Radio Line Exclusions

Kvinesheia Wind Farm

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Summary

A fully three-dimensional method for calculating possible interception between wind turbines and radio lines was used to evaluate the effect of these constraints on the Kvinesheia wind farm. Rather large areas of the site were found to be unsuitable for wind turbines due to radio lines from the radio tower south of the wind farm.

A proposed layout of 18 turbines (110 m hub height, 155 m rotor diameter) was tested up against the identified restricted areas.

None of the proposed turbines positions are assessed to conflict with these areas.

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1 Background

As a radio communications tower is located south of Kvinesheia wind farm, wind turbines in the farm could disturb radio line communication. Problematic areas for wind turbine placement were identified using an ellipsoid description of the radio lines, a spherical description of the rotor and a cylindrical description of the wind turbine tower.

This report is an update to a previous report published by Agder Energi Wind & Site (AE, 2012) before that organization was incorporated into Meventus AS.

2 Description of method

The exclusion areas were determined using a fully three-dimensional representation of the radio lines, terrain, and potential turbine positions. The park area was defined with a 5 x 5 m resolution grid and 5 m height contours. The radio lines were described using a 1.5 Fresnel zone description, where the local radius of the Fresnel zone is calculated using the formula (Freeman, 2004):

$$F_n = \sqrt{\frac{n\lambda d_1 d_2}{d_1 + d_2}}$$

Each radio line is defined by the sender and receiver locations and the signal wavelength. This information, obtained from Torbjørn Tanem (e-mail dated 01.06.2012), is presented in Table 1.

Table 1 Radio lines used in calculations

linjenavn	x_sender (UTM 32V)	y_sender (UTM 32V)	z_sender (m)	x_mottaker (UTM 32V)	y_mottaler (UTM 32V)	z_mottaker (m)	Frekv (GHz)
KAL-STAKK	378477.23	6452036.38	523	370048.37	6504147.32	754	8.2
KAL-URDD	378477.23	6452036.38	528	374310.73	6482682.29	435	13
KAL-NONS	378477.23	6452036.38	528	378772.25	6465891.70	457	18.7
KAL-KNX	378477.23	6452036.38	538	388049.14	6503154.40	803	1.4
KAL-HEKK	378477.23	6452036.38	540	395335.07	6484942.24	623	8.2
KAL-ÅGEKID	378477.23	6452036.38	538	384668.12	6461475.28	350	18.7

Because of the varying heights within the park area, as well as the differing profiles of the radio lines, it is possible that the turbine rotor, the tower, or both could interfere with the radio signals. Using the detailed radio line information, each point within the defined park area was tested for turbine placement viability by checking that both the rotor and the tower would not interfere.

This check was performed by calculating the shortest distance from the straight line between the sender and receiver (representing the radio signal) and both the hub and tower of a notional wind

turbine placed at each point. If this distance was shorter than the local 1.5 Fresnel zones radius plus the rotor radius (77.5 m) or the tower radius, the radio line was considered interfered and the point was marked as unsuitable for wind turbines. A tower radius of 2.2 meters was used in the calculations. Additionally, Earth curvature was account for by adjusting the sender and receiver heights.

A refraction coefficient k=1 is used in the calculations, which can be considered conservative.

3   Results

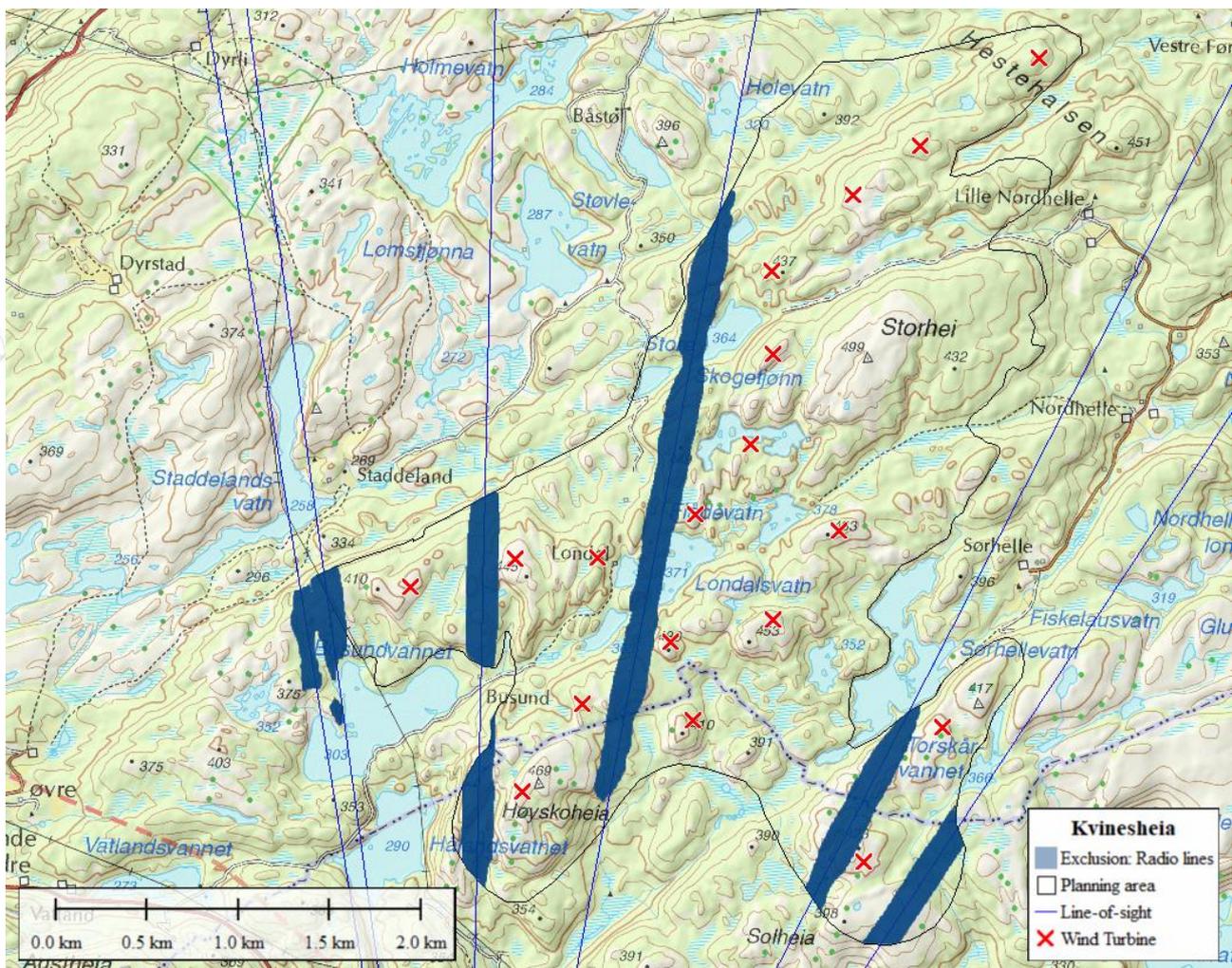The results are indicated in the pictures below, together with the proposed layout of 18 turbines.

Figure 1 Excluded areas using a turbine with 155 m rotor diameter and a hub height of 110 m compared with an 18 turbine layout

It is seen that none of the proposed turbines are assessed to interfere with any of the radio lines.

References

Freeman, R.L. (2004)   Telecommunication System Engineering, R.L. Freeman, 2004

AE (18/2012)   Effects of Radio Line constraints on Kvinesheia Wind Farm, Report 18/2012, Agder Energi Wind & Site, 28/06/2012.