ANNEX

TO ENVIRONMENTAL IMPACT FORECAST OF THE POLISH NUCLEAR ENERGY PROGRAMME

INTRODUCTION

This Annex contains information about all the changes in the Environmental Impact Forecast of the Polish Nuclear Energy Programme in conjunction with the announcement by PGE of potential sites for nuclear power plants to be subjected to detailed examination in the years 2012-2013. They are:

- Choczewo, pomorskie province, Choczewo commune,
- Żarnowiec, pomorskie province, Krokowa and Gniewino communes (the former Żarnowiec NPP construction site),
- Gąski, zachodniopomorskie province, Mielno commune.

The following pages present in an orderly way these pages of the Forecast which are affected by the introduction of the new location. The numbering consistent with the numbering contained in the Forecast was retained. All changes in the text are marked in red. In case of changes in the figures, their captions also marked in red. The pages referring to the new location, "Gąski", are an exception. In this case, the entire text was inserted with the formatting and colours compatible with the original version of the Forecast.

POTENCJALNE LOKALIZACJE ELEKTROWNI JĄDROWYCH WOBEC ROZMIESZCZENIA OBSZARÓW NATURA 2000 (SPECJALNYCH OBSZARÓW OCHRONY SIEDLISK)

Propozycje lokalizacji

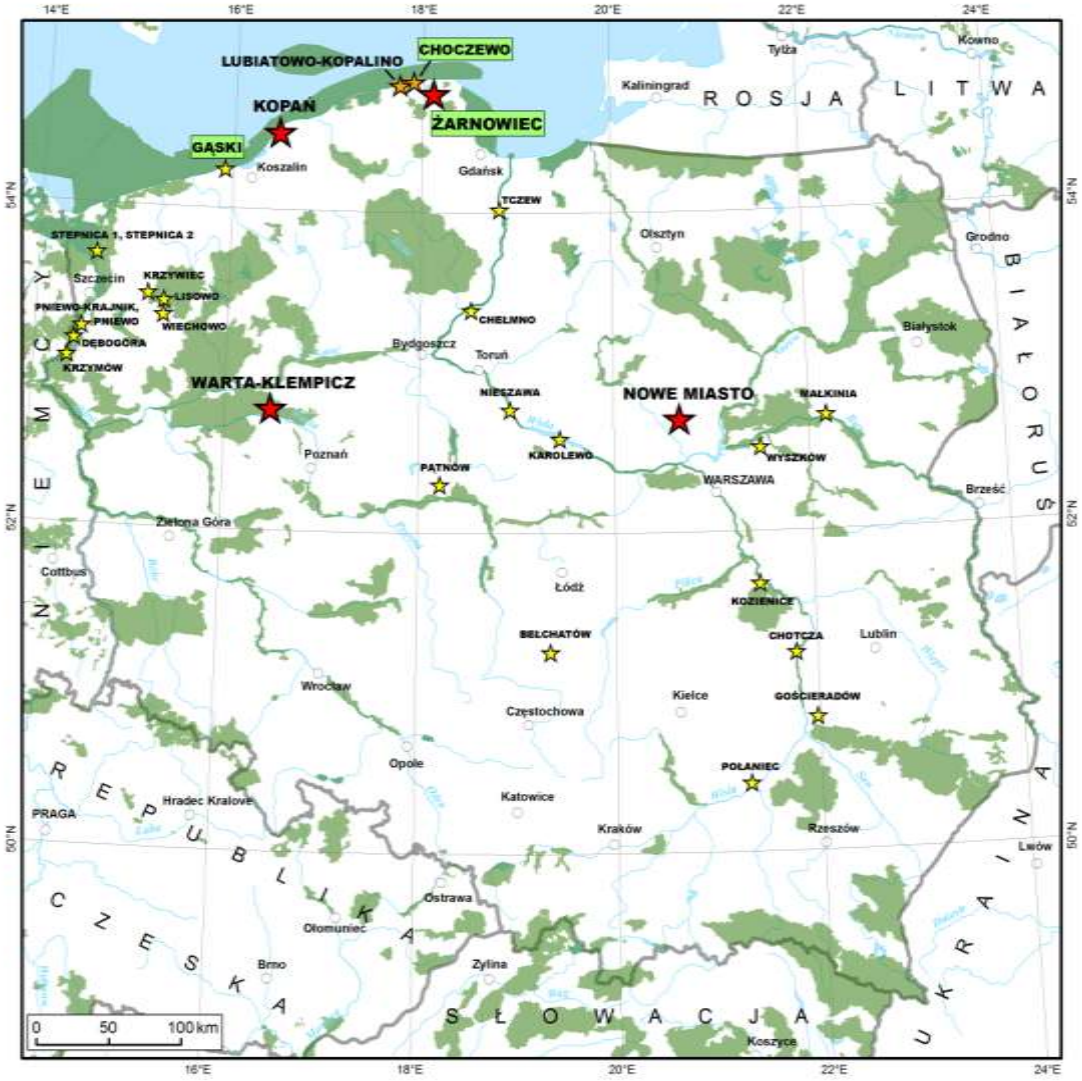
- lokalizacje zalecane
- lokalizacje rezerwowe
- pozostałe propozycje lokalizacji
- CHOCZEWO — potencjalne lokalizacje wybrane przez PGE Energia Jądrowa S.A.
- obszary NATURA 2000 (specjalne obszary ochrony siedlisk)

Opracował: mgr Kacper Jancewicz

Źródła:
"Ekspertyza na temat kryteriów lokalizacji elektrowni jądrowych oraz wstępna ocena uzgodnionych lokalizacji";
"Projekt energetyki jądrowej: kolejne kroki",
PGE Energia Jądrowa SA, konferencja prasowa z 25-11-2011;
www.eea.europa.eu;
VMAP Level 0 (www.gis-lab.info)

Potential locations of nuclear power plants against the deployment of special areas of habitat protection.

POTENCJALNE LOKALIZACJE ELEKTROWNI JĄDROWYCH WOBEC ROZMIESZCZENIA OBSZARÓW NATURA 2000 (OBSZARÓW SPECJALNEJ OCHRONY PTAKÓW)



Propozycje lokalizacji

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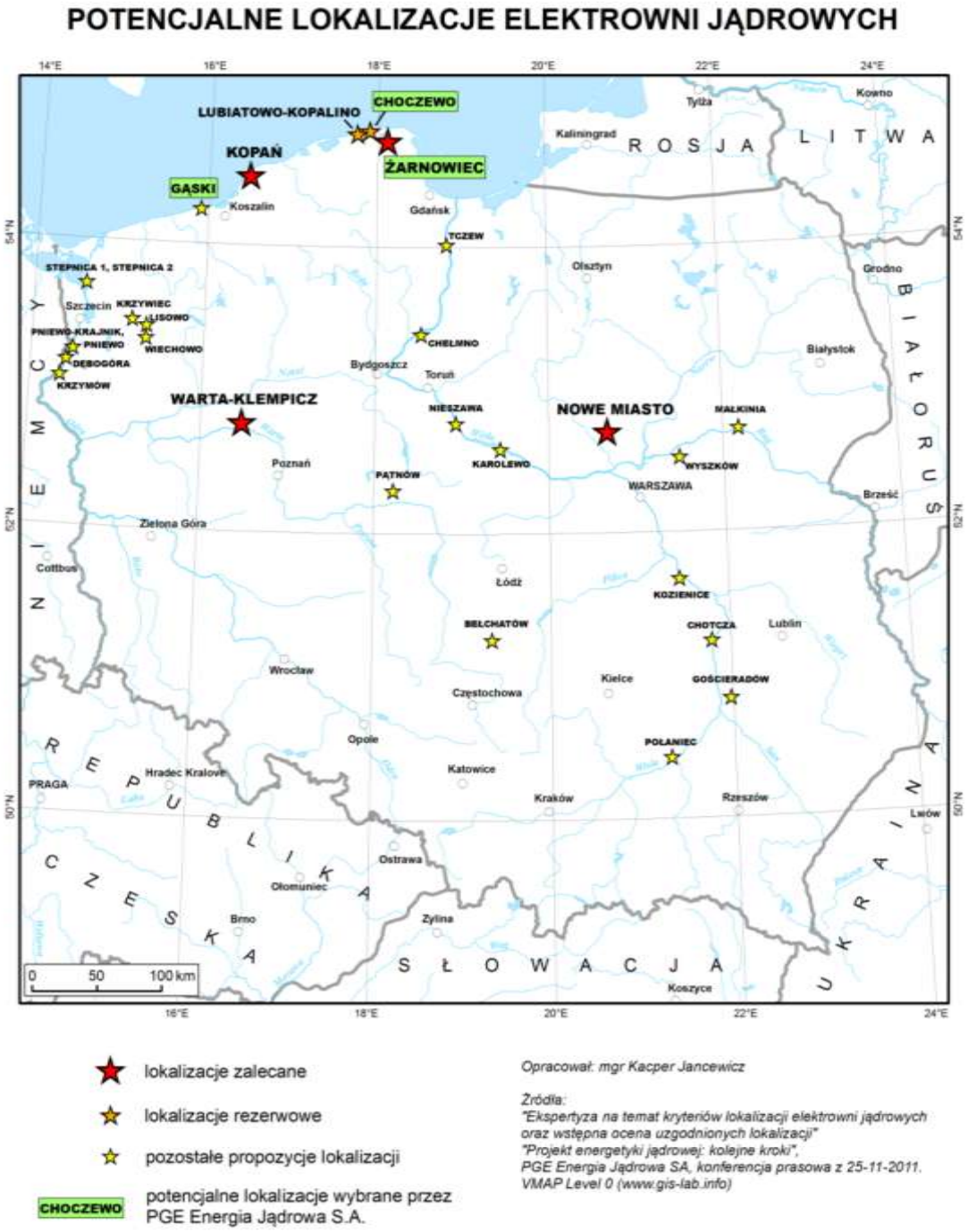
- Obszary NATURA 2000 (obszary specjalnej ochrony ptaków)

Opracował: mgr Kacper Jancewicz

Źródła:
"Ekspertyza na temat kryteriów lokalizacji elektrowni jądrowych oraz wstępna ocena uzgodnionych lokalizacji";
"Projekt energetyki jądrowej: kolejne kroki",
PGE Energia Jądrowa SA, konferencja prasowa z 25-11-2011;
wms.gdos.gov.pl/geoserver/web/;
www.eea.europa.eu;
natura2000.gdos.gov.pl;
VMAP Level 0 (www.gis-lab.info)

Potential locations of nuclear power plants against the deployment of special areas of bird protection



Potential locations of nuclear power plants in Poland

To make the choice of the most optimum location easier, a multi-factor analysis was performed for environmental impacts and technological options for recommended, backup, and other locations. The analysis of potential environmental impacts of the planned investment was based on: number of towns and villages in the restricted-use area; energy efficiency of wind; close vicinity of protected landscape areas; risk of land take and potential restriction of access to natural resources; potential impact on the cultural heritage; and impact on plants and animals. In addition

Chapter III refers to the European Energy Policy and the Polish Energy Policy until 2030 and presents important decisions that have been made concerning the development of the nuclear energy programme in Poland.

Chapter IV presents an analysis of the costs and the economic justification for development of the nuclear energy sector. The analysis assumes the individual costs of electricity generation based on the forecasts of global research centres, with a very conservative approach to state-of-the-art technologies (mostly nuclear power plants). The results of the analysis, in line with the facts presented in the program, confirm the significant advantage of nuclear power plants compared to conventional power plants and RES. Moreover, the analysis confirms the need to implement the nuclear energy programme due to the need to assure the operation of the Polish energy system after 2020 with Poland fulfilling its obligations.

Chapter V describes the organization of the works related to the Programme's implementation.

Chapter VI covers the matter of establishing the conditions for safe implementation of the nuclear energy sector.

Chapter VII discusses the cost of performance and sources of financing of the Programme.

Chapter VIII discusses the issue of selection of the locations for the future nuclear plants in Poland. The chapter presents a review of the siting studies for nuclear power plants in Poland performed before 1990 and information on the current status of the works related to the updates of the previous studies and the new research. The results of the studies was the ranking list prepared by the Ministry of Economy, which included 28 locations. The results of the analysis were submitted to the future investor, the Polska Grupa Energetyczna S.A. (PGE) which selected 4 main locations and 2 backup locations for further detailed studies. As a result of research conducted in 2011, two of the recommended locations and an additional location – Gąski were selected for further works.

Chapter IX discusses the matter of preparation and the required changes in the national power grid system. It mentions the need to expand the national grid system, in particular the 400 kV lines. Upgrade of the system was included in the development plan, to the extent necessary to satisfy the current and future demand for electricity in the years 2010-2025, prepared by the PSE-Operator S.A. The Polish Nuclear Programme underscores the fact that the solutions proposed in the development plan are inadequate and that it is necessary to determine the basic criteria that the connection of the nuclear power plant to the National Power Grid must meet. The Programme indicates that this task should be performed in close cooperation between the PSE-Operator S.A, the Investor, and the Energy Regulatory Office and with the support of independent consultants and experts. The chapter also points at important problems that must be resolved on the occasion of expansion of the National Power Grid, which are connected mostly to the long and excessive administrative procedures.

Chapter X focuses on environmental protection. It discusses mostly questions related to CO_2 emissions and, eventually, it will be replaced with this Report.

Chapter XI emphasizes the need to assure an appropriate number of qualified staff at the project preparation stage, construction phase, and operation phase. It was clearly stated that failure to complete the basic intent described in the chapter will constitute a serious risk to timely completion of the Programme.

Chapter XII describes the formation of the National Centre for Nuclear Research as the technical and scientific-research support for the Polish nuclear energy programme. The Centre will support the government and the nuclear regulatory office in the area of safe operation of nuclear facilities.

Subchapter (9.2) presents the characteristics of these impacts in terms of their scale of impact, nature, duration, continuity and the possibility of occurrence. Subchapter (9.3) shows the total balance of impacts, both positive and negative.

In the successive sub-chapter (9.4), the reader is made familiar with the possibility of cumulative impacts, while sub-chapter (9.5) presents, in accordance with the statutory requirement, an analysis of the possibility of trans-border impacts. The last sub-chapter (9.5) comprises an analysis of the likelihood of public conflicts.

Chapter 10 presents analyses of possible alternative scenarios. Because of the unique assessment of the strategic document, in addition to the analyses of possible technical and location scenarios, an additional analysis was performed of the possible scenarios of the strategy to acquire energy for Poland and to assure the country's energy safety. The analysis of the location scenarios focused most of all on the seven most likely locations, as the impact matrixes prepared in the previous chapters were superimposed on them. Also, less detailed references to the remaining locations were made (the expert opinion on the location, prepared by Energoprojekt Warszawa S.A. defines them as not suitable as a site of a nuclear power plant).

The document ends with a concluding chapter which presents the conclusions and recommendations, as well as the anticipated methods of analysis of the consequences of the program's implementation (**chapter 11**).

1.1.1 Description of the assumptions made and the methods of the individual analyses

The reference objects method

The reference objects method was selected to determine the anticipated significant impacts related to the performance of the Polish Nuclear Program. The method consists in applying the impacts of a specific implemented project to the location of the proposed investment. For this purpose, the monitoring data and the relevant EIA reports are used for this purpose.

No data on the implemented nuclear power projects including Generation III EPR, AP1000 and ESBWR reactors that will be potentially used in Poland was available during the preparation of this Report. The author of the Report has, however, obtained access to safety analyses of such nuclear power plants, which define the radiation impact of the plant on the environment and on people during regular operation and during emergencies.

Also, monitoring data for Generation II nuclear power plants that have been built in other countries was used. Because Generation III nuclear power plants will have all the good characteristics of the operating Generation II plants, the monitoring data from the existing plants can be used to determine the likely impacts of Generation III plants.

Thus, to determine the consequences of the implementation of the Programme, a mixed method was used, which consisted in extrapolating the monitoring data for Generation II plants to Generation III plants and in using the data from the safety analyses. Based on this, a model of Generation III nuclear power plant's impact on the environment was elaborated; this model will be applied to the proposed locations.

Analysis and evaluation of the impact of emissions from nuclear power plants

A separate chapter (**chapter 7**) is dedicated to the matter of radiological impact, which is the single impact causing the greatest concern.

