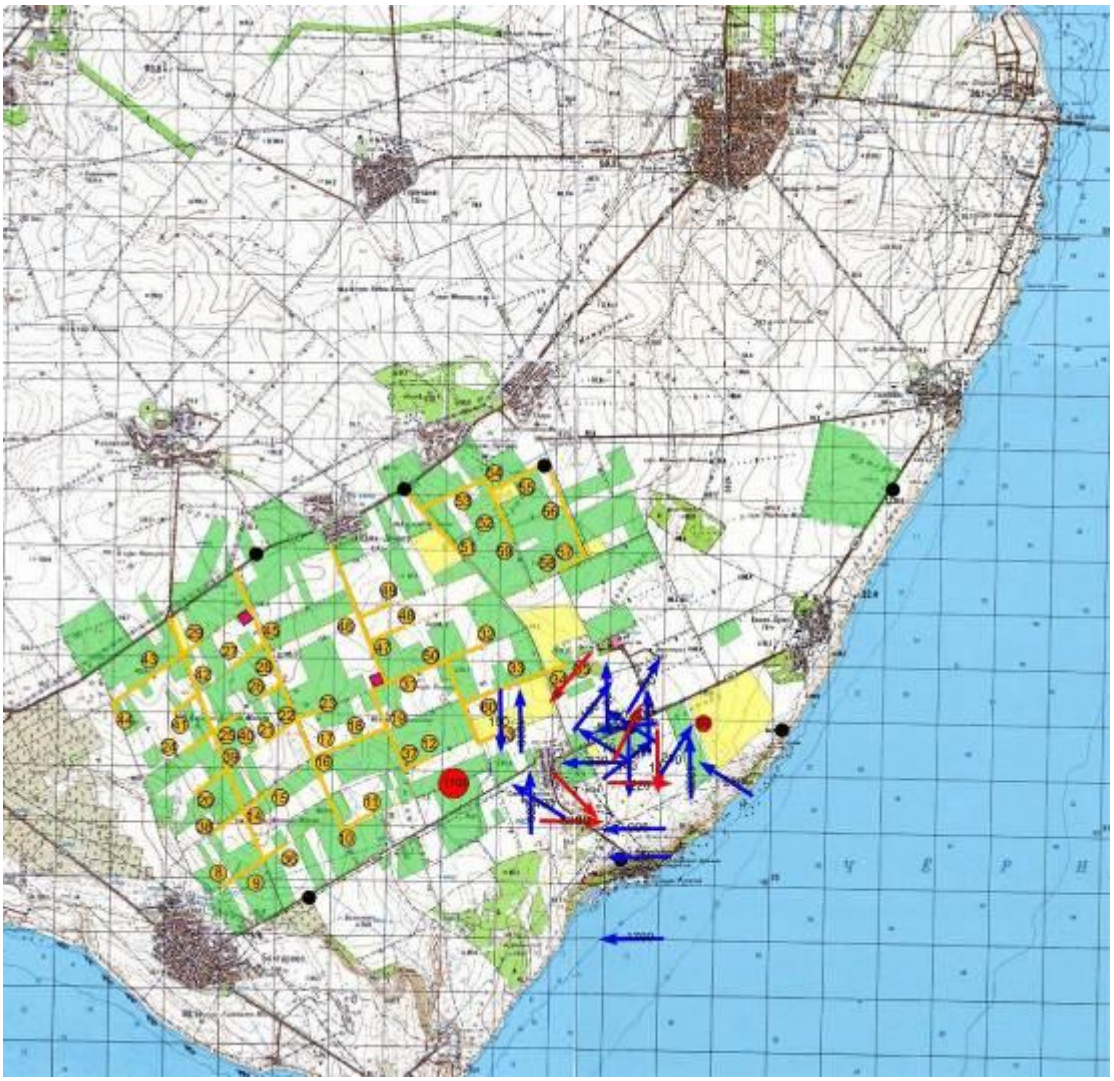

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