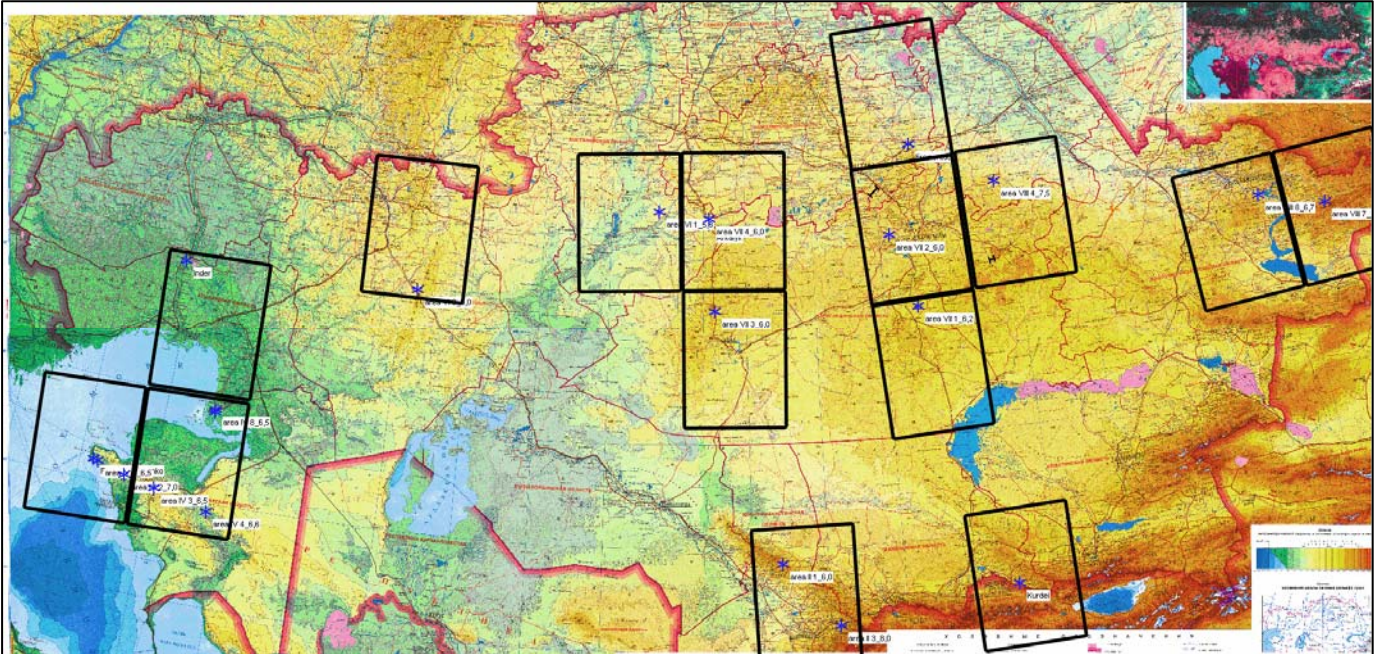


d. Map of the 24 best locations selected after step 2 dispatched into 15 areas corresponding to the data from the World Wind Atlas. (See the map in appendix)



## **F. Step 3: Detailed calculation for the 15 retained WWA area**

### **a. Introduction step 3:**

The 15 areas depicted on the map above are the windiest area in Kazakhstan but we need to know exactly where the most wind is blowing to propose a list of suitable sites for wind masts and future wind parks.

That is why a second and more detailed calculation will be run at step 3 for each of the 15 areas. Each area will be named according to the coordinates of the virtual meteorological station from the World Wind Atlas (see definition in the glossary) located in the middle.

Each area as been named according to the coordinates of the meteo object from the world wind atlas located at the centre as for example "50\_45\_site 1"

As elements used for step 3 calculation are different and much more precise than those used at step 1, it is likely that new site will appear that had been ignored at step 1. Regarding this, it has been decided to make a new list of potential sites out of the results from step 3 calculation. That is why area selected at step 1 can not be found anymore at this step of the study.