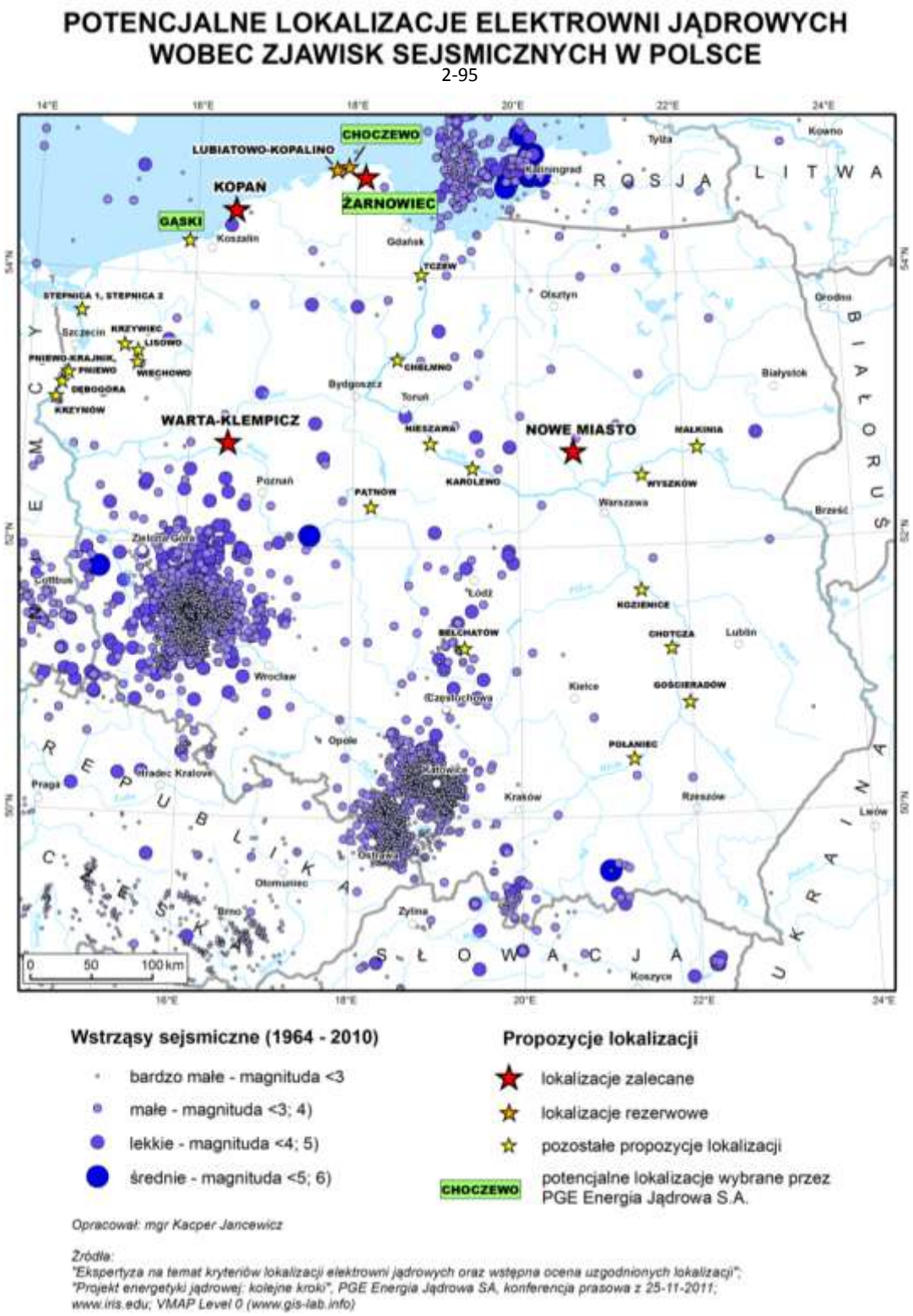


Fig. 4.2.4. Potential locations of nuclear power plants against seismic phenomena in Poland

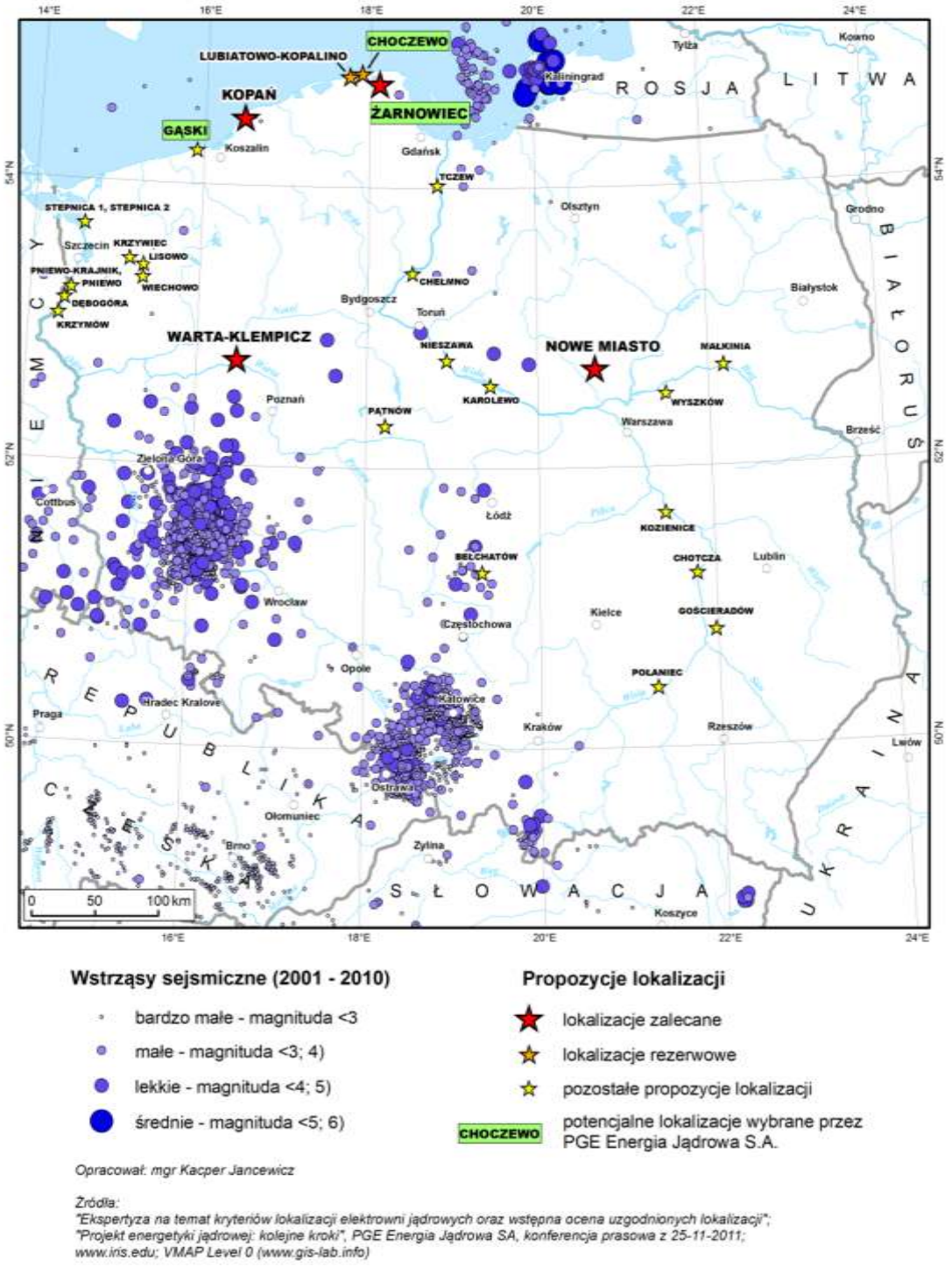


Fig. 4.2.5. Potential locations of nuclear power plants against seismic phenomena in Poland in the last decade

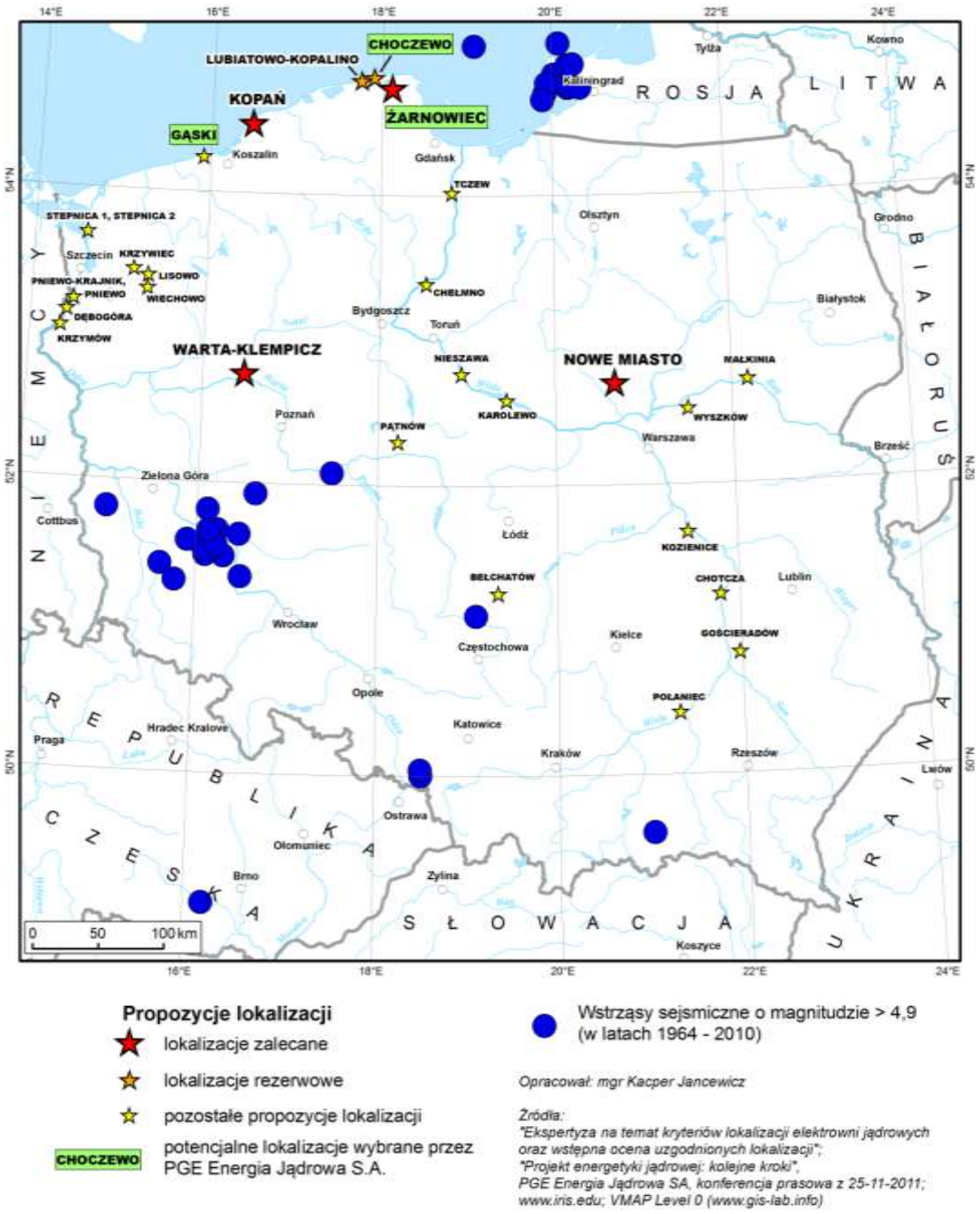


Fig. 4.2.6. Potential locations of nuclear power plants against the most potent seismic phenomena in Poland in 1964–2010.

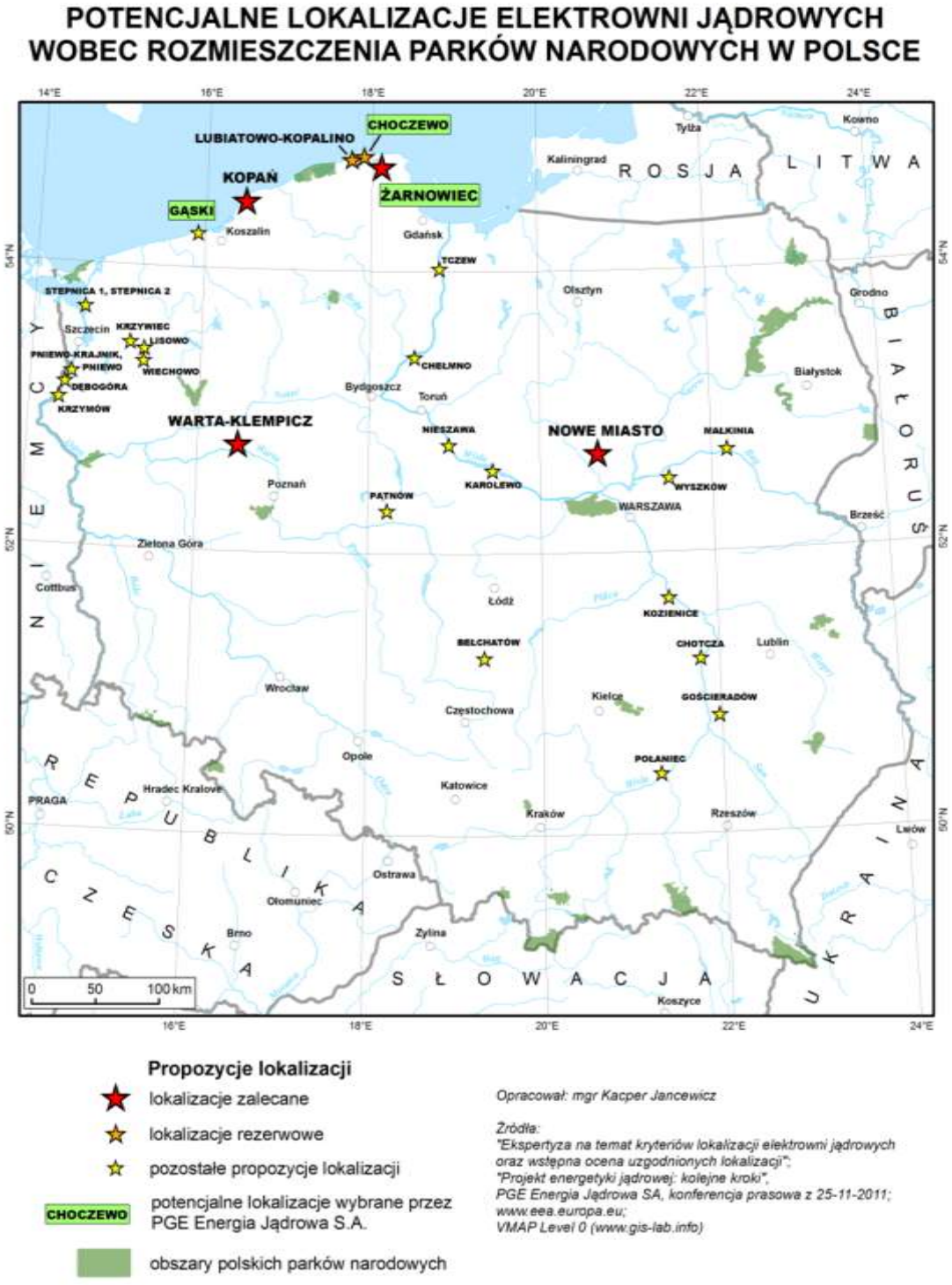


Fig. 4.9.8 Potential locations of nuclear power plants against the deployment of national parks in Poland

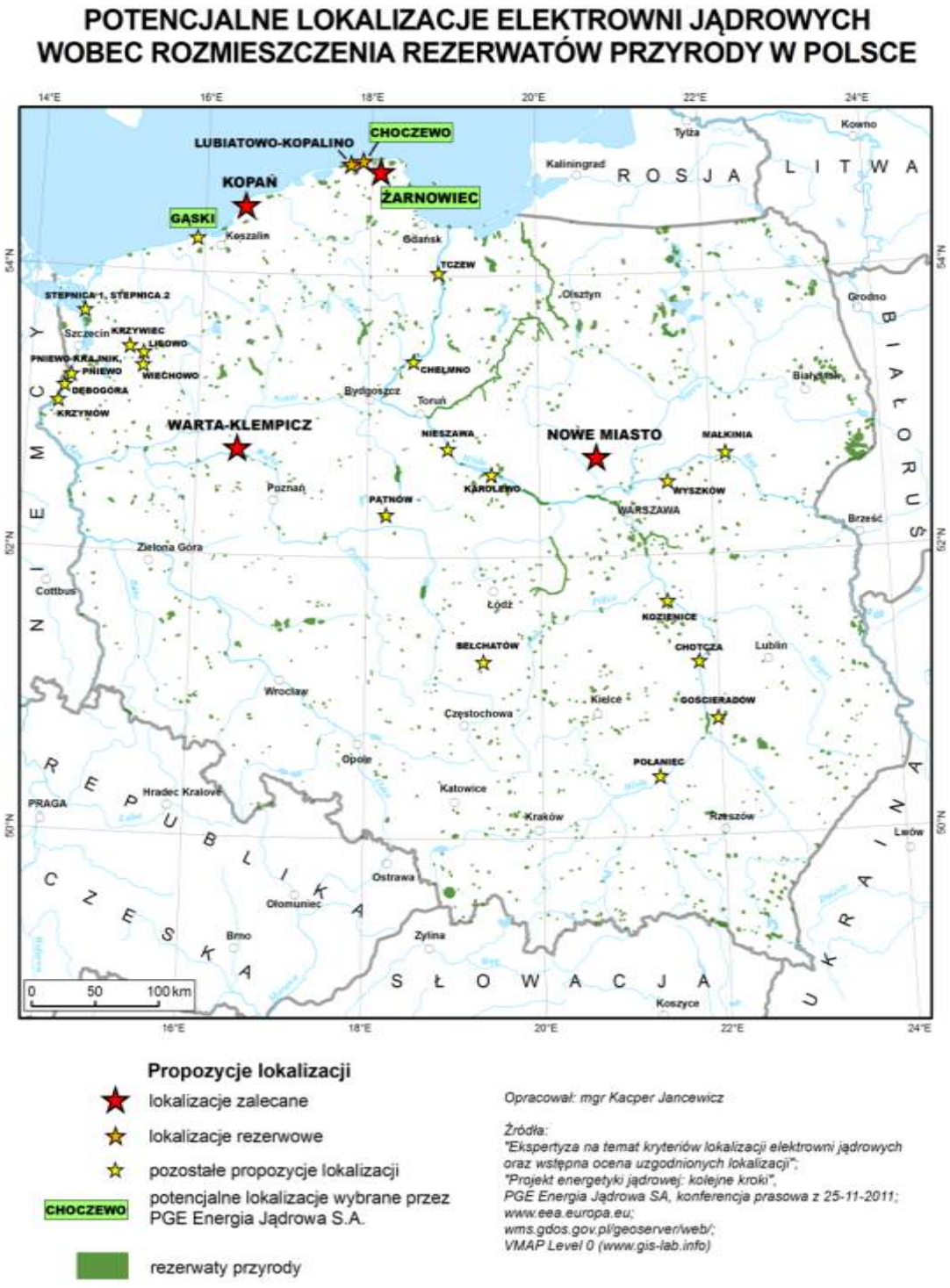


Fig. 4.9.9. Potential locations of nuclear power plants against the deployment of natural reserves in Poland

Landscape parks

A landscape park is a protected area due to the natural, historical and cultural heritage and landscape values, designed for preservation and popularisation of these values in conditions of sustainable development. A landscape park is one of the reserve (area) forms of nature and it is created by resolution of the regional council, which specifies its name, area, boundaries and potential buffer zone. It also describes the specific objectives of protection, and prohibitions

applicable to a park. Currently in Poland there are 121 landscape parks with a total area of 260,705.8 hectares.