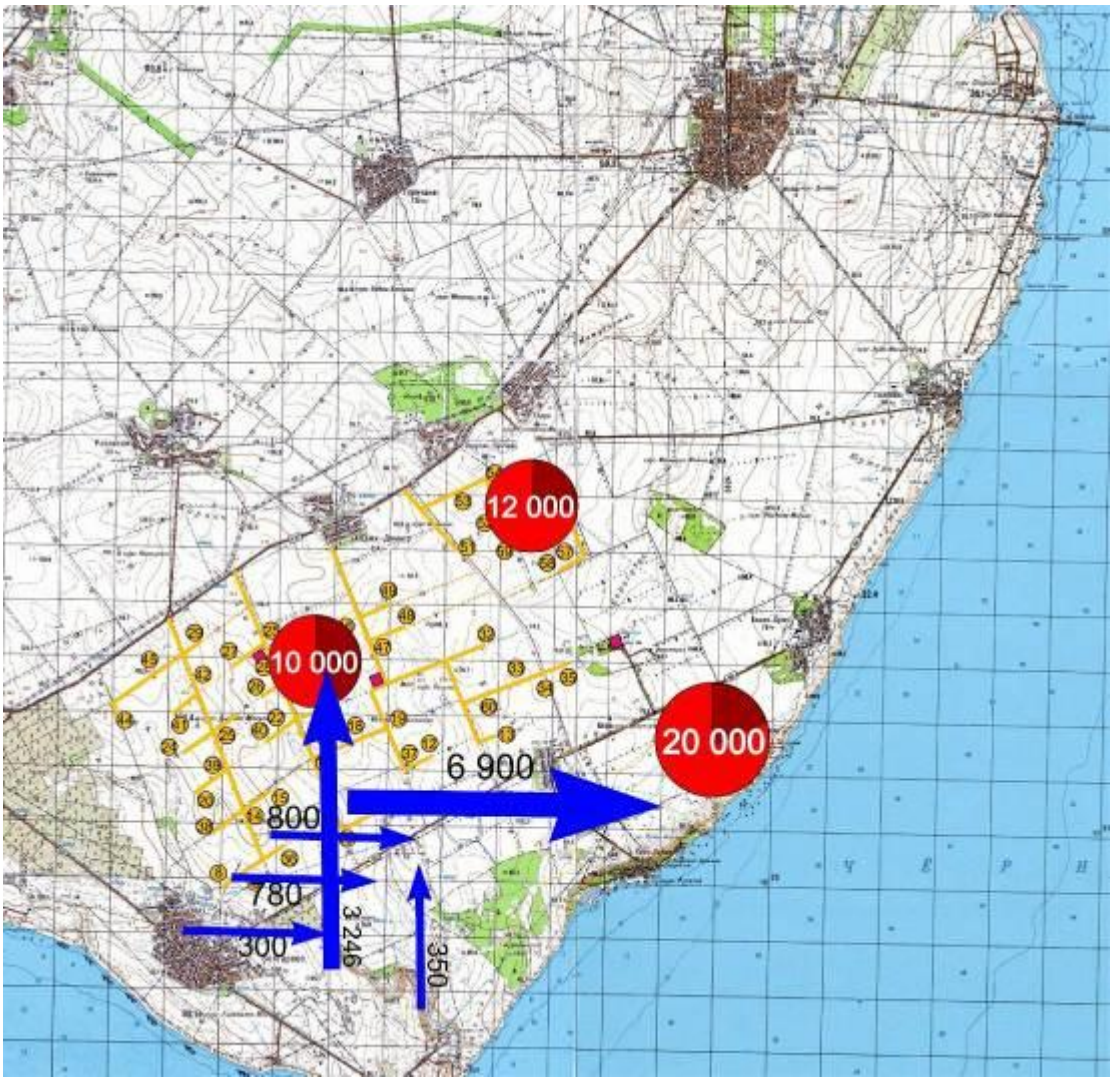

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