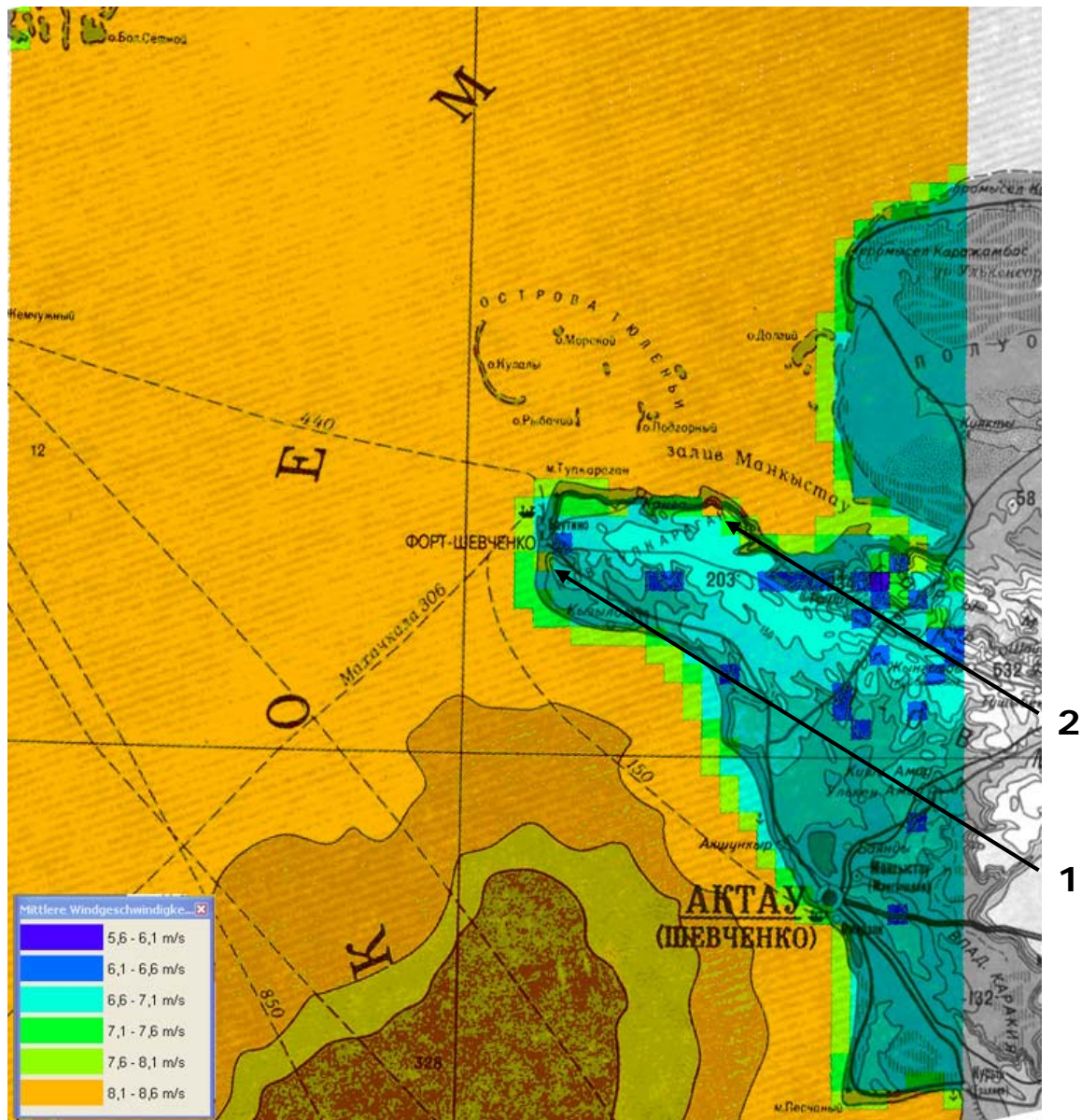
Elements used for this calculation

- World Wind Atlas for Kazakhstan (Time period 1995-2004),
- Element size: 5\*5 km,
- Roughness model (relatively imprecise),
- NASA topographical model (10 m step between lines).
- Raw data (wind speed and direction) from Kazakh meteorological station over the same period were meant to be included, at least one per area from the World Wind Atlas but despite efforts from Energieteam and UNDP, it was not possible to get these data before the end of part I (Cf chapter "limits of part I report ). Only average wind speeds from these stations were sent to Energieteam at the time of the writing of this report.

A brief comment will be written for each interesting area found on the result map of each of the 15 WWA areas, explaining the interest of the site and the reason why it has been retained for step 4 or let aside. Out the 15 area, a minimum of 24 sites will be selected for step 4, from as many different areas as possible.

Choice of interesting sites: After the description of calculated wind speed for the WWA area, the windiest site will be picked on the map and briefly describe in a sheet (one for each WWA area) regarding accessibility and distance to the network. In case many location would have the same average wind speed, then only the most suitable (access and network) would be picked and described. The purpose of this first part is to select the most promising sites for future wind park, so area let aside that are let aside should not automatically considered as irrelevant.