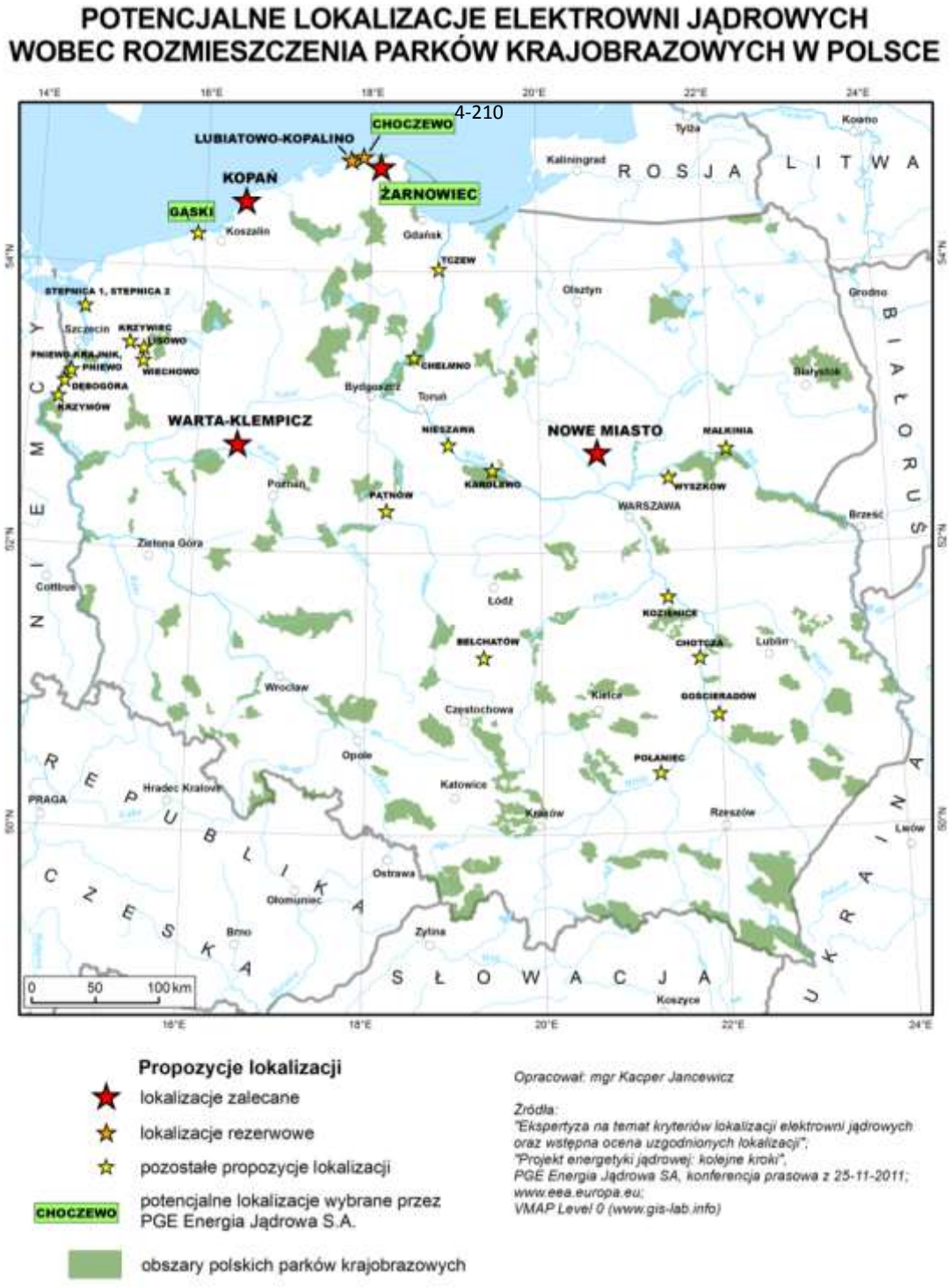


Fig. 4.9.10 Potential locations of nuclear power plants against the deployment of landscape parks in Poland

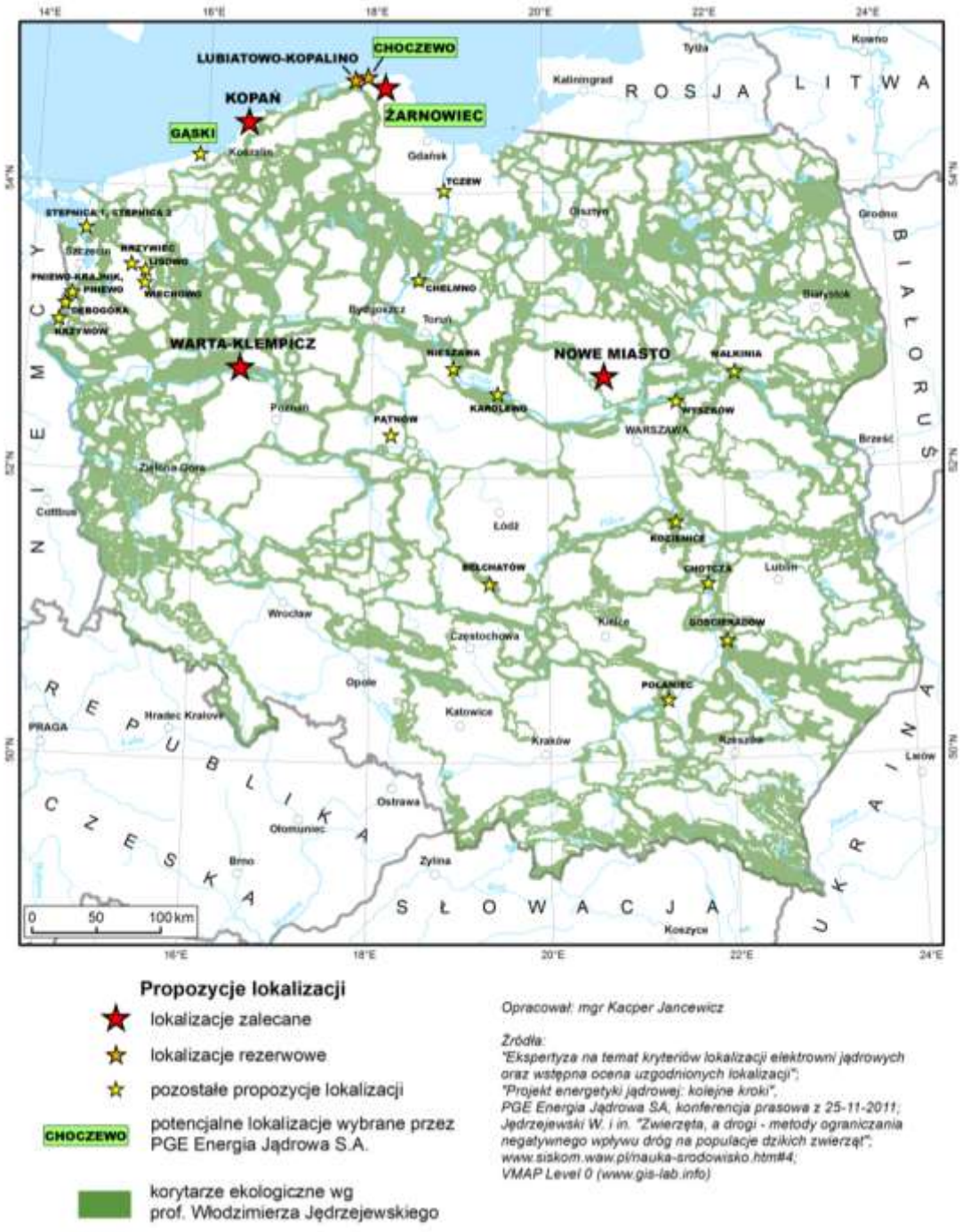


Fig. 4.9.11 Potential locations of nuclear power plants against distribution of ecological corridors in Poland

Nature conservation on an international scale

Natura 2000

European Ecological Network Natura 2000 is a system of protection of threatened components of biological diversity of the European continent implemented since 1992, in a consistent manner under

Currently, the habitats part of the network consists of 823 areas covering about 11% of Polish territory.

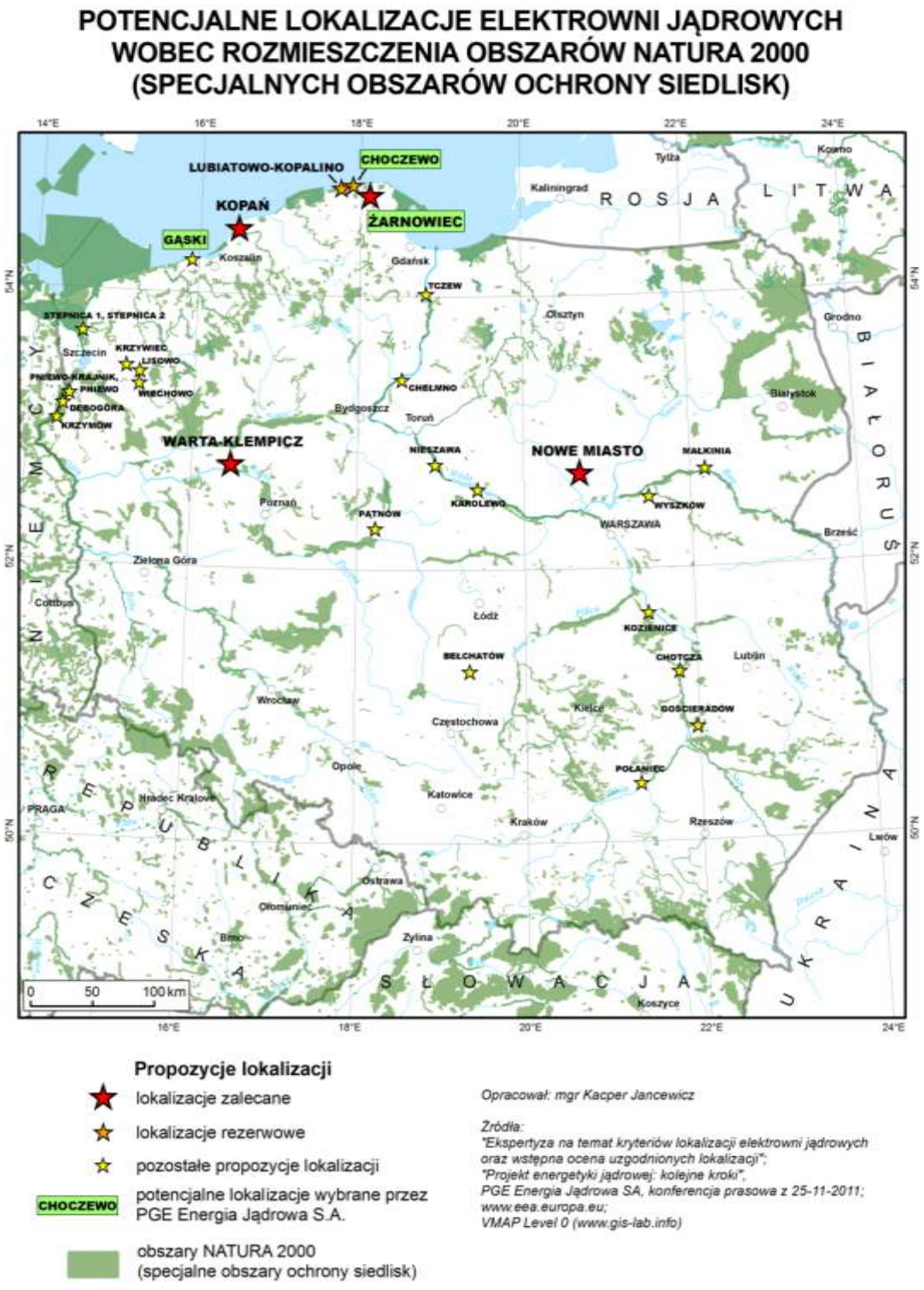
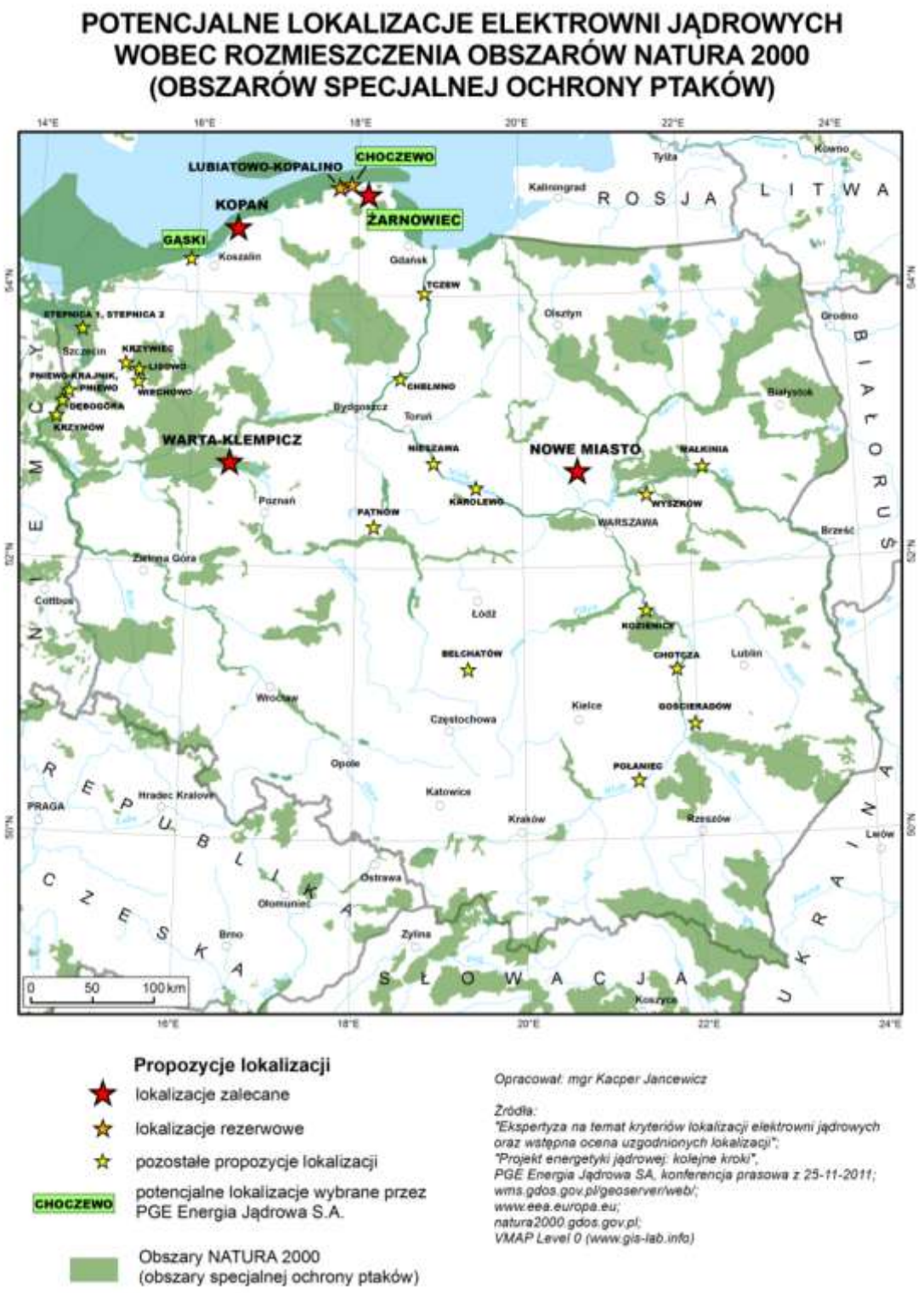


Fig. 4.9.12 Potential locations of nuclear power plants against the deployment of special areas of habitat protection