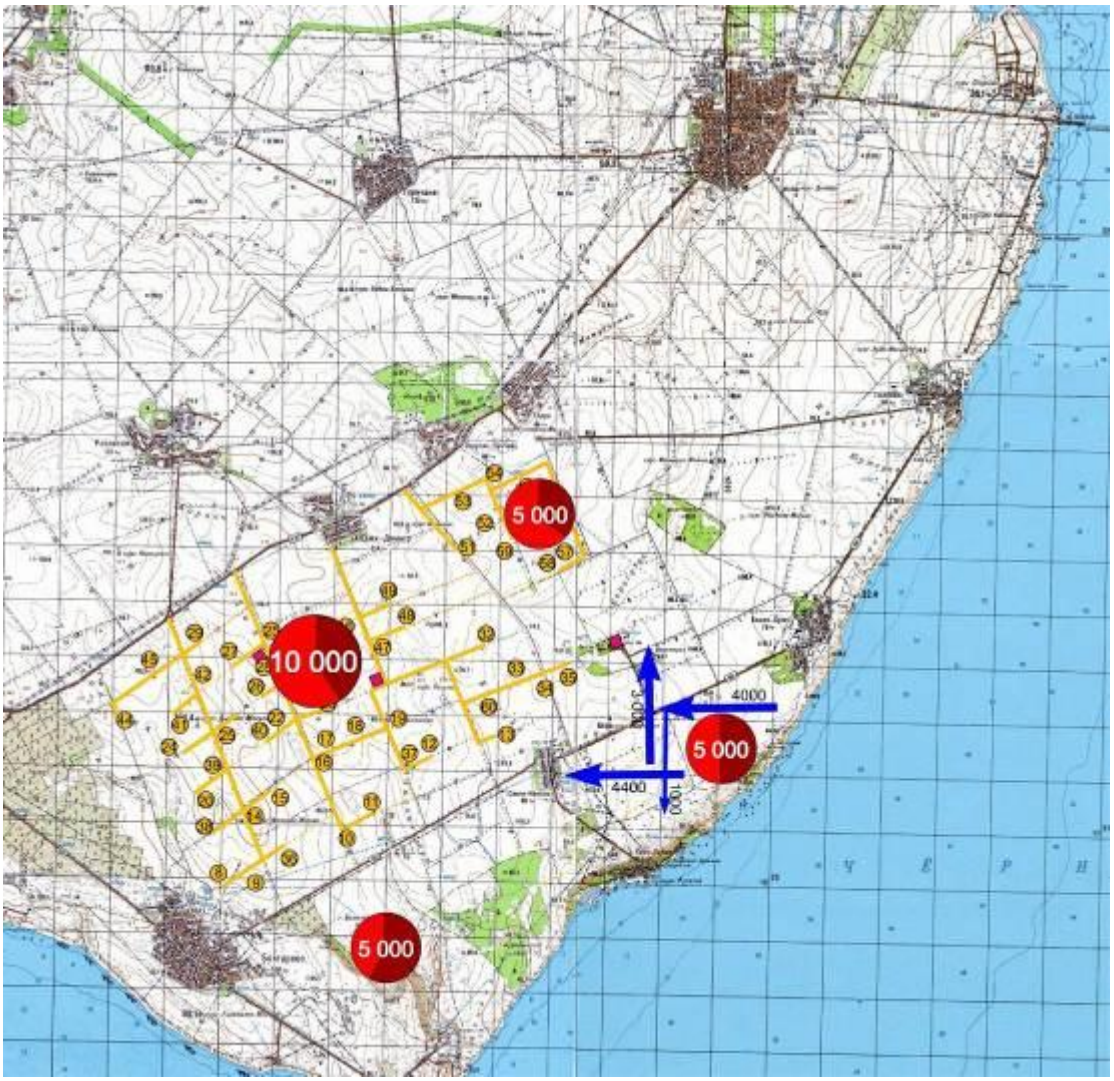

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