**b. Wind map for Area 50,0\_45,0**

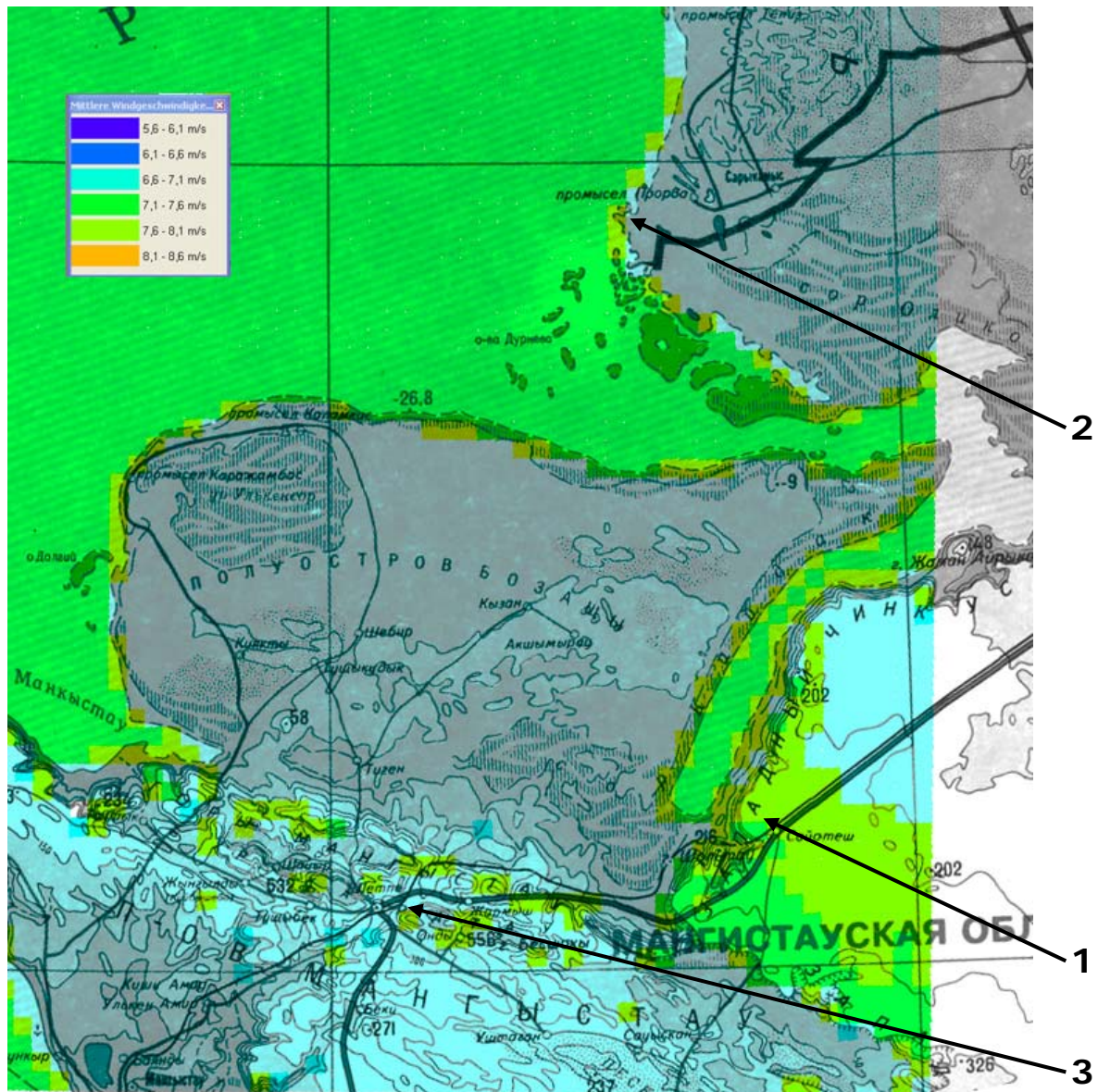


**Comments:**

As expected, the wind speed on the coast is close to 8 m/s at 50m. This is true all along the coast between Fort Chevchenko and Aktau but Fort Chevchenko remains more interesting than other sites for it is located at the Point and so it is open to more wind direction than any other location along the coast of this area. As the main wind direction in this area seems to be North-east, we recommend installing the wind mast on the northern coast of the Point of Fort Chevchenko or at site 1.