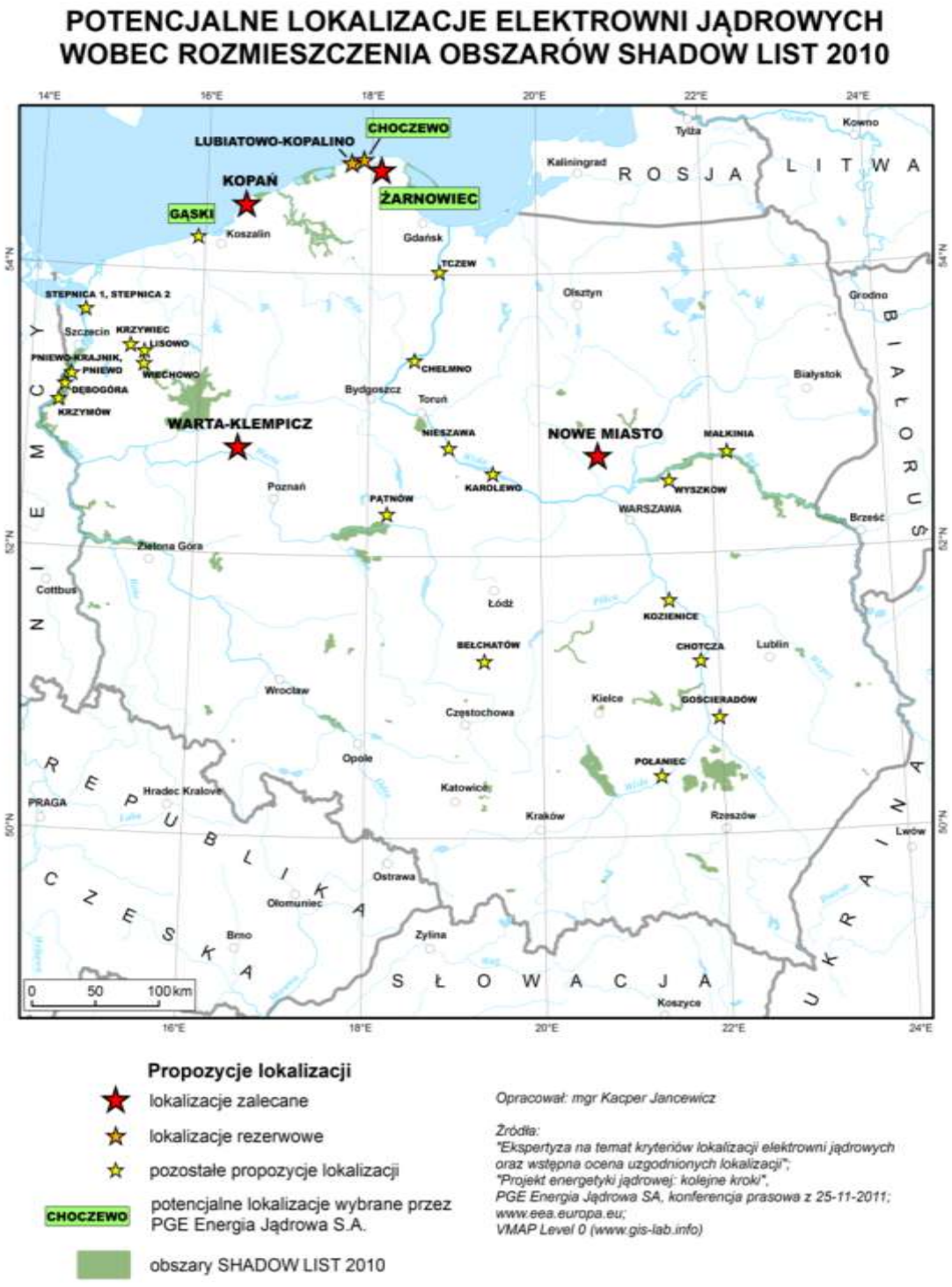
In Poland, 174 bird refuges have been selected so far, occupying about 20% of the country.



Potential locations of nuclear power plants against the deployment of special areas of bird protection.

Five annexes are assigned to the Birds Directive:

- Annex 1 Lists the species under special protection



Potential locations of nuclear power plants against the deployment of Shadow List 2010 areas.

International conventions to which Poland is a party

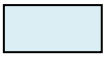
Washington Convention (CITES) - Convention on International Trade in Endangered Species threatened with extinction, done at Washington on 3 March 1973, is also known as the Washington Convention or CITES for short. The purpose of the Convention is to protect wild populations of animals and plant species threatened with extinction by controlling and restricting international trade in these animals and plants, their recognizable parts and derivatives. The Republic of Poland ratified the accession to the Convention on 12 December 1989. It entered into force in Poland on 12 March 1990.

Tab. 4.9.9 Tabular summary of the distribution around the individual locations of area forms of nature conservation

	Locations / Forms of conservation	Żarnowiec	Warta Klempicz	Kopań	Nowe Miasto	Choczewo	Lubiatowo Kopalino	Chełmno	Nieszawa	Gościeradów	Chotcza	Bełchatów	Karolewo	Kozienice	Małkinia	Wyszków	Tczew	Połaniec	Pątnów	Krzywiec	Lisowo	Wiechowo	Pniewo	Pniewo Krajnik	Dębogóra	Krzymów	Stepnica 1	Stepnica 2	Gąski
1	**Special Habitat Protection Areas**																												
a	covering/on the border of location			1		1			1		1						1						1	1	1	1	1	1	
b	in close proximity to the location	7	1	2		3	3	1	2	5	1		4	3	2	3	2	3	2		1	2	6	6	7	3	2	2	1
2	**Special Bird Protection Areas**																												
a	covering/on the border of location		1						1		1			1			1			1	1	1	1	1	1	1	1	1	1
b	in close proximity to the location	3		1		1	1	1		1			2	1	1	2			1				3	3	2	3	3	3	
3	**New Areas of Natura 2000 - Shadow List 2010**																												
a	covering/on the border of location																												
b	in close proximity to the location			1																									
4	**Nature reserves**																												
a	covering/on the border of location																												
b	in close proximity to the location	4	1			4	4	3	1	3	3	1	8	3	4		2	1	4		1	1				1	3	3	
5	**Landsacape Parks**																												
a	covering/on the border of location							1			1		1										1						
b	in close proximity to the location	1				1							1	1	1	1					1	1		1	1	1			
6	**Protected Landscape Areas**																												
a	covering/on the border of location		1			1	1										1		1										1
b	in close proximity to the location	1		1	1				4	2	4			1															

Explanations for Tab. 4.9.9:

- recommended locations

 - back-up locations

 -other locations

Żarnowiec – locations selected by PGE

- 23 kWe/MW_t for a closed system with a wet-dry hybrid cooling tower (increased consumption of cooling water by the pumps + uptake by the cooling tower fans).

At this stage, **designs of cooling systems** for nuclear power plants in Poland have not been developed yet. They will be developed for specific locations selected by the investor.

Upon commission of PGE Energia Jądrowa S.A., BSiPE „Energoprojekt Warszawa" S.A. conducted in 2010 a more specific study of the following 6 locations (from 28 proposed): Żarnowiec, Lubatowo-Kopalino, Choczewo, Kopań, Warta-Klempicz and Nowe Miasto. Based on this study, the Investor has selected 3 locations for preliminary closer assessment: Żarnowiec (closed cycle) and Lubatowo-Kopalino and Kopań (open cycle - cooling with sea water). As a result of research conducted by PGE in 2011, two locations among 28 submitted (Choczewo and Żarnowiec) were selected for further works and an additional location – Gąski was submitted. the final selection of location for the first nuclear power plant will be made by the end of 2013. One of the selection criteria will be information in this forecast.

Open (flow) cooling systems without cooling tower

This cooling system in a nuclear power plant may be used in locations with an access to large reservoirs of cooling water, without hydrothermal limitations.

In practice, this option is possible only for the following locations: coastal, on the river - in lower course of big rivers, and situated at the estuaries of big rivers (including bays).

For a nuclear power unit with net capacity of **1000 MW_e** expenditure of cooling water, with 10 K heating, is ca. **50.2 m^3/s** (with 12 K: ca. 41.8 m^3/s).

Option of sea water cooling is attractive due to lower temperature, which allows for deeper vacuum in turbine condensers and obtaining higher energy generation efficiency) and practically no limits in terms of resources and hydrothermal limitations.

However in technical terms, sea water intake and discharge presents technical problems due to:

- low depth in coastal zone and sandy bed;
- dynamic effect of sea water in coastal zone (variable sea currents, waves);
- intense rubble movement along the coast;
- tendencies for changing coastal line and embacles.
- Basic parameters of Baltic Sea:
- area: 415,266 km^2;
- capacity: 21,721 km^3;
- temperature of surface water in coastal zone: from -0.5°C (in winter) to +18÷20°C (in summer).

Cooling water intakes are planned at the depth of 10 m, in the following distance from the coast: 400-500 m (Kopań), 500-800 m (Lubatowo-Kopalino). Discharge of cooling water should be in the distance of ca.

26	**Krzymów**	Commune Chojna, District Gryfino, Zachodniopomorskie	River	Open			Sufficient
27	**Stepnica 1**	Commune Stepnica, Zachodniopomorskie	Zalew	Open	Zalew Szczeciński	911.8 km^2 (457.3 km^2 in Polish territory); 2.75 km^3; average depth 4m; average annual Odra outflow 16.3 km^3; salinity 0.5-2.0 ‰	Sufficient
28	**Stepnica 2**	Commune Stepnica, Zachodniopomorskie	Zalew	Open			Sufficient
29	**Gąski**	Mielno commune, Zachodniopomorskie province	Coastal	open	Baltic Sea (0.85 km)	Baltic Sea as in pt. 12	Sufficient

Explanations: SSQ – average annual flow; SNQ – average low flow value per year; SWQ – average high flow value in a year; NNQ – the lowest observed flow value

Raw water demand

Annual water demand of a PWR unit with net electric capacity of **1000 MW_e** (estimated on the basis of data for EPR **total 195 000 m^3/a** (which corresponds to average intake ca. 530 m^3/d = 22 m^3/h = 0.0062 m^3/s), of which:

Make up water for process cycles (except for a cooling water cycle) - demineralised: ca. **94 000 m^3/a** (demineralised water demand of the unit falls between ca. 256 m^3/d – during normal operation, and ca. 694 m^3/d – during start-up);

Water for other process purposes, not requiring treatment: ca. **72,000 m^3/a**;

Treated (potable) water for household needs (drinking, sanitary - WC and showers, preparing meals) and industrial purposes (laundry, labs, washing electrolysers, air conditioning etc.): **29,000 m^3/a.**

For comparison purposes: raw water intake (underground water from the second water-bearing layer of Quaternary) for **"old" Żarnowiec power plant** (1830 MW_e gross, ca. 1700 MW_e net) has maximum capacity exceeding 500 m^3/h = 0.14 m^3/s, i.e. per 1000 MW_e net: 294 m^3/h = 0.08 m^3/s.

Therefore, raw water demand of a nuclear power unit with net capacity **1000 MW_e** is relatively small (on average ca. 530 m^3/d) and **it will not restrict a nuclear power plant location.**

The sources of raw water for filling and making up process systems will be - depending on availability and hydrological and hydrogeological conditions at a specific site - surface or underground waters (from Quaternary or Tertiary formations).

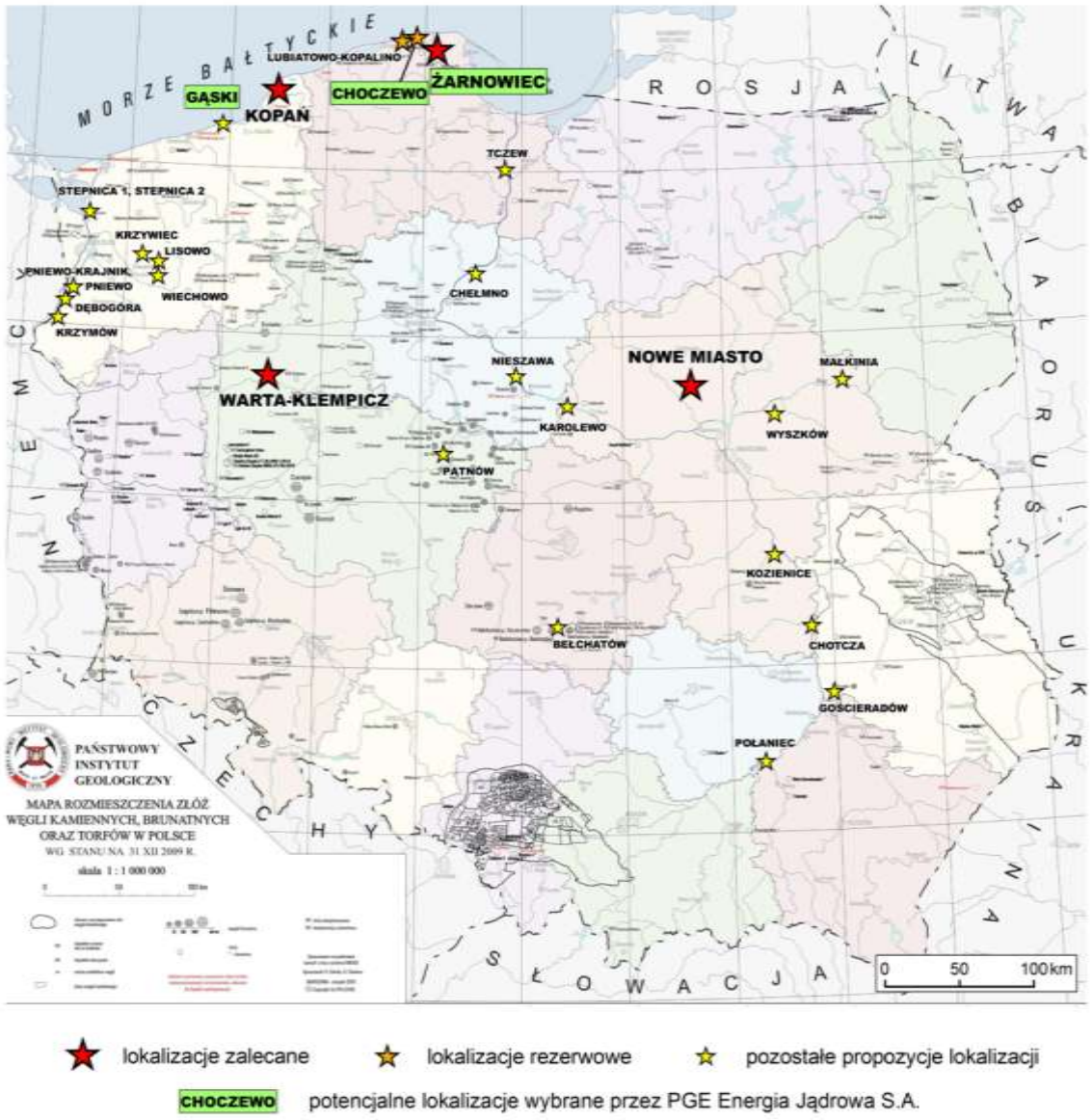


Fig. 8.3.45 Distribution map of hard coal, brown coal and peat deposits in terms of potential nuclear power plant sites (source: http://old.pgi.gov.pl/surowce_mineralne/).

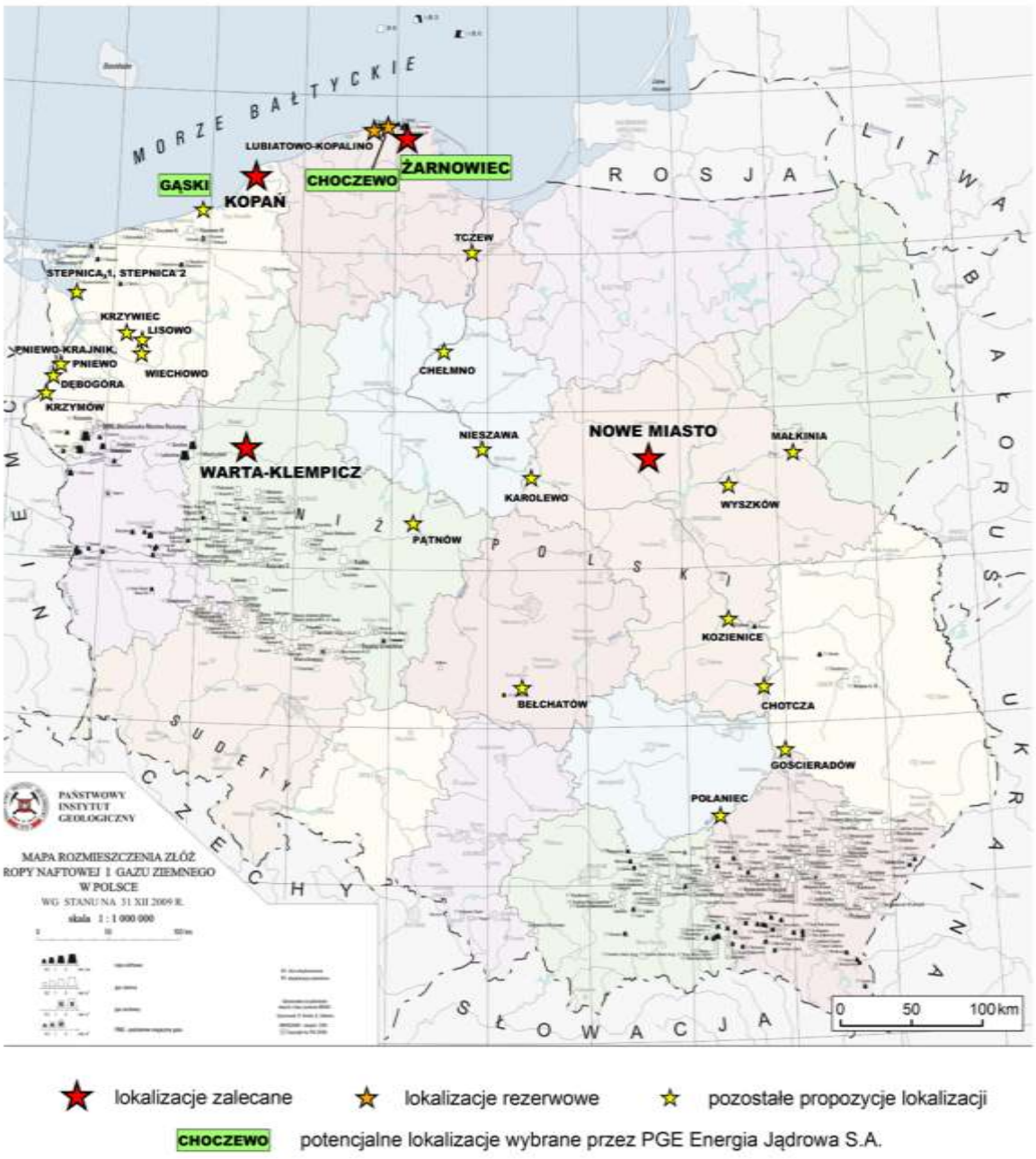


Fig. 8.3.46 Distribution map of petroleum and natural gas deposits in terms of potential nuclear power plant sites (source: http://old.pgi.gov.pl/surowce_mineralne/).