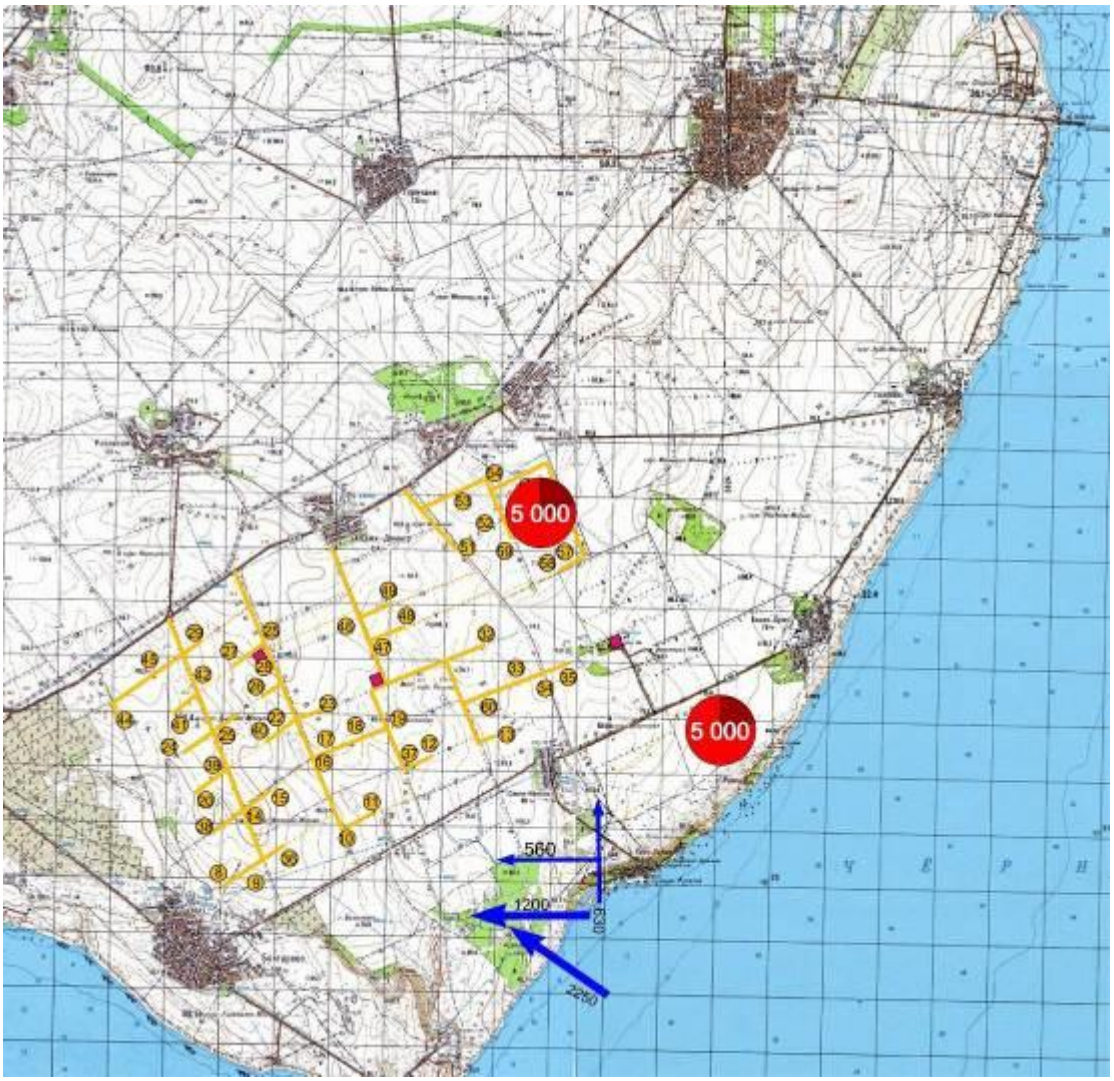