SITE	Comments	retained for step 5 quotation
50/45,0_1_8,3	electrical sub-station, accessible by secondary roads,	Yes
50/45,0_1_8,3	electrical network, accessibility more doubtful	Yes

c. Wind map for Area 52,5\_45,0

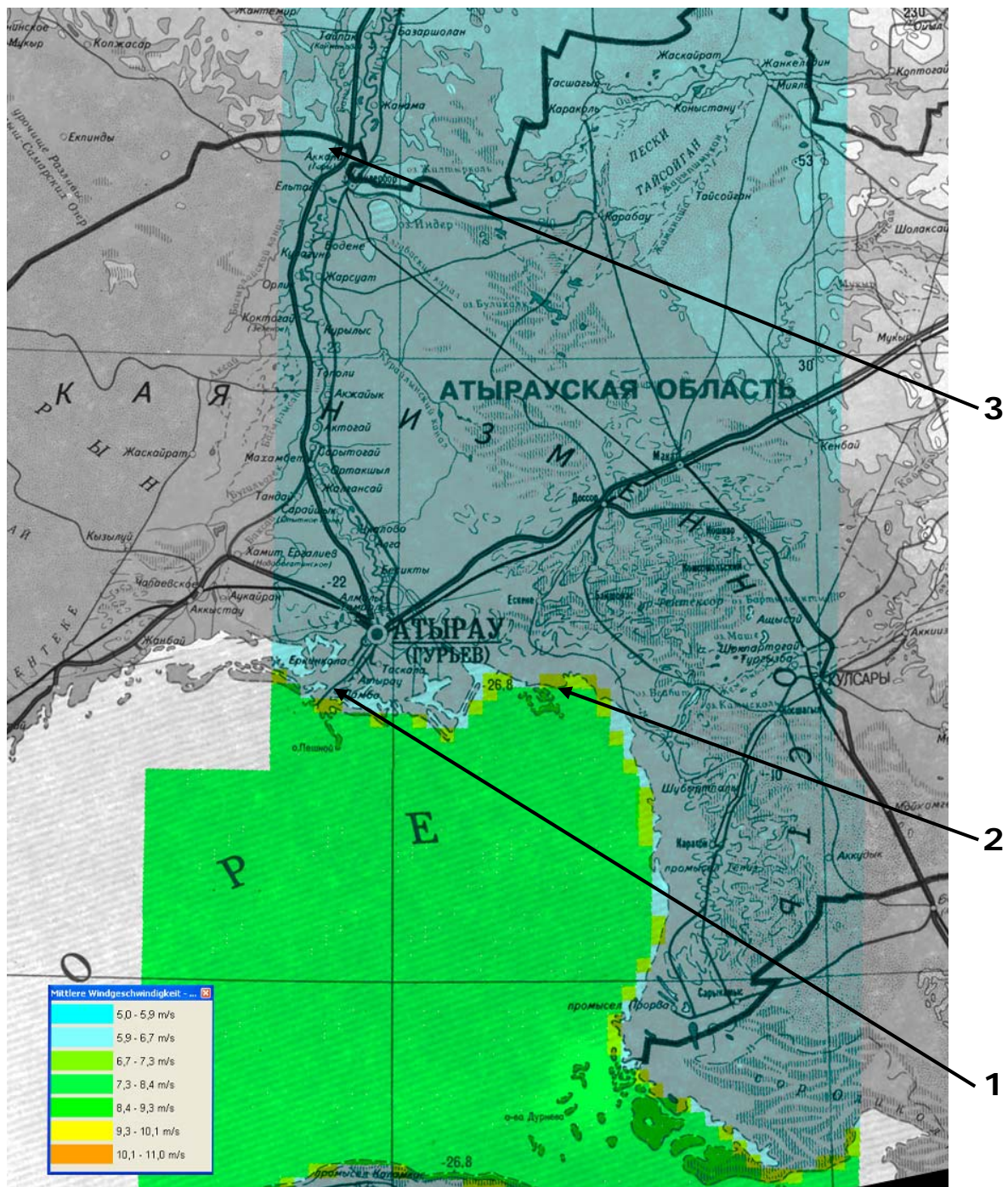


**Comments:**

The calculation for this area seems 1 m/s lower than what the meteorological station announce for Prorva. The most of interesting sites for building a wind mast are located along the coast and on the highest point (without possibility to access). But the calculation also seems to indicate a high wind speed area at site 1. It is probably due to North-East wind (main wind direction for this area) being channelled by the topography.

SITE	Comments	retained for step 5 quotation
52,5/45,0_1_7,8	electrical network, accessible by secondary roads,	Yes
52,5/45,0_2_7,6 PRORVA	electrical substation, accessible by secondary roads,	Yes
52,5/45,0_3_7,8	Electrical substation but accessibility too doubtful because of complex topography	No

d. Area 52,5\_47,5



**Comments:**

The calculation shows how the wind speed decrease after 10 km from the coast.

Average calculated wind speed along the coast is around 7 m/s and decrease rapidly to 6,1 m/s inside the lands. The coast should be equipped in priority but the inland part of the region offers also quite good conditions.

For Inder that was part of sites proposed by Kaszelenergoproject, the difference between the average measured wind speed and the calculated one is 1 m/s so local condition must increase the wind flow. As the position and characteristics of the meteorological station of Inder are not known, it is not possible to explain this