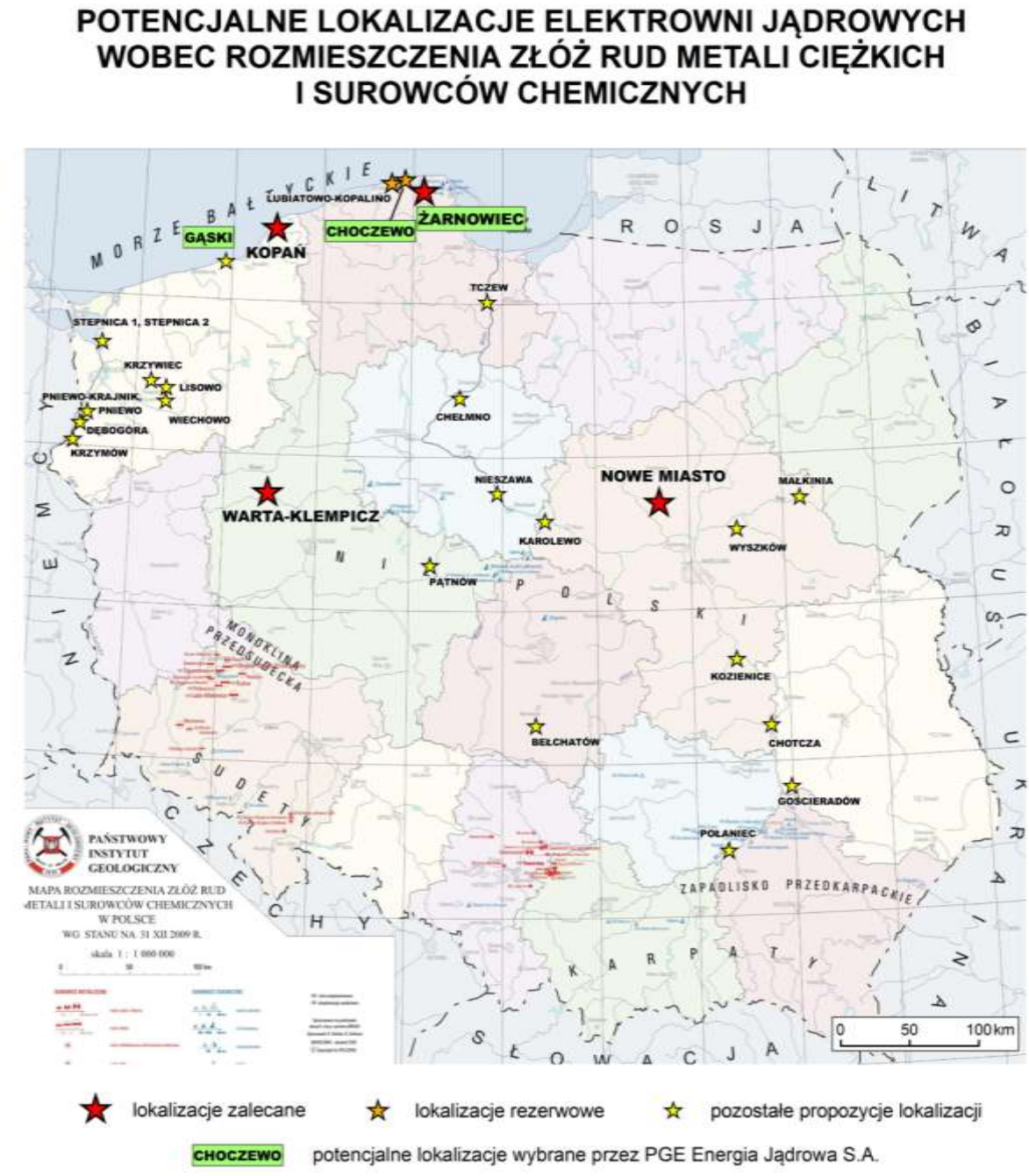


Fig. 8.3.47 Distribution map of metal and chemical deposits in terms of potential nuclear power plant sites (source: http://old.pgi.gov.pl/surowce_mineralne/).

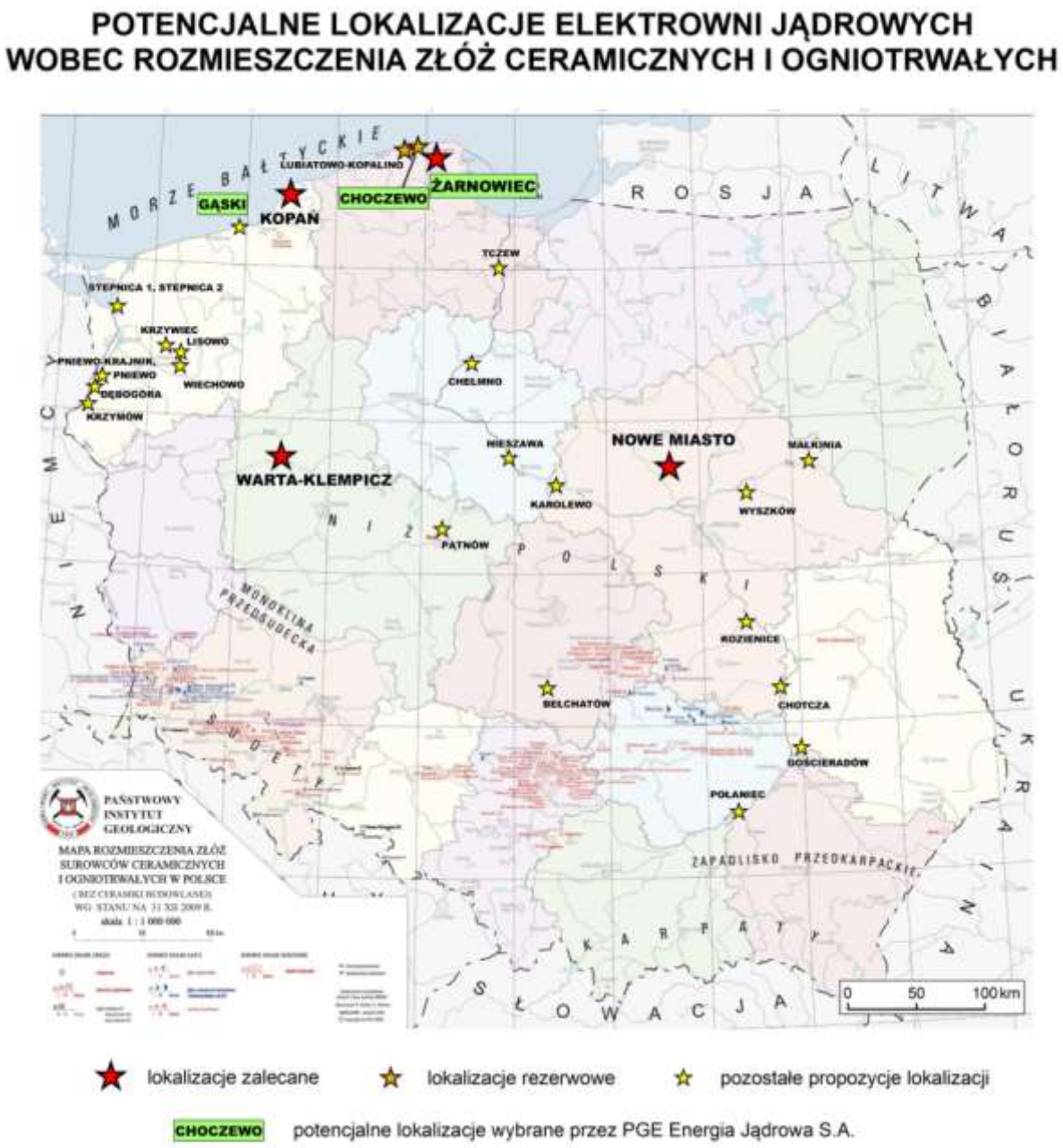


Fig. 8.3.48 Distribution map of ceramic and refractory deposits in terms of potential nuclear power plant sites (source: http://old.pgi.gov.pl/surowce_mineralne/).

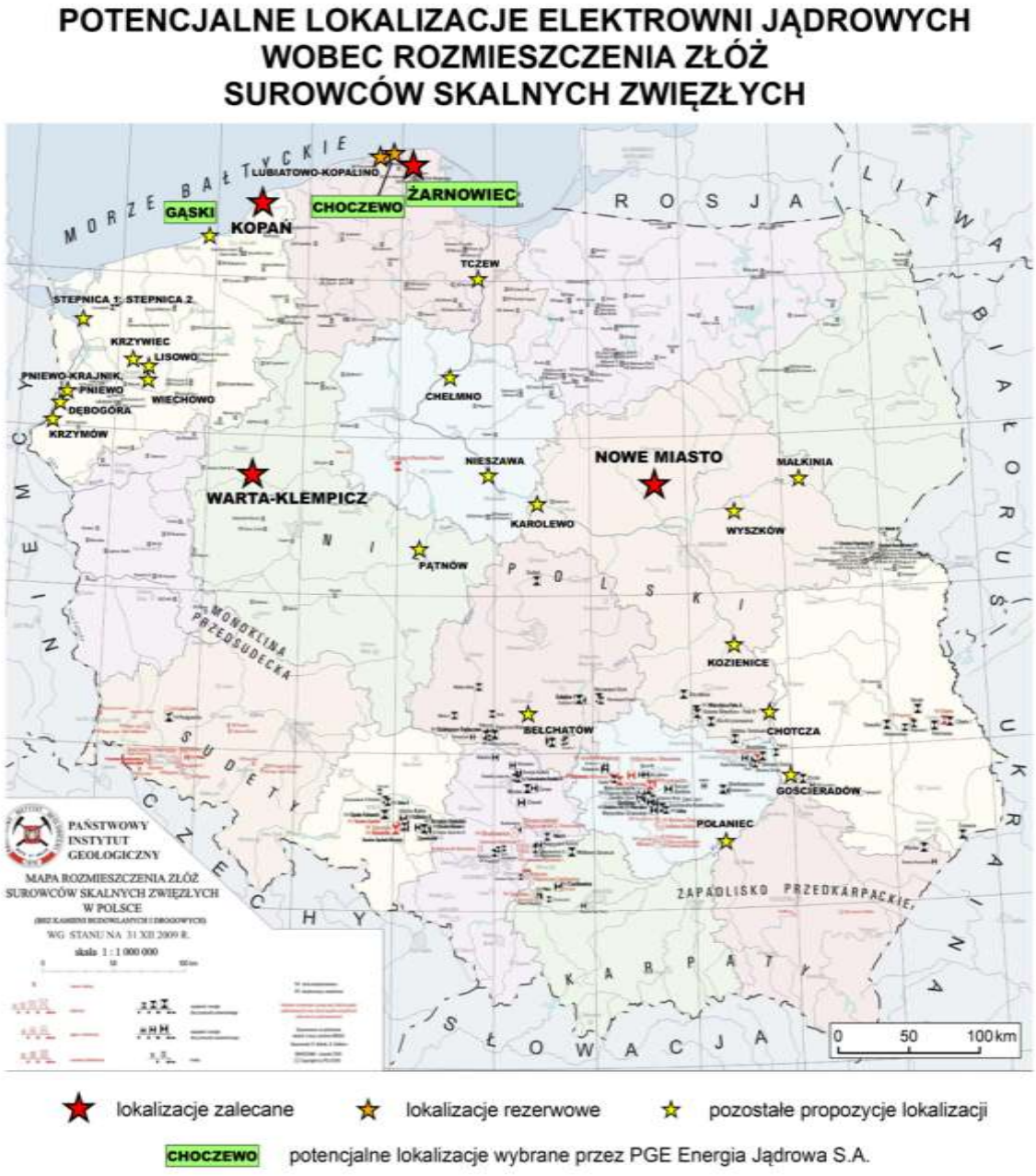


Fig. 8.3.49 Distribution map of firm rock deposits in terms of potential nuclear power plant sites (source: http://old.pgi.gov.pl/surowce_mineralne/).

Impact of the infrastructure development

Condition of Polish infrastructure and necessary directions of changes (specified in PSE strategy)

Polish high-voltage power supply grid is made up by grid infrastructure (state as of 2009), including the following facilities:

- 236 lines with total length of 13053 km, including one 750 kV, 114 km long, 68 lines with 400 kV voltage of total length 5031 km and 167 lines with 220 kV voltage, of total length 7908 km,
- 106 high voltage stations; 174 LV/110 and LV/LV kV transformers with total capacity of 38 450 MVA.

Fig. 8.3.50 Power supply grid in Poland

Territorial scope of power supply transmission system covers entire Poland. The greatest grid density occurs in southern part, and the lowest - in north-eastern part.

nuclear power plants and preliminary assessment of the agreed locations", which analyzes the locations in the ministerial list. The study recommended six potential sites: Żarnowiec, Nowe Miasto, Kopań, Warta-Klempicz and Choczewo and Lubiatowo-Kopalino. As a result of research conducted by PGE in 2011, two locations among those six (Choczewo and Żarnowiec) were selected for further works and an additional location – Gąski was submitted. Use of other locations (except for Kozienice) in foreseeable term is unlikely, especially for the construction of the first two nuclear power plants - as is clear from the information obtained from the Ministry of Economy and PGE S.A.

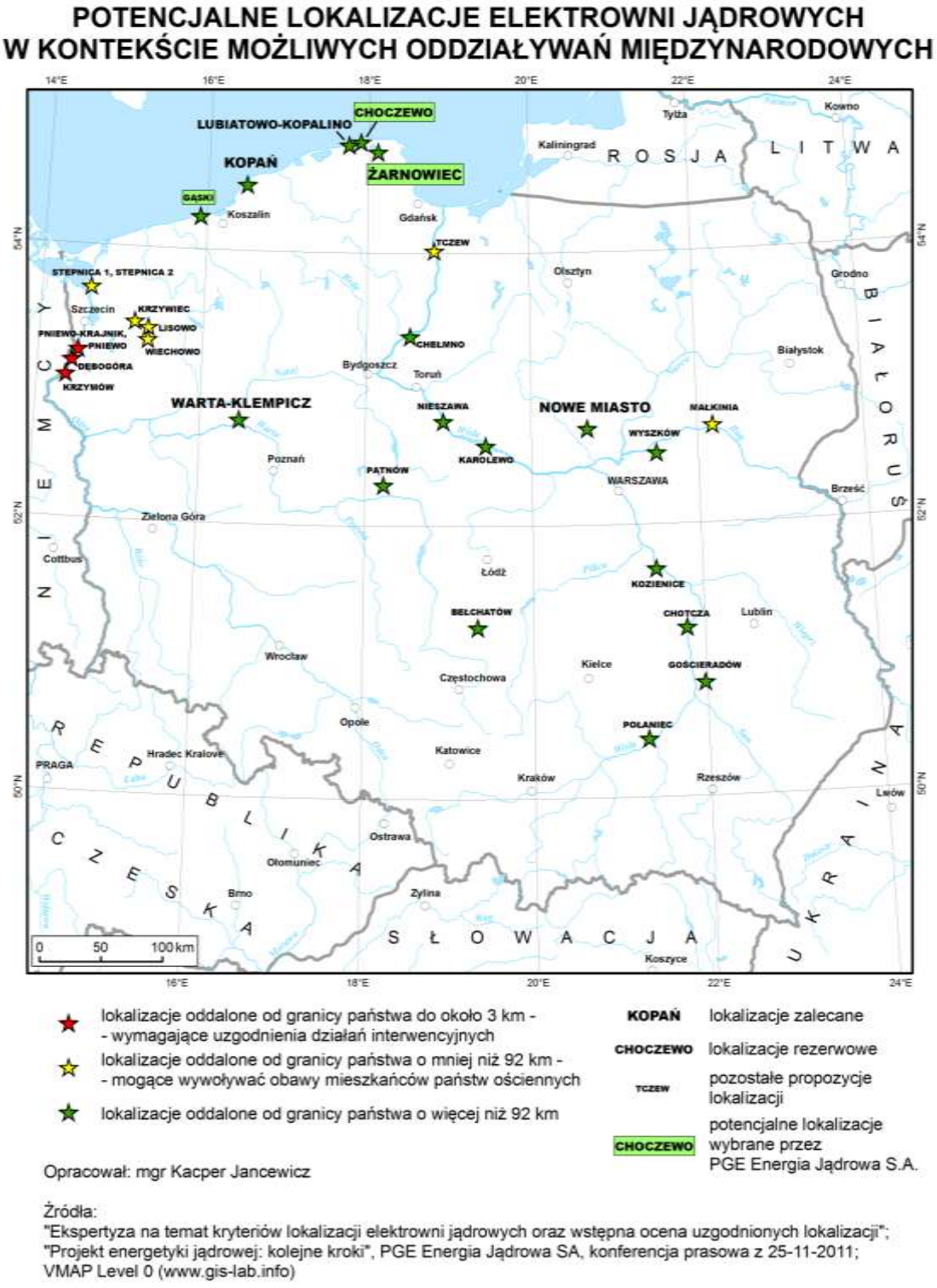


Fig. Virhe. Tällä tyylillä kirjoitettua tekstiä ei ole asiakirjassa..**1 Nuclear power plant sites in Poland in the context of possible international impacts**

For all locations, a table was developed with distances to the nearest Polish borders. The table marks the locations which are closer than 92 km from the Polish border and those whose limited use area goes beyond the State boundary. In the latter case the locations were also marked which are not in the immediate limited use area, but are very close.