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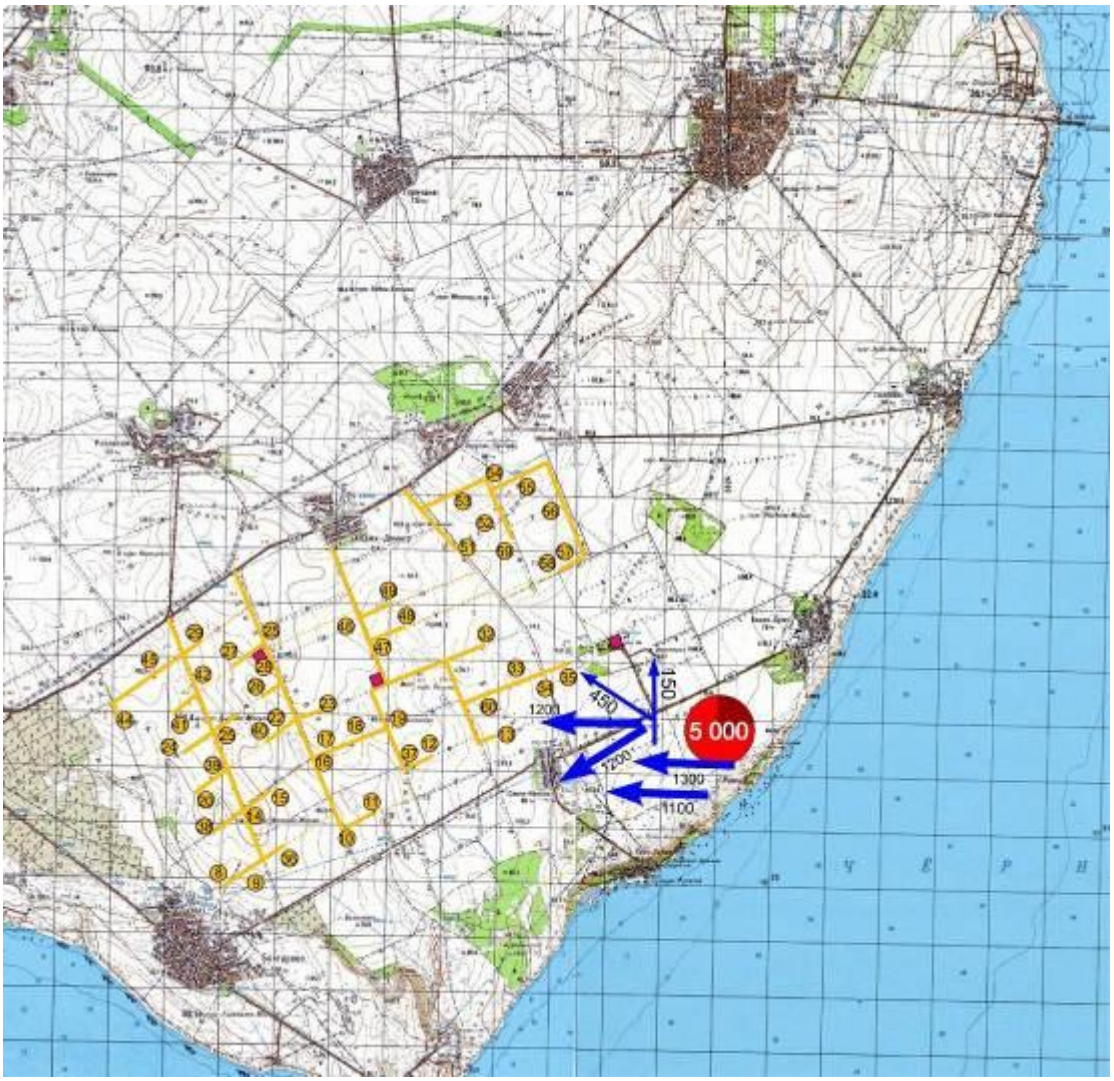

22.02.2012