Table Virhe. Tällä tyylillä kirjoitettua tekstiä ei ole asiakirjassa.**.1 Approximate distances of potential sites of nuclear power plants in Poland from the borders of the state.**

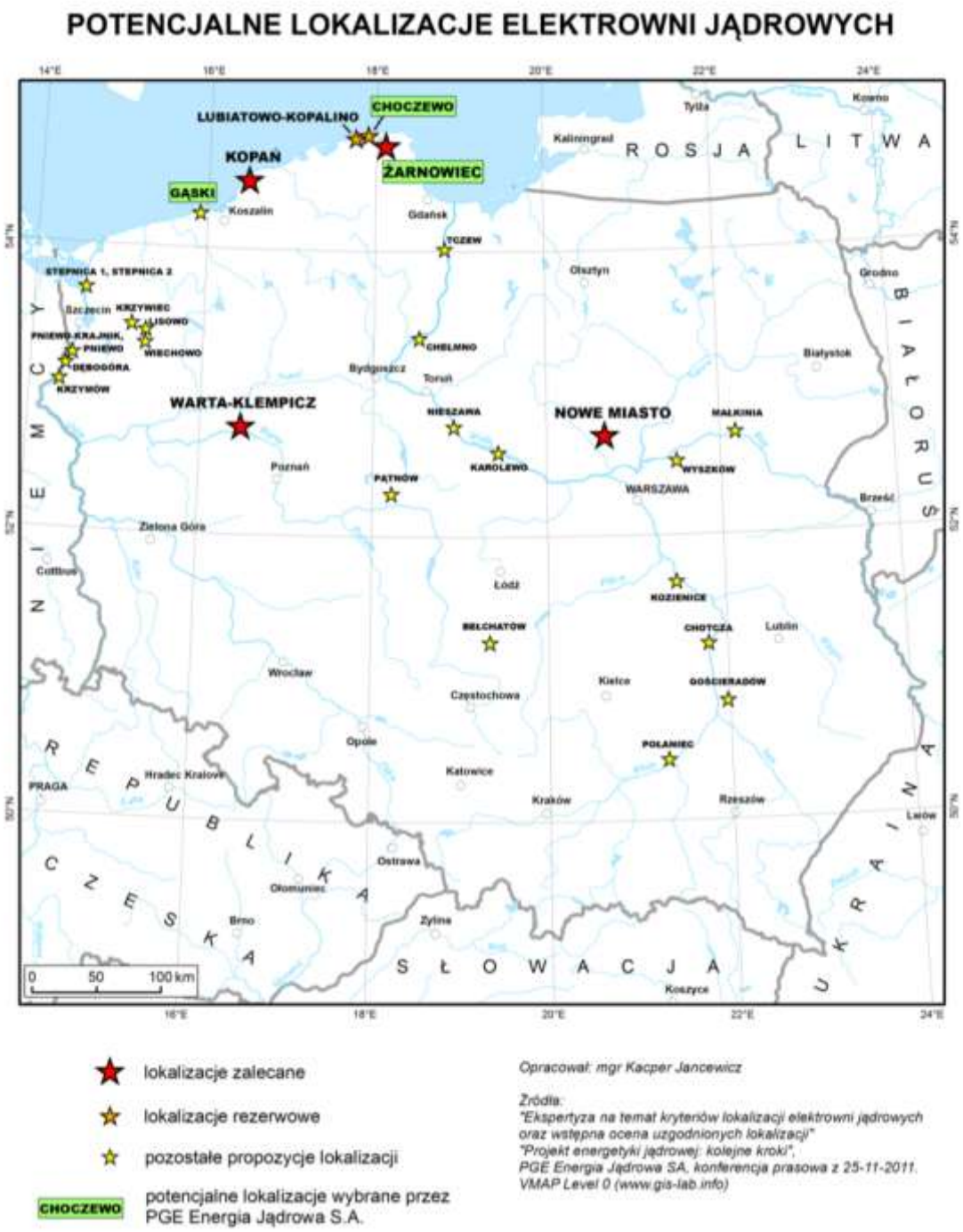
		Distance [km]							
No.	**Location**	**Baltic Sea***	**Germany**	**Czech Republic**	**Slovakia**	**Ukraine**	**Belarus**	**Lithuania**	**Russia**
1	Bełchatów	329,6	300,5	154,9	184,3	299,4	287,4	412,3	354,4
2	Chełmno	107,6	272,4	338,9	426,2	398,6	334,4	284,5	139,1
3	Choczewo	0,3	257,6	460,1	589,7	523,2	377,0	245,9	120,0
4	Chotcza	369,8	470,9	270,6	199,5	129,5	128,6	322,7	343,5
5	Dębogóra	48,9	**2,3**	233,3	499,4	650,3	599,2	524,2	373,2
6	Gościeradów	416,3	488,4	260,0	156,2	124,3	136,3	360,8	389,2
7	Karolewo	181,7	324,9	280,0	332,1	306,6	255,4	296,4	206,5
8	Kopań	2,7	159,8	395,4	573,1	575,5	461,4	342,5	204,6
9	Kozienice	316,1	447,7	281,3	246,9	151,8	135,2	289,0	294,4
10	Krzymów	62,0	**1,2**	220,9	492,3	652,3	602,5	534,0	382,5
12	Krzywiec	43,8	54,7	269,1	497,8	606,5	550,1	462,1	311,4
13	Lisowo	52,5	61,0	265,9	490,7	597,9	542,8	456,8	305,7
14	Lubiatowo-Kopalino	0,0	251,6	456,5	589,7	527,0	382,6	252,1	125,4
15	Małkinia	247,0	510,3	399,6	365,5	156,9	80,6	164,3	180,5
16	Nieszawa	163,9	291,8	285,5	354,2	345,9	292,4	309,8	193,1
17	Nowe Miasto	189,3	408,5	336,0	355,5	236,2	176,3	231,5	183,2
18	Pątnów	226,9	238,6	222,9	312,2	379,8	337,5	380,2	257,7
19	Pniewo	41,2	3,1	240,7	503,5	649,0	597,1	518,3	367,6
20	Pniewo-Krajnik	42,7	3,3	239,3	502,7	649,1	597,4	519,3	368,5
21	Połaniec	442,2	450,6	197,6	108,0	134,2	201,3	419,0	433,2
22	Stepnica-1	2,5	19,6	293,4	542,3	654,3	587,9	488,8	341,8
23	Stepnica-2	4,0	21,2	293,7	541,6	652,7	586,2	487,2	340,1
24	Tczew	36,5	300,7	410,1	493,0	419,7	306,6	224,2	72,0
25	Warta-Klempicz	155,6	125,9	213,5	392,0	506,1	457,7	433,7	281,9
26	Wiechowo	55,8	60,3	259,4	484,6	595,4	541,0	459,3	307,8
27	Wyszków	236,1	462,4	354,0	341,3	177,8	117,2	209,2	200,1
28	Żarnowiec	10,3	267,1	458,1	579,1	507,7	362,4	234,8	104,9
29	Gąski	0,85	115,5	361,7	558,7	581,5	497,5	343,7	243,6

* distances for the Baltic Sea including the Szczecin and Vistula Lagoon

Analysis of results:

Recommended and reserve (primary) sites:

- None of the primary locations is close enough to the border to make it necessary to coordinate interventions with the administrative authorities of the neighbouring state. Thus, in accordance with approved methodology, no State will be directly affected by the choice of one of the primary locations.
- None of the primary sites is located closer than 92 km from the border, therefore it can be assumed, in accordance with accepted methodology, that societies of neighbouring States will not feel concern as a result of the selection of one of the primary sites.



Ryc. 10.3.1 Potential locations of nuclear power plants in Poland

Expert opinion on the siting criteria for nuclear power plants and preliminary assessment of the agreed locations

In 2010, commissioned by the Ministry of Economy, a document was prepared, entitled "The study on the siting criteria for nuclear power plants and preliminary assessment of the agreed locations". The ranking of locations was performed, taking into account the expert assessment of the 17 evaluation criteria (the last place in the ranking is the location for which no geographical coordinates

were handed over, which due to formal reasons prevented its inclusion in the ranking).

The expertise carried out as part of this study revealed the following sequence of the most favourable locations of the first Nuclear Power Plant in Poland (Fig. 10.3.2.).

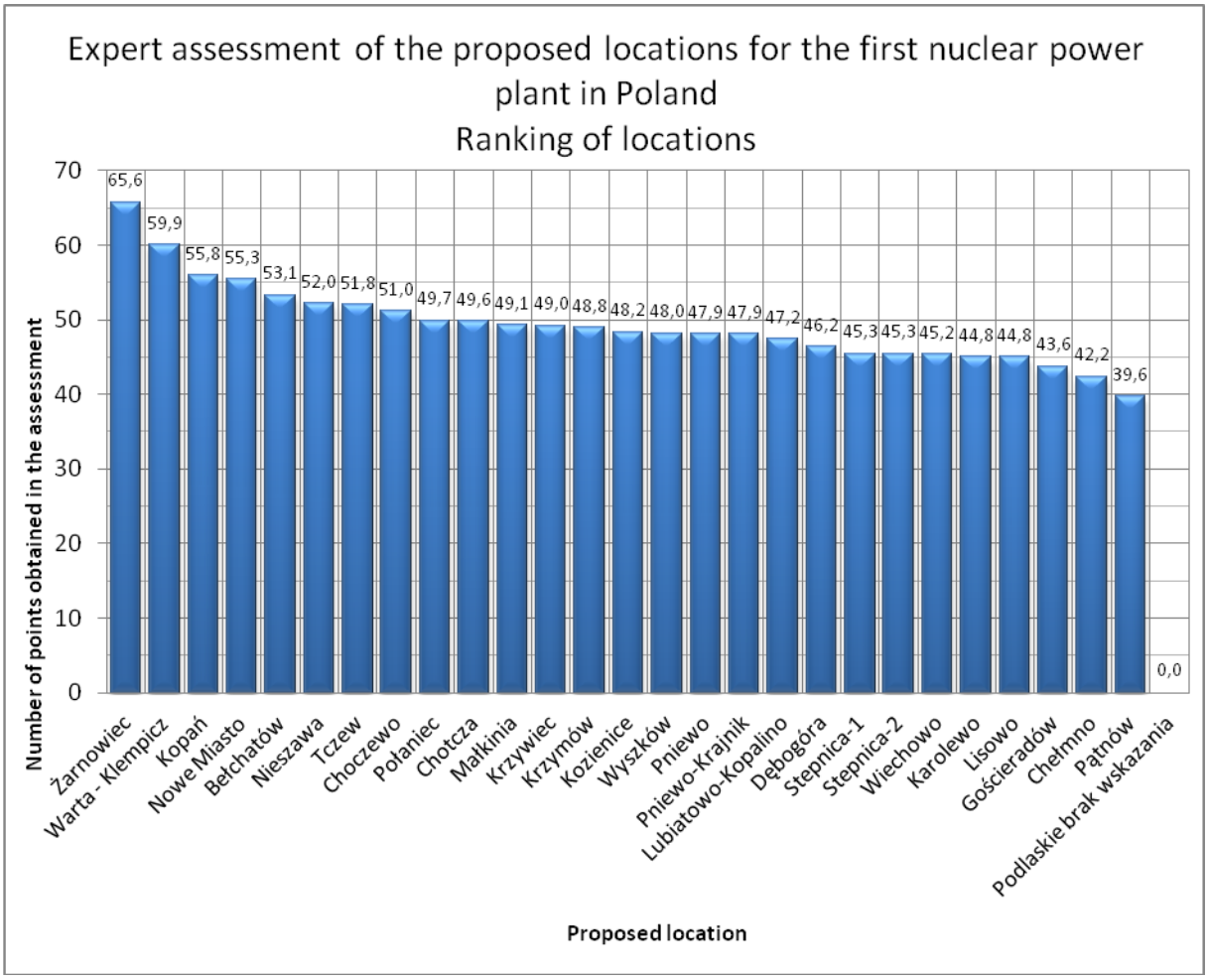


Fig. Virhe. Tällä tyylillä kirjoitettua tekstiä ei ole asiakirjassa..**2. Ranking of the proposed locations of nuclear power plant in Poland**

At the request of the Minister of Economy, funds were secured in the budget of the National Fund for Environmental Protection and Water Management to carry out further work on location analysis for nuclear power plants. According to information received at the Ministry of Economy, a company will be selected in the near future which will perform detailed fieldwork for three potential locations identified by the investor (the information obtained shows that these will be locations indicated by the expert opinion). This work should be completed by the end of the first half of 2013.

Returning to the results of the already developed site expertise, attention should be paid to the fact that Żarnowiec site was assumed (with vast majority) to be the site of the first nuclear power plant, recommended by the expertise authors. Żarnowiec was also recommended for further detailed studies of location.
The expertise also recommends another three (almost equivalent) locations: Warta-Klempicz, Kopań, Nowe Miasto for simultaneous location studies. Additionally, Choczewo and Lubiatowo-Kopalino were added. As a result of research conducted by PGE in 2011, two locations among those six (Choczewo and Żarnowiec) were selected for further works and an additional location – Gąski was submitted. On the basis of detailed studies and location expertise, other locations were excluded for various reasons and according to the information from Ministry of Economy and PGE S.A. it is very unlikely that they will be chosen as sites for two first

-

occurring in the vicinity of the site will not be used. In order to determine the occurrence of such an event, the presence of mineral deposits near the location has been analyzed. The analysis was based on maps of the raw materials developed by the Polish Geological Institute.

Description of **geological and hydrological structure** was developed on the basis of data in the study by Energoprojekt and literature. During the analysis, particular attention was paid to the geological structure of the substrate and susceptibility of lithology to infiltration rate, permeability, and cracking and discontinuous structures. In addition, attention was paid to the depth of groundwater levels and possible anthropogenic impacts.

Infrastructure related to electricity production and transmission is one of the most important factors affecting reasonable location of nuclear power plants. Here, accessibility of transmission grids, their current load as well as demand for electricity were analysed in the area which could be supplied in electricity from a nuclear power plant at a given site. Description of this factor uses an Expert assessment of the locations of nuclear power plants in Poland from the viewpoint of the possibility of connecting to the transmission network made for PSE S.A. and data from the study by Energoprojekt.

Factors affecting **fauna and flora** of a given site were described by experienced naturalists. Biodiversity in areas of individual locations was determined without field research, but only on the basis of literature data. The quality and accuracy of data in the source studies is relatively high, but the precision with which they can be accurately attributed strictly to the sites of the planned investments is approximate. Characteristics of diversity thus refer not to the point where a power plant is to be built, but to the area in which it is planned. It is difficult to precisely determine the boundaries of so adopted study, it may only be assumed that the established data refer to the area approximate in size to municipality or county. This should not however be a serious problem for two reasons: methodological and substantive. First of all, all the locations were analyzed in the same way, so regardless of their accuracy and possible errors, in all cases the data are comparable, and at this stage this is the main goal, i.e. comparison of locations. From the substantive point of view, extending the analysis from the scope of a specific place, which will be occupied by the plant, to closer or further surroundings is also justified, because construction of every plant is associated with infrastructure that can have a direct negative impact on diversity, even further away.

Recommended sites

Lokalizacja – Żarnowiec

Potential location selected by PGE

Basic environmental conditions

Żarnowiec site is a reserve location from the 1980s, additionally assigned by the Marshal of Pomorskie. Due to earlier work in this area associated with the construction of power plant (construction was halted pursuant to the resolution of the Polish Government of 04.09.1990) it is the most recognized terrain in terms of conditions associated with the location of nuclear power plants. Additionally, Żarnowiec has been positively assessed by the Mission of the International Atomic Energy Agency in 1990.

The potential construction of Żarnowiec NPP would occupy the area located in the municipality Krokowa (District Puck) and the municipality Gniewino (District Wejherowo), Pomorskie. Exact location

The site is the poorest in every respect - habitat flora, nature conservation - among all the analyzed sites, therefore **potential negative impacts will also be the lowest.**

Lack of protected areas.

Reserve sites

Site – Choczewo

Potential location selected by PGE

Basic environmental conditions

Choczewo NPP site was reported by Marshal of Pomorskie. It is located in the municipality of Choczewo, Wejherowski district, Pomorskie Province. The exact location of the power plant is shown in Fig. 10.3.17. The municipality where the power plant is to be located has low population density (32 residents/km^2 at average population density in Poland 122 residents/km^2) due to which impacts of power plant construction and operation **will affect a small number of people**.

In the limited use area (the area within 800 meters from the plant) there are currently no residential or other buildings intended for human residence. Therefore, **there is no need for relocations** due to power plant construction.

Preliminary analyses show that due to location in the vicinity of the sea coast and **sufficient water resources** open cycle cooling system can be used in the power plant. The environmental impact of each cooling system solution has been discussed in detail in chapter 8.3.3.

To the east of the proposed site there is Nadmorski Park Krajobrazowy [Seaside Landscape Park]. Depending on the plant's architectural form, **it may decrease landscape values** of this area.

The surroundings of Choczewo NPP have a very favourable wind energy zone, due to which **there will be no accumulation of potential pollutions** emitted from the power plant and other facilities in vicinity.

There are no archaeological sites in the construction area and its vicinity, **thus eliminating hazards to cultural heritage** during ground works or construction delays due to halting works for the period of work of archaeologists.

In the vicinity of the planned investment **occurrence of natural resources and other useful minerals** was not stated, therefore a threat of difficult access and exploitation of deposits does not exist (see: chapter 8.3.6.2).

10. 3.4.3. Site – Gąski

Potential location selected by PGE

Basic environmental conditions

Gąski NPP site is located in north-western Poland in Zachodniopomorskie Province, in the district of Koszalin, in the municipality Mielno. The exact location of the power plant is presented in Fig. 1. The site area is situated directly on the Baltic Sea.

The commune where the power plant is to be located is characterised by average population density (82 residents/km^2 with average density population in Poland 122 residents/km^2).

In the limited use area (the area within 800 meters from the plant) **there is a permanent residence area:** eastern edge of the town Gąski. Therefore, in the case of construction, **there may be a need of relocation of a small number of people** living in the area at a distance of 800 m from the plant.

The nearest municipality, with a population of 457 (as of 2009) is tourist village Gąski, while the next largest town, with a population of 2438, is tourist village commune Ustronie Morskie.

Most residents of the municipality mainly live from tourism. Agricultural land occupies only 34% of the area of municipality. The municipality has a very small proportion of forest areas of 10%.

The center of location of a proposed power plant is located about 1.8 miles west of the village Gąski. The location has an area of about 176 hectares. Location size and orientation, as well as its position on the shores of the Baltic Sea makes it suitable for the construction of a nuclear power plant with an **open cooling system** using water from the Baltic Sea as normal and final heat discharge. The corridor of cooling water intake in Gąski site, leading to the Baltic Sea is located approximately 550 m from the center of the location, and 0 km from the northern boundary of the site.

The north-eastern part of the site has the lowest (ca. 1 m) above sea level location. The highest point of the site (about 12 m above sea level) is located in its southern part. The terrain therefore is relatively flat and falls on the entire surface in the direction from south to north. Denivelations of the area should not to give rise to any problems with the engineering work associated with levelling of land for construction of nuclear power plant.

There is no known risk of contamination by dangerous chemical waste on the surface or beneath the surface of the location and its surroundings. Within the site there are no significant industrial installations, and the only potential source of contamination is the surrounding farms.

In the municipality area, **there are no** registered deposits of natural resources. **Therefore, there is no hazard** to easy access and exploitation of deposits.

In the restricted-use area (800 m from the plant) there are building structures (residential housing, and camp site in Gąski). This implies the need for relocation of the population.

NPP location area was largely devoid of trees in connection with agricultural activities, so there is no need for deforestation associated with the construction of power plant in the area.

The location

- on the east borders with agricultural land and scattered rural residential buildings of Sarbionowo,
- on the west borders with agricultural land and single residential buildings,

- on the north borders partially with camping grounds and in large part directly with the Baltic Sea,
- on the south borders with agricultural land..

The neighbourhood of Gąski NPP site is characterized by a favourable wind energy zone, due to which **there will not be any accumulation of potential pollutants** emitted from the premises of power plant and other facilities located nearby. The annual distribution of winds is dominated by south – west, west and south directions, where the most days with strong winds occur in the winter months (January). Silence in the coastal area is very infrequent.

Gąski location and associated access corridors to the cooling water and transmission line are located over 100 km from the nearest UNESCO World Heritage sites.

Numerous places with archaeological, cultural or historical value (mansions, churches, a cemetery and a lighthouse located at a distance from 1.1 to 4.9 km from Gąski site.

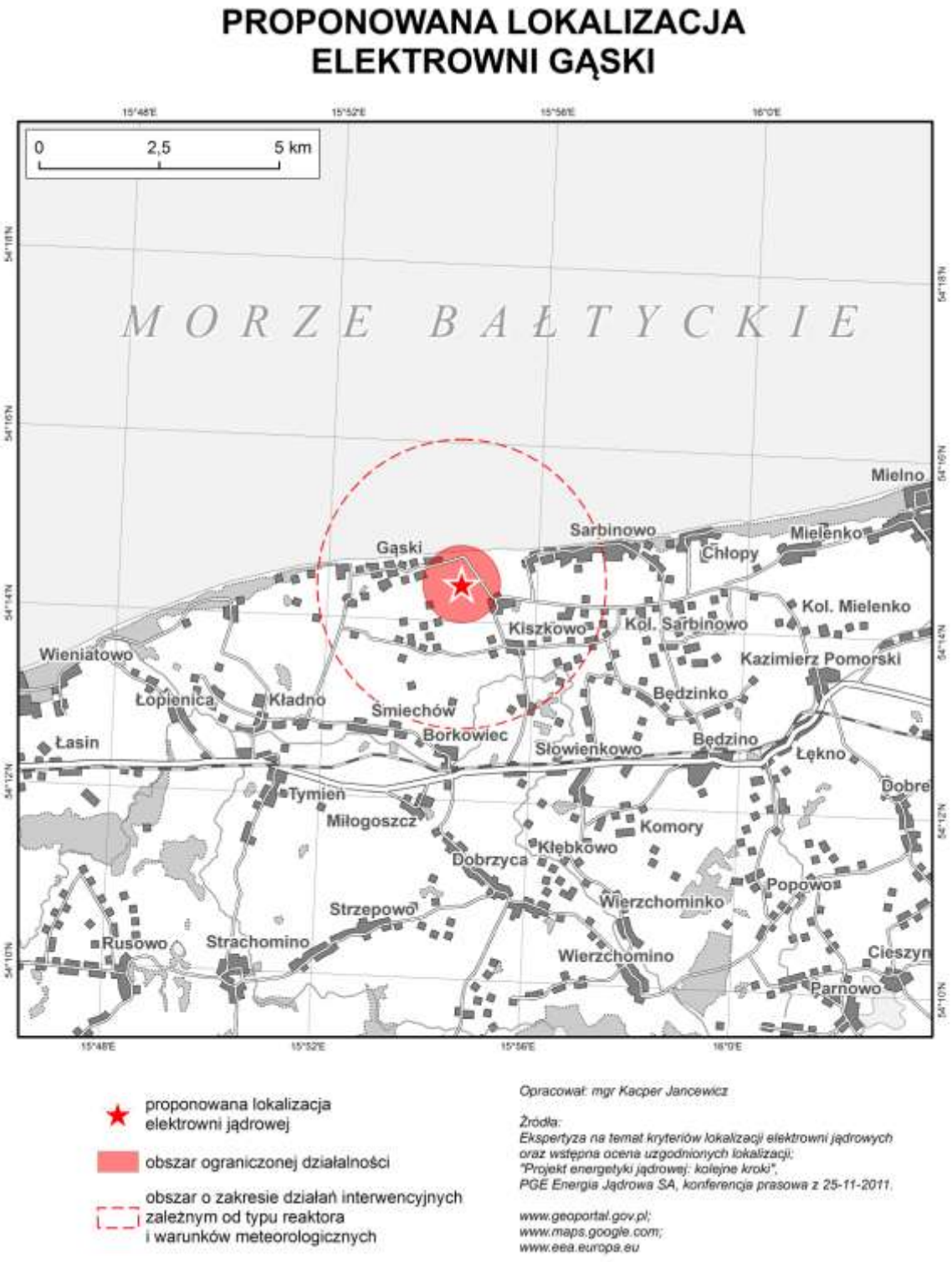


Fig. 1 Proposed site of Gąski NPP

[PROPOSED SITE OF GĄSKI POWER PLANT
Proposed power plant site
Limited use area
Area of interventions depending on reactor type and weather conditions
Developed by: mgr Kacper Jancewicz

Sources:
"Expert opinion on criteria of nuclear power plant locations and preliminary assessment of established sites"
"Nuclear power industry project: next steps",
PGE Energia Jądrowa SA, press conference on 25-11-2011.
www.geoportal.gov.pl;
www.maps.google.com;
www.eea.europa.eu]

Geological structure and hydrogeology

The nearest existing test hole is located about 1.1 km from the location border.

Other existing test holes are located within 2 km or more from the location border. Data available on the basis of the analysis of boreholes show a relatively lithologically consistent profile of soil layers, yet heterogeneous in terms of thickness. The nearest borehole indicates thick Quaternary deposits, mainly boulder clay to a depth of about 53 m below the surface.

In this area there are no Main Groundwater Reservoirs (Główne Zbiorniki Wód Podziemnych, GZWP) and their protection zones (ONO and OWO). Groundwater occurs at depths from 1.5 to 14.8 m below ground level. Aquifers have **low sensitivity to contamination**. Good insulation from the ground surface of the pulp layer of clay sediment with low infiltration and movement of pollutants **should not cause** pollution of groundwater in the event of contamination from the surface.

Based on metrics of boreholes, lithologic profile consists of alternating Quaternary boulder clay, sands, gravel mudstones at depths between 34.5 and 85 m below the surface. Boulder clay is already present at a depth of 10 m below the surface in all boreholes and is dominant for the first 30 m below ground level. Under the quaternary layers there are tertiary mudstones and claystones. The substrate composed of chalk marl is present in one borehole at a depth of 83.5 m below ground level. Rock substrate does not occur in the remaining four boreholes at depths from 52.5 m to 85 m.

Seismic and geologic hazard

Based on available data, the maximum ground vibration acceleration (PGA) for Gąski location is less than 40 cm/s^2 (below 0.04 [g]), with 10% probability of exceeding this value over the next 105 years ($1x10^{-3}$ per year). This value **is a negligible activity risk for the location.**

The nearest active or periodically active mine which might pose a risk of collapse of the land is located about 19 km from the site to the southwest.

Infrastructure

The existing railway line number 427 Koszalin - Mielno Koszalińskie is located approximately 3.5 km from the center of location.

The nearest main road No. 11 is located 3.9 km from the center of location.

The nearest port is situated in Kołobrzeg about 22.7 km west of the location.

The corridor connecting the high-voltage lines is about 20 km to the nearest existing 400 kV line.

High voltage lines do not run through Mielno commune. The municipality is powered by 15 kV overhead lines from 110/15 kV substations Koszalin “Morska”, Koszalin “Przemysłowa” and Koszalin “Północ” and the GPZ Sianów. These lines bring power to the transformer station, where voltage is reduced from 15 kV to 0.4 kV value - consumer and lighting grid voltage.[1]

[1] Gąski Municipality Renewal Plan, January 2010

Location assessment

From the standpoint of balance of power, the location appears to be beneficial and is an alternative to other proposed locations. Connection of the nuclear power plant could be completed to Dunowo station (where there is a transformer station 400, 220 and 110 kV) or Słupsk station. TSO development plans assume a significant improvement in the linkages of these stations to the network with a voltage of 400 kV.

Fauna and flora

Fauna

Within the Protected Landscape Area of Koszaliński Pas Nadmorski, within which there is the NPP location, numerous birds nest, including bittern, white stork, marsh, corncrake, crane, common tern, swan.

In the Zatoka Pomorska special bird protection area, adjacent to the planned NPP location, presence of three species of birds was stated, listed in Annex I to the Council Directive 79/409/EEC:

A001 *Gavia stel lata*

A002 *Gavia arctica*

A007 *Podiceps auritus.*

During migration and in winter there is at least 1% of the population of the migration route of the following species: great crested grebe, red-necked grebe, horned grebe, smew, long-tailed duck, common scoter, black guillemot, red-breasted merganser and velvet scoter, as well as black-throated loon and red-throated loon. Water birds are present in concentrations of more than 20,000 individuals - in the winter more than 100,000 individuals.

In the special area of conservation of habitats Trzebiatowsko-Kołobrzeski Pas Nadmorski (PLH320017) neighboring within 1.6 km of the planned location of NPP the following species of birds listed in Annex I of Directive 79/409/EEC were found:

A002 Gavia Arctic

A007 Podiceps auritus

A021 Botaurus stellaris

A030 Ciconia nigra

A031 Ciconia ciconia

A045 Branta leucopsis

A075 Haliaeetus albicilla

A081 Circus aeruginosus

A082 Circus cyaneus

A084 Circus pygargus

A089 Aquila pomarina

A094 Pandion haliaetus

A119 Porzana porzana

A122 Crex crex

A127 Grus grus

A140 Pluvialis apricaria

A151 Philomachus pugnax

A166 Tringa glareola

A176 Larus melanocephalus

A177 Larus minutus

A191 Sterna sandvicensis,

A195 Sternula albifrons

A222 Asio flammeus

A229 Alcedo atthis

A294 Acrocephalus paludicola

A307 Sylvia nisoria

A338 Lanius collurio.

The location may have a potential negative impact on migratory birds (expansion of overhead transmission lines). **More detailed analysis of the impact of NPP on Natura 2000 sites will be performed at the stage of preparing the Environmental Impact Report for construction of power plant when selecting a location.**

Flora

Within the Protected Landscape Area of Koszaliński Pas Nadmorski, within which there is the NPP location, there are unique plant species, among others common sundew, Marsh Labrador tea, black crowberry, Marsh Calla, cross-leaved heath, Oxycoccus palustris, and bog-rosemary.

The nearest plant refugia IPA (Important Plant Areas)

- PL058 – The valley of Radwia, Chotla and Chociel,
- PL083 – Spits of Jamno and Bukowo lakes

are located at least 20 km from the NPP location.

In the special area of conservation of habitats Trzebiatowsko-Kołobrzeski Pas Nadmorski (PLH320017) neighboring within 1.6 km of the planned location of NPP the following types of habitat listed in Annex I of Directive 92/43/EEC were found:

1130 Estuaries

1150 Coastal Lagoons

1210 Annual vegetation of drift lines

1230 Cliffs on the Baltic coast

1330 Coastal saline soils (Glauco-Puccinietalia part - coastal plant communities)

2110 Embryonic shifting dunes

2120 Coastal white dunes (Elymo-Ammophiletum)

2130 Coastal gray dunes

2160 Coastal dunes with thickets of seabuckthorn

2170 Coastal dunes with sand willow thicket

2180 Mixed and coniferous forests on coastal dunes

2330 Inland dunes with Agrostis grasslands

3150 Oxbow lakes and natural eutrophic ponds with the communities of Nympheion, Potamion

4010 Humid heaths with Erica tetralix (Ericion tetralix)

4030 Dry heaths (Calluno-Genistion, Pohlio-Callunion, Calluno-Arctostaphylion)

6430 Mountain herbs (Adenostylion alliariae) and riparian herb growths (Convolvuletalia sepium)

7110 Raised bogs with peat-creating vegetation (live)

7120 Raised degraded bogs, yet capable of natural and stimulated regeneration

9130 Fertile beech (Dentario glandulosae-Fagenion, Galio odorati-Fagenion)

9160 Sub-atlantic broadleaved forest (Stellario-Carpinetum)

91D0 Bog woodland (Vaccinio uliginosi-Betuletum pubescentis, Vaccinio uliginosi-Pinetum, Pino

91E0 Riparian willow, poplar, alder and ash (Salicetum albo-fragilis, Populetum albae, Alnenion.

Due to the fact that the location Gąski covers mostly agricultural areas and does not encroach on Natura 2000 sites, the possibility of significant adverse effects on Natura 2000 sites is relatively small. The most critical may be the area of works associated with construction of cooling system canal, which might affect the integrity of the SPA “Zatoka Pomorska”.

More detailed analysis of the impact of NPP on Natura 2000 sites will be performed at the stage of preparing the Environmental Impact Report.

Areas of nature conservation

Gąski location is within the Protected Landscape Area of Koszaliński Pas Nadmorski.

Nearby the location there are the following areas of nature conservation (Fig. 2):

Special bird protection areas (Fig. 3):

- Protected area: Zatoka Pomorska, Area code: PLB990003, Form of protection within Natura 2000 network: special bird protection area (The Birds Directive),

Special habitat protection areas (Fig. 4):

- Protected area: Trzebiatowsko-Kołobrzeski Pas Nadmorski, Area code: PLH320017 Form of protection within Natura 2000 network: special habitat protection area (The Habitat Directive),
- Protected area: Bukowo Lake, Area code: PLH320041, Form of protection within Natura 2000 network: special habitat protection area (The Habitat Directive),
- Protected area: Bukowy Las Górki, Area code: PLH320062, Form of protection within Natura 2000 network: planned special habitat protection area (The Habitat Directive).

Natural reserves (Fig. 5):

- Wierzchomińskie Bagno (floristic reserve),
- Warnie Bagno (bog reserve).

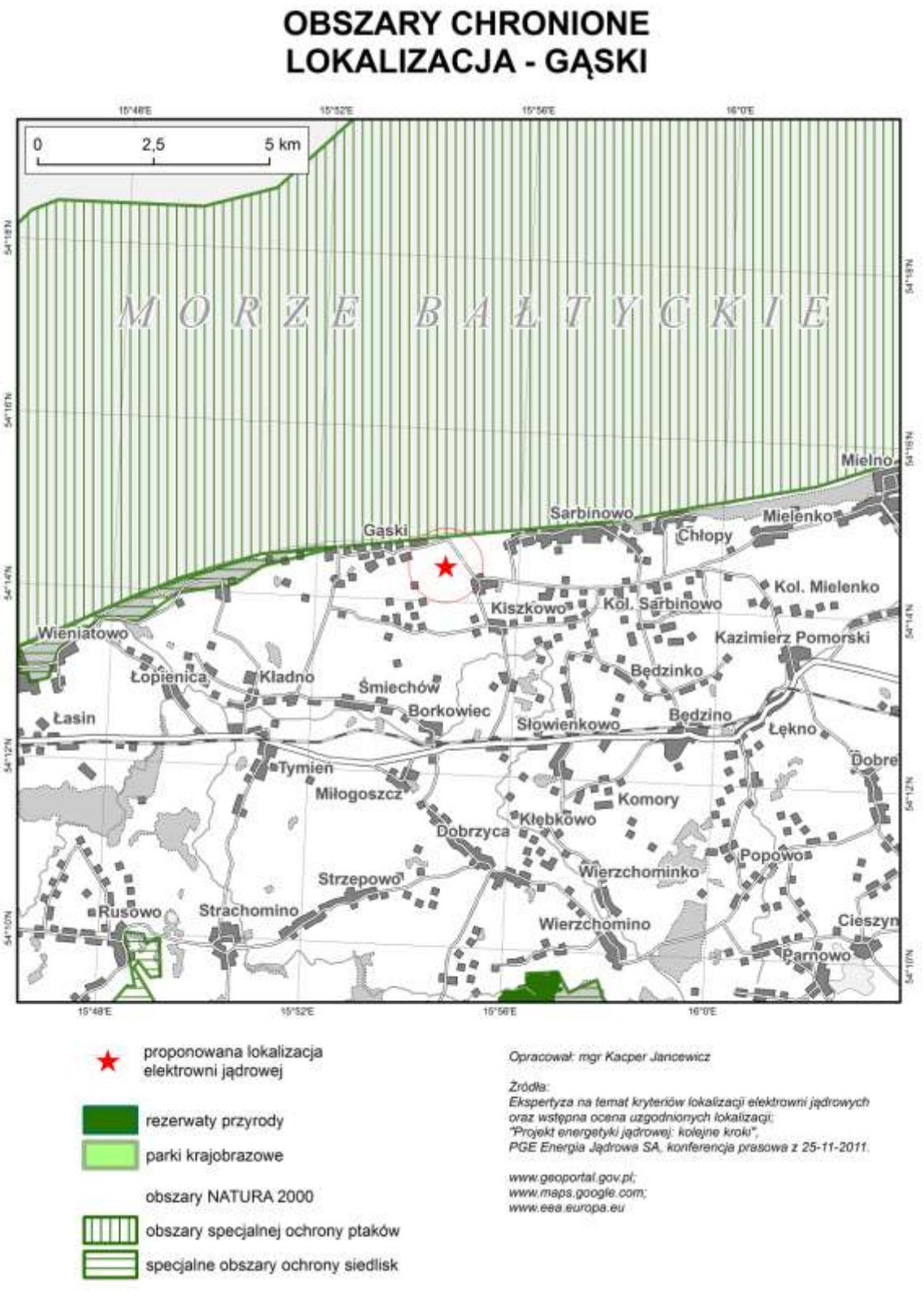


Fig. 2 Protected areas near Gąski site

[PROTECTED AREAS - GĄSKI SITE
Proposed power plant site

Natural reserves
Landscape parks
NATURA 2000 areas
Special bird protection areas
Special habitat protection areas
Developed by: mgr Kacper Jancewicz
Sources:
“Expert opinion on criteria of nuclear power plant locations and preliminary assessment of established sites”
“Nuclear power industry project: next steps”,
PGE Energia Jądrowa SA, press conference on 25-11-2011.
www.geoportal.gov.pl;
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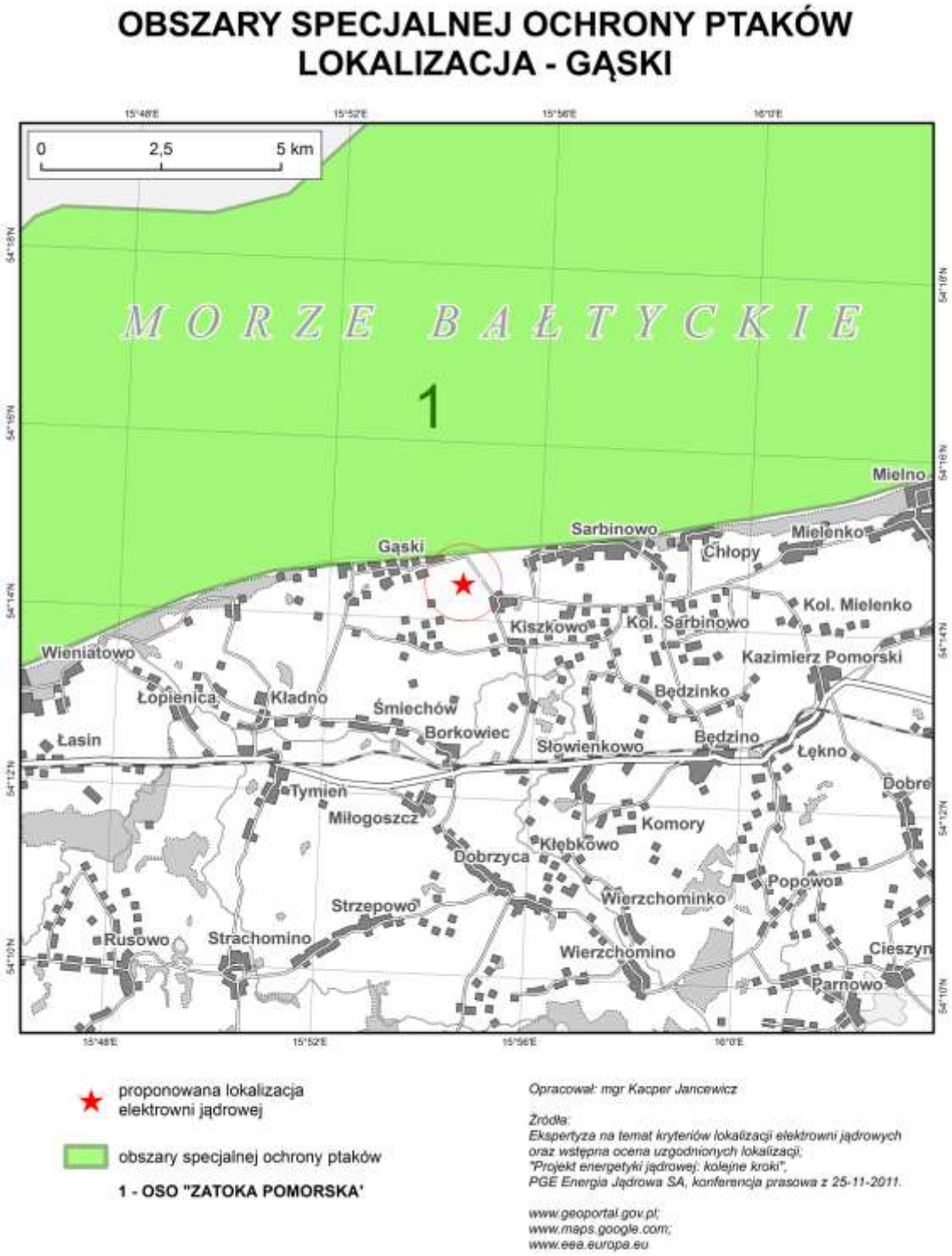

Fig. 3 Special bird protection areas in the vicinity of Gąski site.

[SPECIAL BIRD PROTECTION AREAS - GĄSKI SITE
Proposed power plant site
Special bird protection areas
Developed by: mgr Kacper Jancewicz
Sources:

“Expert opinion on criteria of nuclear power plant locations and preliminary assessment of established sites”
“Nuclear power industry project: next steps”,
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www.maps.google.com;
www.eea.europa.eu]

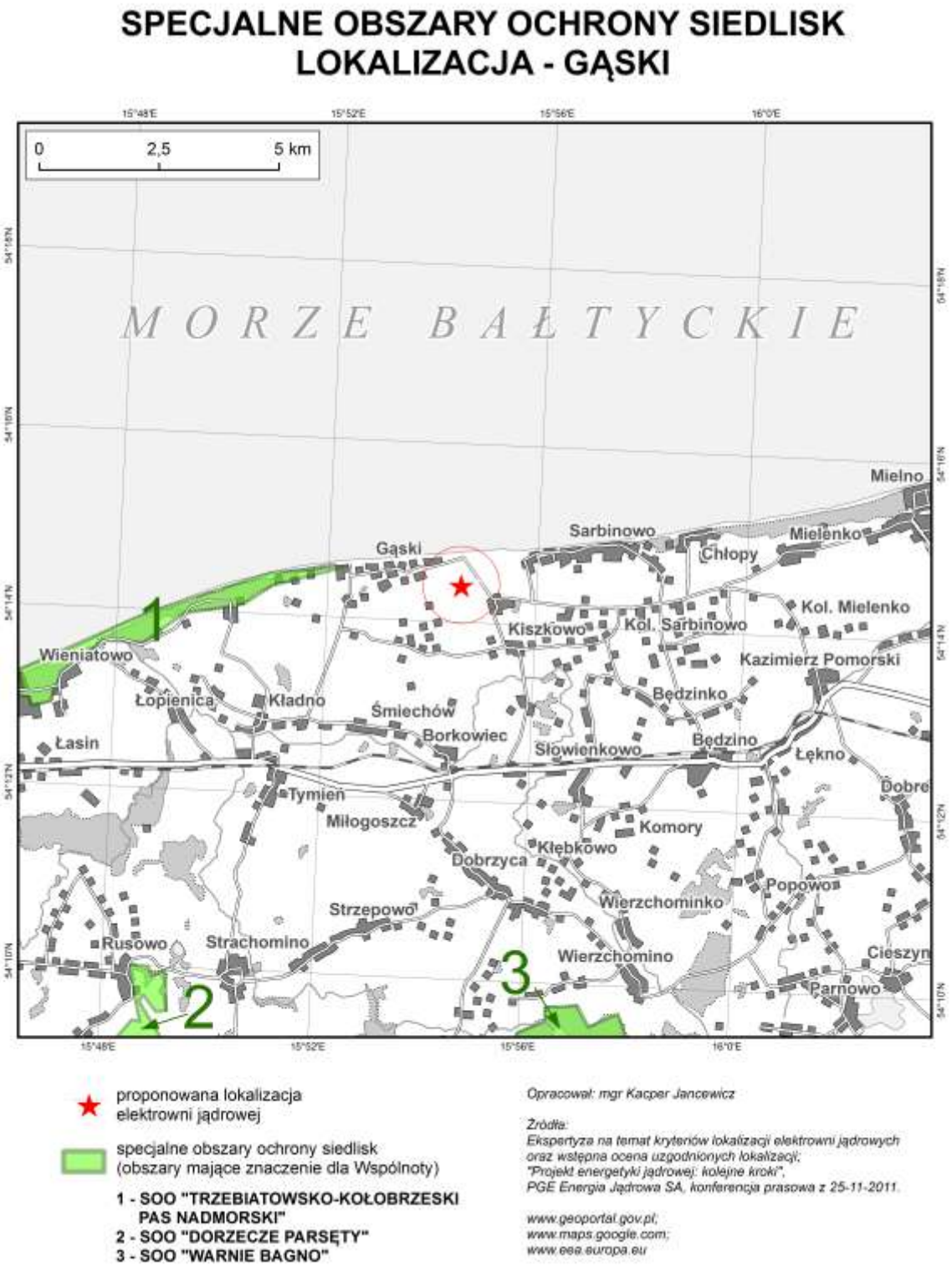

Fig. 4 Special habitat protection areas in the vicinity of Gąski site.

[SPECIAL HABITAT PROTECTION AREAS - GĄSKI SITE
Proposed power plant site
Special habitat protection areas (significant for the Community)
Developed by: mgr Kacper Jancewicz
Sources:

"Expert opinion on criteria of nuclear power plant locations and preliminary assessment of established sites"
"Nuclear power industry project: next steps",
PGE Energia Jądrowa SA, press conference on 25-11-2011.
www.geoportal.gov.pl;
www.maps.google.com;
www.eea.europa.eu]

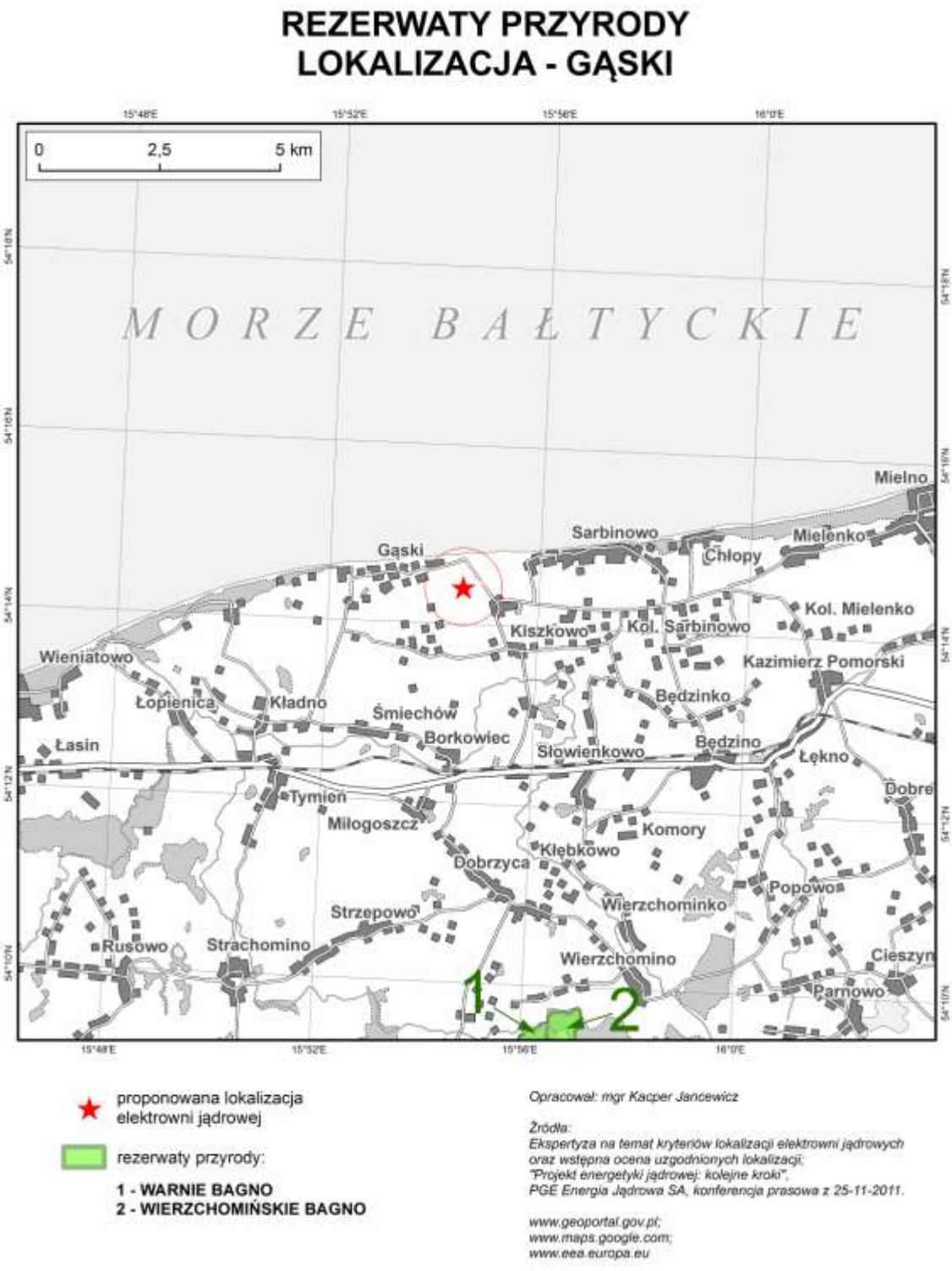

Fig. 5 Natural reserves in the vicinity of Gąski site.

[NATURAL RESERVES - GĄSKI SITE
Proposed power plant site
Natural reserves
Developed by: mgr Kacper Jancewicz
Sources:

“Expert opinion on criteria of nuclear power plant locations and preliminary assessment of established sites”
“Nuclear power industry project: next steps”,
PGE Energia Jądrowa SA, press conference on 25-11-2011.
www.geoportal.gov.pl;
www.maps.google.com;
www.eea.europa.eu]